DRUG AND BEHAVIORAL ADDICTIONS DURING SOCIAL-DISTANCING FOR THE COVID-19 PANDEMIC

EDITED BY: Giuseppe Bersani, Fernando Barbosa, Ornella Corazza and Hironobu Fujiwara

PUBLISHED IN: Frontiers in Psychiatry and Frontiers in Public Health

frontiers Research Topics

ISSN 1664-8714
ISBN 978-2-88974-462-6
DOI 10.3389/978-2-88974-462-6

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Topic Editors:
Giuseppe Bersani, Sapienza University of Rome, Italy
Fernando Barbosa, University of Porto, Portugal
Ornella Corazza, University of Hertfordshire, United Kingdom
Hironobu Fujiwara, Kyoto University Hospital, Japan

Citation: Bersani, G., Barbosa, F., Corazza, O., Fujiwara, H., eds. (2022). Drug and Behavioral Addictions During Social-Distancing for the COVID-19 Pandemic. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88974-462-6

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frontiers in Psychiatry

PERSPECTIVE
published: 21 July 2020
doi: 10.3389/fpsyt.2020.00714

Substance Use Disorders and COVID-19: Multi-Faceted Problems Which Require Multi-Pronged Solutions

Wossenseged Birhane Jemberie[1,2,3*], *Jennifer Stewart Williams*[4,5], *Malin Eriksson*[1], *Ann-Sofie Grönlund*[1], *Nawi Ng*[4,6], *Marcus Blom Nilsson*[1], *Mojgan Padyab*[1,2], *Kelsey Caroline Priest*[7], *Mikael Sandlund*[8], *Fredrik Snellman*[1], *Dennis McCarty*[9] *and Lena M. Lundgren*[1,10]

[1] Department of Social Work, Umeå University, Umeå, Sweden, [2] Centre for Demography and Ageing Research (CEDAR), Umeå University, Umeå, Sweden, [3] The Swedish National Graduate School for Competitive Science on Ageing and Health (SWEAH), Department of Health Sciences, Faculty of Medicine, Lund University, Lund, Sweden, [4] Department of Epidemiology and Global Health, Faculty of Medicine, Umeå University, Umeå, Sweden, [5] Research Centre for Generational Health and Ageing, Faculty of Health, University of Newcastle, Callaghan, NSW, Australia, [6] School of Public Health and Community Medicine, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden, [7] MD/PhD Program, School of Medicine, Oregon Health & Science University, Portland, OR, United States, [8] Psychiatry Unit, Department of Clinical Science, Umeå University, Umeå, Sweden, [9] Oregon Health & Science University- Portland State University, School of Public Health, Portland, OR, United States, [10] Cross-National Behavioral Health Laboratory, Graduate School of Social Work, University of Denver, Denver, CO, United States

OPEN ACCESS

Edited by:
Giuseppe Bersani,
Sapienza University of Rome, Italy

Reviewed by:
Ruben David Baler,
National Institutes of Health (NIH),
United States
Domenico De Berardis,
Azienda Usl Teramo, Italy

Correspondence:
Wossenseged Birhane Jemberie
wossenseged.jemberie@umu.se

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *19 May 2020*
Accepted: *07 July 2020*
Published: *21 July 2020*

Citation:
Jemberie WB, Stewart Williams J, Eriksson M, Grönlund A-S, Ng N, Blom Nilsson M, Padyab M, Priest KC, Sandlund M, Snellman F, McCarty D and Lundgren LM (2020) Substance Use Disorders and COVID-19: Multi-Faceted Problems Which Require Multi-Pronged Solutions. Front. Psychiatry 11:714. doi: 10.3389/fpsyt.2020.00714

COVID-19 shocked health and economic systems leaving millions of people without employment and safety nets. The pandemic disproportionately affects people with substance use disorders (SUDs) due to the collision between SUDs and COVID-19. Comorbidities and risk environments for SUDs are likely risk factors for COVID-19. The pandemic, in turn, diminishes resources that people with SUD need for their recovery and well-being. This article presents an interdisciplinary and international perspective on how COVID-19 and the related systemic shock impact on individuals with SUDs directly and indirectly. We highlight a need to understand SUDs as biopsychosocial disorders and use evidence-based policies to destigmatize SUDs. We recommend a suite of multi-sectorial actions and strategies to strengthen, modernize and complement addiction care systems which will become resilient and responsive to future systemic shocks similar to the COVID-19 pandemic.

Keywords: substance use disorder (SUD), COVID-19, addiction care, integrated care, social capital, pandemic, evidence-based policies and practices, risk environment

INTRODUCTION

Persistent use of psychoactive substances increases risk of substance use disorders (SUDs) – biopsychosocial disorders with multiple risk factors interacting at individual and contextual levels resulting in co-morbid health conditions and affecting people from all social and economic backgrounds (1, 2). The health consequences of SUDs (e.g., cardiovascular diseases, respiratory diseases, type-2 diabetes, immune and central nervous system depression, and psychiatric disorders) and the associated environmental challenges (e.g., housing instability, unemployment, and criminal justice involvement) increase risk for COVID-19 (3–7). COVID-19 adds to the complexity of SUD as it affects the lives of individuals with SUD.

THE INTERSECTION OF SUBSTANCE USE DISORDER AND COVID-19

SUDs and COVID-19 intersect on five dimensions. First, drug and alcohol use are often communal (e.g., sharing blunts, smoking pipes, or syringes) and may contribute to the spread of COVID-19 (8). Second, many individuals with SUD have limited financial resources, unstable housing and limited access to clean water and soap increasing their risk of infection (8, 9). Third, co-morbidities prevalent among people with SUD are associated with more severe COVID-19 symptoms, complications and fatalities and increase vulnerability to COVID-19 (3–7). Fourth, COVID-19 public health mitigation measures (i.e., physical distancing, quarantine and isolation) may exacerbate loneliness, mental health symptoms, withdrawal symptoms and psychological trauma (10–13). Fifth, COVID-19 mitigation measures are likely to inhibit access to SUD treatment services (8). For many patients, the face-to-face interaction with practitioners is a key therapeutic ingredient for their recovery. These collisions between COVID-19 and SUD lead to more severe outcomes, especially among older adults with SUD who already have limited individual and social resources (3).

Finally, because COVID-19 burdens health care and social services, resources may be diverted from addiction services at a time when people with SUD need additional interventions. Lived experience of stigma and discrimination may also deter people with SUD from seeking healthcare during the pandemic (14). It is important that addiction care and social service providers are made aware regarding the vulnerability of the different sub-populations to COVID-19. This will enable providers to treat people with SUD in a non-stigmatizing and nondiscriminatory manner and provide appropriate services (15–17).

The COVID-19 pandemic has serious implications for individuals with SUD including long-term socioeconomic and public health effects. Drawing on evidence from previous economic and health disasters, we examine the potential economic, public health and social implications of COVID-19 and SUDs, and provide a short description of efforts to ensure continuity of addiction services during the pandemic. The article closes with recommended policy approaches and solutions for tackling SUD within both the context of COVID-19 and the resulting shock to health and economic systems.

COVID-19 INDUCED ECONOMIC, PUBLIC HEALTH, AND SOCIAL CHALLENGES

Unemployment, Substance Use, and Mental Health Comorbidity

The COVID-19 pandemic impacted the global economy leaving millions of people unemployed, without a social safety net and limited access to healthcare and social services (18, 19). The associations of involuntary or unexpected unemployment with SUD and mental health, and the positive effect of reemployment are well established. When individuals with SUD lose the structure of employment and sense of purpose, substance use and SUD symptom severity may increase (9, 17, 20–30). Home foreclosure in the United States (US) was associated with a delayed onset of depression and anxiety after controlling for pre-existing depression and anxiety (31). As pandemic-related unemployment soars, and home foreclosures and housing eviction rises, there may be increases in mental health and SUD problems.

Studies of economic crises, similar to the pandemic-induced recession, suggest that SUD-related mortality and suicide will increase. Unemployment in Sweden during the severe recession in the 1990s was associated with alcohol-attributable hospitalization and mortality (32) and suicide during a 12-year follow-up (33). An analysis of economic changes in 26 European Union (EU) countries over three decades showed that increases in unemployment were associated with a 28% increase in mortality from SUD and a 4.5% increase in suicide (34). During the 2008–2010 financial crisis socioeconomic vulnerability among millennials (compared to older generations) was associated with increased alcohol and drug use disorders in the US (35).

Cuts in Public Expenditures on Healthcare and Social Care: “Where Recession Hurts, Austerity Kills”

Cuts in healthcare and social care expenditures, measures taken in response to the economic impact of COVID-19, may exacerbate the public health effects of acute economic change (20, 36–39). These changes, compounded with unemployment and loss of income in the post-COVID-19 period, may affect resource allocation and priority setting, widen socioeconomic disparities, and magnify the marginalization of individuals with SUDs (40, 41).

When an economic crisis worsens and austerity measures are implemented, public health infrastructure can be stressed and the “risk environments” for SUD may expand (42). Poverty drives people to rely on informal economies (e.g., sex work, drug dealing) associated with illicit drug use. Compounded by weakened public health infrastructure, this can lead to a rise in preventable infectious diseases. The rapid increase in the HIV infection rate among persons who inject drugs (PWIDs) after the collapse of the Soviet Union and the formation of newly independent states in Eastern Europe, reflected the dismantling of public health infrastructures and increased unemployment (43). Similarly, the 2008–2010 financial crisis in Greece resulted in ongoing economic depression. Severe austerity measures led to a 40% reduction in hospital budgets by 2013 (44). However, the austerity measures also resulted in a 30% increase in the utilization of public healthcare services (44). Further, one-month prevalence of major depression increased from about 3% in 2008 to 8% in 2011 (45) and suicide mortality increased 56% between 2007 and 2011 (46, 47). The austerity also led to budget cuts for harm reduction and opioid treatment programs. Between 2008 and 2010 the number of people who used drugs increased 12% and was much higher for adults between 35 and 64 years (88%) most likely due to relapse (48). Finally, the number of HIV infected people among PWIDs in Greece increased 16-fold between 2010 (n = 15 cases) and 2011 (n = 260 cases) (49).

The ongoing pandemic is straining healthcare systems across the globe. Data from the Swedish Perioperative Register (SPOR) reflect a 74% decline in elective surgeries in April 2020 compared to April 2019 due to acute reorganization of healthcare to respond to COVID-19 (50). If governments react to the economic crisis through reductions in spending for healthcare and social care, the stress on healthcare may be exacerbated and lead to a resource triage and decline in healthcare quality (51).

People with SUD may be further affected as the COVID-19 impact worsens. This group already faces stigma and discrimination from the general public (52), policy makers (53, 54) and healthcare workers (14, 55–58). Resource allocation and clinical practice with embedded stigma and discrimination has a prohibitive effect on healthcare utilization by individuals with SUD (14). Therefore, a reasonable, open and transparent, inclusive, accountable, and responsive process is necessary in priority setting and resource allocation during and after COVID-19.

Changes in Drug Use Patterns During the COVID-19 Induced Systemic Shock

Confinement rules, unemployment and fiscal austerity measures during and following the pandemic period can affect the illicit drug market and drug use patterns. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) and Europol analyses and data from the Global Drug Survey (GDS) suggest that there has been a shift in drug market and drug use patterns during the pandemic (59, 60). While the use of several psychoactive substances increased, use of recreational synthetic drugs, such as MDMA, diminished likely due to closure of clubs and festival avenues in several European countries.

Economic crises in the United States between 1959 and 2003 were associated with increased adolescent cannabis and illicit drug use, and elevated involvement in illicit drug markets (61). As people who use drugs lose income and can no longer afford their primary drug of use, suppliers may adulterate drugs or introduce novel psychoactive substances with unknown risks for overdosing and infectious disease transmission. A Hungarian study reported a shift from heroin and amphetamine injection to synthetic cathinone (bath salt) and reduced availability of heroin after the 2008–2010 financial crisis (62). Synthetic cannabinoids (spice), similarly, became a primary drug of use among the homeless population following a ban on novel psychoactive substances in the United Kingdom (63). Finally, a wastewater analysis from Northern Italy in 2009 noted a reduction in metabolites from expensive drugs (e.g., cocaine and heroin) and increased metabolites from less expensive drugs (e.g., methamphetamine and cannabis) (64).

Bereavement and Loneliness: Lasting Effects of the COVID-19 Pandemic

In addition to the economic peril in the post-COVID-19 period, the pandemic is traumatizing people. Shrinking social networks and deaths from COVID-19 leaves many without coping resources (65). Social isolation, loneliness, death of loved ones, complicated grief, and prolonged bereavement are associated with problematic substance use and relapse both in younger and older adults, and can adversely affect mental health (17, 66–75).

Older adults who are living alone are more likely to have SUD when compared to married older adults (5). Living alone is also associated with depression in older adults (76). The current pandemic potentially adds to the already high percentages of older adults living alone (77). For some older adults with depression, the pandemic-related bereavement might also affect their remission (78). Unless socially protective measures are taken, the post-pandemic period will likely exacerbate these risk factors for substance use and mental health disorders.

CURRENT ADDICTION CARE PRACTICE DURING THE COVID-19 PANDEMIC

Countries differ in legal and regulatory frameworks and the organization of addiction care systems; addiction treatment, however, is recognized internationally as an essential service that should be maintained even in a disaster or pandemic (79). Many countries have national policies guiding the implementation and application of interventions linked to health and social care systems. During the pandemic, psychiatric and addiction care services are making efforts to ensure continuity of care while mitigating the risk for spreading COVID-19 infections (80, 81). In Sweden, the National Board of Health and Welfare posted informational materials on how to prevent the risk of COVID-19 transmission in opioid treatment programs (OTPs); in the United States, the Substance Abuse and Mental Health Services Administration released guidance to allow safer administration of methadone during the pandemic. Most of the measures focus on reducing the number of outpatient treatment visits, increasing the use of telehealth and expanding take-home medication for OTPs (82). While these current actions mitigate the negative impact of COVID-19 on individuals with SUD, there remains a need to adopt proactive policies which support individuals with SUD and strengthen addiction care services.

POLICIES AND STRATEGIES TO PREVENT AND TREAT SUD IN THE COVID-19 CONTEXT

SUD is a biopsychosocial disorder with multiple individual risk factors and consequences. SUD and mental health disorders also have distal determinants. Hence, interventions must be multipronged with community involvement and empowerment. It is important to adopt coordinated multi-sector strategies and innovative holistic approaches to benefit individuals with SUD.

Protective Social Policies Can Improve Living Conditions and Access for Addiction Care Services

Social policies impact health, directly and indirectly, through proximal and distal social determinants such as income, housing, employment, education, place of residence and social capital. Outcomes measured at the population level, mask effects on vulnerable groups and individuals with substance use disorders (83). Program evaluations do not always account for unintended consequences although realist evaluation methods take a different approach in seeking to answer what works, for whom, in what respects, to what extent, in what contexts and how.

Strong financial assistance systems can alleviate the negative impact of economic peril on mental health, during COVID-19 pandemic induced recession (22, 41, 84). A study of 26 European countries, with cause-specific mortalities as the outcomes (1970–2007) found that countries with stronger social protection (employment support and welfare systems) fared better compared to their counterparts (34). In a Norwegian study, reemployed individuals were 65% less likely to become harmful alcohol users compared with those who stayed unemployed (85). These studies suggest that public expenditures for labor market programs supporting gainful employment or earning capacity were associated with reductions in alcohol-related mortality and suicide.

Strong public safety nets for health, unemployment and social care insurances, support vulnerable groups such as people with mental health disorders and SUD, and ensure that they have access to treatment despite loss of income or employment related health insurance (63, 86). The number of individuals receiving care for opioid use disorder, for example, increased nearly twofold after Oregon's Medicaid expansion in 2014 (87). Given the acute reorganization of healthcare during the pandemic and decrease in healthcare utilization, healthcare plans and resources can be redirected to making structural changes to reduce health disparities and promote health in vulnerable populations (88).

Develop and Expand Integrated Primary Care, Addiction, and Mental Health Care Systems

National and local policymakers need to accept that substance use disorders, as any other biopsychosocial disorder (e.g., diabetes), often require several intervention components and multiple treatment episodes. These include services for alcohol and drug, mental health and medical problems plus linkages to unemployment services, housing services, and family support services. In many societies, there is little understanding of the complexities of SUD. Many countries have regressive and punitive national policies which are based on prohibitive and moralistic views rather than evidence-based policies promoting the integration of biopsychosocial services and care for individuals with SUD. The lack of willingness to give up on the legacy of separate health, addiction and mental health care systems, true for many countries, further reduces the likelihood that clients with SUD (who as a result of COVID may have developed a number of co-occurring disorders) will receive integrated care, especially in limited resource settings. Parallel treatment between several care providers means that the patient is responsible for the coordination of treatment between different agencies. An integrated care system, however, reduces this burden and can address coexisting conditions simultaneously (89). Compared to fragmented care, integrated care can increase access to healthcare for individuals with SUD, and may reduce infectious diseases such as COVID-19.

Implement Professional Education About SUD and Co-Occurring Disorders

Health professionals face challenges while using empirically supported screening, assessment, referral treatment, and follow-up for SUD and co-occurring disorders because they lack training about causes and consequences of substance use (including the biomedical aspects), and have limited training with evidence based practices (90, 91). In the United States, medical, nursing, and social work programs are beginning to add SUD curricula to their training (92). Given the likely effects of COVID-19 and other diseases on SUD populations, it is even more critical that physician, nursing, psychology, and social work education programs include addiction and SUD content in their core-curriculum. Rapid training of addiction care professionals, in an emergency situation, (e.g., the current COVID-19 crisis) can help to control rapid outbreaks and provide safe addiction care.

Integrate IT Solutions to Strengthen and Modernize the Addiction Care System

As the current pandemic and the economic crisis threatens health and social care expenditures, information and communication technologies can play vital roles in improving healthcare and social services. New technology solutions that can modernize and strengthen the health and social care systems should be studied, and evaluated for cost-effectiveness.

The Internet of Things has shown effectiveness in monitoring elderly health and medication adherence (93–96). OTPs and other medical treatments for individuals with SUD may benefit from similar technology. Individuals with SUD can learn to manage their substance use and self-monitor symptoms. This can lead to reduced outpatient treatment visits and hospitalizations.

Telehealth has been used in some settings during the COVID-19 pandemic to maintain access to treatment (97). A systematic review and meta-analysis reported that telehealth, especially live video interaction with therapists, had significant positive effects on patient mental health (98, 99). A non-randomized trial found that telehealth-delivered treatment for opioid use disorder was associated with better one-year retention compared to in-person delivered treatment (100). Studies have showed that older adults can benefit from telehealth services through reduced visits to emergency departments, increased knowledge of infectious diseases prevention, and improved social functioning and mental health (101, 102). Future studies should investigate how the telehealth services provided during COVID-19, impacted SUD treatment outcomes and stigma.

Concerns related to telehealth services, in addition to scarcity of evidence on their effectiveness, focus on their accessibility

(103). Limited access to smartphones and internet services leaves millions of people without access to those services (104). People with SUD may not afford such devices and might not have access to telehealth. One possible solution for this disparity can be mobile health (m-health) technologies. These are less costly and are effective for SUD treatment (105); they might also be utilized for pandemic surveillance in vulnerable groups (106, 107). Social policies focusing on equitable resource allocation and social support (such as health insurance and income insurance) can also address this disparity.

Artificial intelligence (AI), another promising technology that could be used during emergency situations, could support trained clinicians to make treatment decisions. Currently, the research on the potential use and benefits of AI in addiction care and mental health services is in early development and needs to address important scientific, legal and ethical issues (108, 109). Current AI research is focused on assisting addiction care practitioners with treatment for alcohol use disorder (110), identifying and preventing relapse (111), and identifying risk factors (112, 113). Practitioners should, however, be aware that algorithms can be subject to biases (due to misclassification and measurement error, missing data, and small sample size) (108). The implication of such biases can be severe as they might create disparities in addiction care (108, 109). Involving addiction care specialists and patient advocacy groups from the beginning in the development of AI can facilitate innovative, ethical, acceptable, and effective solutions.

Finally, when the technology around unmanned aerial vehicles (drones) improves and becomes cost-effective and ethical and legal issues are addressed, harm reduction kits, and medications could be delivered to individuals with SUD (114–116). Drones can deliver medications (e.g., naloxone) and save lives especially in highly congested cities and rural areas. They can also be used as an alternative for take-home medication for OTPs. Drones are already used for medical delivery services in emergency situations (115). However, current policies and views on harm reduction and addiction vary from country to country, and this might influence the acceptability of drones as kit-delivery vehicles.

Mobilization of Community Social Capital

During the COVID-19 pandemic voluntary efforts from community members and non-governmental organizations seek to help vulnerable groups. Mental health hotlines opened so that older adults can talk to professionals if they feel lonely or worried. Mobile apps and chat groups are now available for digital support. Community level coalitions and inclusion will be needed to support individuals with substance use and mental health disorders.

Mobilization of community social capital is an important resource in disaster management (117). A socially cohesive community with strong networks of civic engagement and norms of reciprocity and trust (118) may be better able to prepare for, manage, and recover from systemic shocks such as the COVID-19 pandemic (119). Resources (such as social support) from strong community networks, however, often require adhering to the dominant norms in a particular community. Thus, the same mechanisms that provide support based on reciprocity norms, might lead to increased social exclusion of outsiders who do not conform to the dominant norms (120, 121). For this reason, the focus should be on policies which promote parity for the treatment of substance use disorder to that of other biopsychosocial health conditions, support the development and implementation of community initiatives that complement addiction and mental health care services and can be leveraged during disaster (14, 54).

Strengthening of Cross-National Collaboration

Many illicit substances and their precursors are manufactured and transported through multiple countries, before reaching users. Collaboration between countries can counteract the interplay between SUD and economic crises. After the 2010–2011 HIV outbreak among PWID in Greece, the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) and the European Centre for Disease Prevention and Control (ECDC) were instrumental in setting priorities for responding to and controlling the rapid HIV infection rate (122). EMCDDA also provides EU countries with early warning systems for novel psychoactive substances and new drug patterns which can emerge during economic crises.

The World Health Organization and the United Nations Office on Drugs and Crime are international organizations guiding efforts to develop and expand effective, evidence-based and ethical treatment for substance use disorders (79). Hence, national governments should continue funding these organizations, especially during COVID-19 and similar disease outbreaks. Strengthening community treatment capacity is essential during disaster and public health emergencies.

CONCLUSION

As globalization continues, COVID-19 is unlikely to be the last pandemic, and there will undoubtedly be subsequent global economic crises. These crises, compounded by austerity measures, will disproportionately burden people with SUD due to accumulated social, economic, and health inequities.

Ad hoc measures taken to ensure continuity of care might alleviate some of the challenges these groups face in emergency situations. Evidence-based, collective, and proactive policies and actions are necessary to strengthen and modernize addiction and mental health services.

The acknowledgement of SUD as a biopsychosocial condition and its destigmatization by policy makers and practitioners are essential components for comprehensive multi-sectorial strategies which will protect and address the needs of people with SUD.

COVID-19 presents opportunities to: adopt social protective policies; shift from fragmented health and addiction care systems to integrated care systems; mobilize community social capital; train healthcare and social care professionals on SUD and mental health disorder, and identify and integrate evidence-based information technology and digital tools into addiction care systems. Only then, will it be possible to provide equitable health and social care to people with SUDs and to have addiction care services which are resilient in the face of future systemic shocks.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

Ethical approval was not needed for this article as no animal nor human studies are presented, and there are no potentially identifiable human images or data.

AUTHOR CONTRIBUTIONS

Writing—original draft: WJ, ME, MP, KP, DM, LL, Writing—Review and editing: WJ, JS, ME, A-SG, NN, MB, MP, KP, MS, FS, DM, LL. Conceptualization: WJ, JS, NN, DM, LL. Investigation: WJ. Formal Analysis: WJ. Funding acquisition: LL. All authors contributed to the article and approved the submitted version.

FUNDING

Grants from The Swedish Research Council for Health, Working Life and Welfare (FORTE) *Grant no. 2016-07213* and *Grant No. 2019-01453* have supported this study. An award from the National Institute on Drug Abuse (*F30 DA044700*) supported KP's participation in the development of the manuscript. The funding organizations were not involved in the design of the study, data collection, data analysis, the interpretation of data, or writing of the manuscript.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

OPINION
published: 29 July 2020
doi: 10.3389/fpsyt.2020.00767

COVID-19: The Hidden Impact on Mental Health and Drug Addiction

Stefania Chiappini[1*], *Amira Guirguis*[1,2*], *Ann John*[2], *John Martin Corkery*[1] *and Fabrizio Schifano*[1]

[1] *Psychopharmacology, Drug Misuse & Novel Psychoactive Substances Research Unit, School of Life and Medical Sciences, University of Hertfordshire, Hatfield, United Kingdom,* [2] *Swansea University Medical School, Swansea University, Swansea, United Kingdom*

Keywords: COVID-19, addiction, mental health, drug abuse, prescription drug misuse

OPEN ACCESS

Edited by:
Fernando Barbosa,
University of Porto, Portugal

Reviewed by:
Domenico De Berardis,
Azienda Usl Teramo, Italy
Mercedes Lovrecic,
National Institute for Public Health, Slovenia

***Correspondence:**
Stefania Chiappini
stefaniachiappini9@gmail.com
Amira Guirguis
amira.guirguis@swansea.ac.uk

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *13 June 2020*
Accepted: *20 July 2020*
Published: *29 July 2020*

Citation:
Chiappini S, Guirguis A, John A, Corkery JM and Schifano F (2020) COVID-19: The Hidden Impact on Mental Health and Drug Addiction. Front. Psychiatry 11:767. doi: 10.3389/fpsyt.2020.00767

INTRODUCTION

There is concern the Coronavirus Disease (COVID)-19 pandemic is having a negative impact on the mental health of the general population through a range of suggested mechanisms: fear, uncertainty, and anxiety; social distancing/isolation; loneliness; and economic repercussions (1–3). Previous disasters such as the Severe Acute Respiratory Syndrome (SARS) in 2003 (4–6) contributed to increased anxiety, mood, and thought disorders, adjustment disorders, and post-traumatic stress disorders (PTSD) (1, 7–15), resulting, in extreme cases, in suicidal behaviours (e.g., suicidal ideation, suicide attempts, and actual suicide) (10, 16), especially in cases of concomitant Substance Use Disorder (SUD) (17, 18). According to a recent study from the Well Being Trust (18) the high levels of stress, isolation and unemployment due to the COVID-19 pandemic could cause up to 75,000 "deaths of despair" related to deaths to drug, alcohol, and suicide (18). High risk of mental illness was previously identified in individuals with existing or history of mental illnesses (1, 9, 12, 14, 19), but also vulnerable categories might be considered the elderly (>80 years old), children/adolescents, individuals from deprived areas, peri-natal women and BAME (Black, Asian and minority ethnicities) (1, 12, 14, 19). Finally, healthcare workers have been experiencing emotional overload due to several reasons, including both organizational issues relating to the shortage of suitable personal protective equipment, reduction in human resources and relentless work shifts (20–23), but also the burden developed by the fear of becoming infected and infecting relatives, high mortality rates, grieving the loss of patients and colleagues, separation from families (22–24). Specifically, according to Huang et al. (25), among the first-line medical staff of a Tertiary Infectious Disease Hospital for COVID-19 in China, the incidence of anxiety and post traumatic symptoms in female medical staff was higher than that in male, and in nurses more represented than that in doctors (25).

DISCUSSION

Often overlooked in this scenario are those with SUD (26, 27), who may experience: (a) changes in levels of drug use—an increase is often seen as a reactive behaviour to negative impact of disasters; (b) a shift to other substances if access to those previously used become limited; (c) a relapse, if they had already recovered from alcohol/drug addiction. Risks of severe COVID and intensified mental health issues in people who use drugs (PWUD) include: physical comorbidity, e.g., lung or cardiovascular disease, HIV, viral hepatitis infections; psychological comorbidity, e.g., general distress, sleep disorders, anxiety/mood disorders, psychotic symptoms; and homelessness, incarceration, economic difficulties, and socioeconomic issues deriving from drug addiction (8, 11, 27, 28). Overdose risk for addicted people who are home-isolating, and hence with typically no one to inject them with naloxone, should be considered in a time of overloaded emergency services and healthcare systems in general (27, 29). The COVID-19 pandemic is already impacting drug markets, including shortages of numerous types of drugs at the street level, price increases for consumers on the black market and reductions in purity. Synthetic drugs' availability, such as methamphetamine, is drastically reduced due to air travel restrictions and flight cancellations, while cocaine, mostly trafficked by sea, continues to be detected in European ports during the pandemic (30). Heroin and opioids seem to be pushed toward being trafficked along maritime routes. Finally, cannabis appears to be less available, due to restrictions on movement across regions and borders under coronavirus lockdown. These disruptions are likely to grow and further increase risks for people who use drugs, for example by increasing variability in drug purity, the likelihood of adulteration, and contamination of heroin supply with synthetic opioids, such as fentanyl. These issues can also encourage shifts to more at-risk drug using behaviours such as use of drugs such as street benzodiazepines, and synthetic cannabinoids (31). Additionally, the COVID-19 crisis is likely to increase the need to access drug treatment and services, e.g., extra demand for opioid substitution therapy and other medication. Access to drug services is being disrupted by self-quarantine, social distancing and other public health measures adopted for dealing with COVID-19 (27, 29, 31). Similarly, community pharmacies are challenged by staff shortages, service disorganisation, and self-isolation (27, 29, 32).

In response to the long-lasting and wide-ranging challenging effects of the pandemic (5, 12, 19, 27, 29), some harm-avoiding interventions have been adopted, including: more flexible take-home-medication treatment programmes for opioid addicted patients (33, 34); guidance for facilitating controlled substance prescribing (26, 29, 35); tele-health for monitoring drug-dependent patients; and access to virtual support groups through online meetings (15, 26, 32). Conversely, both peer-support groups and rehabilitation facilities have suspended programmes and limited new admissions (27, 32). Hollander & Carr (36) compared and contrasted the acceptability and impact of telemedicine versus in-person consultations. During the COVID pandemic, telehealth has demonstrated to enable continuity of services, while protecting service providers from infection. However, in-person consultations are still needed for certain groups of patients where maintenance in treatment is at risk.

In this context, due to the disruption of drug markets, reduced supply and access to illicit drugs, internet drug-seeking activities may be on the increase. In line with this, rogue/illicit pharmaceutical products, such as benzodiazepines, has also reportedly doubled their prices in some areas (24). Alternative drugs or medications might be considered by users including quetiapine, gabapentinoids, Z-drugs (e.g., zolpidem) (37–39) and some Over-The-Counter (OTC) medications (37, 38), such as codeine; ephedrine and pseudoephedrine; and the antidiarrhoeal loperamide ("poor man's methadone").

IMPLICATIONS IN PRACTICE

Interventions addressing the health, psychological, and social effects of the pandemic are required. Healthcare professionals have an important role in educating patients about the common psychological effects of a pandemic. COVID-19, together with general environmental factors, such as stress or trauma, may contribute to both a mental illness and a SUD developing. A proactive approach to upscale our mental health care, emergency preparedness and response for people with SUDs is urgently needed; mental health services should develop and evaluate: clear remote assessment; care pathways for people at risk; psycho-education strategies, regarding self-harm/suicide, overdoses, and domestic violence; and staff training to support new ways of working (1, 7, 12). Healthcare providers, including pharmacists, and public health policies are challenged to: develop strategies to implement prevention measures against transmission of COVID-19 in drug users settings, such as preventing overcrowding or sharing drug-using equipment; and ensure continuity of care for drug-users and people with SUDs. Specifically, access to community maintenance, e.g., expand methadone delivery *via* mobile teams for quarantined patients should be facilitated (40, 41). Monitoring psychosocial needs and delivering psychosocial support to vulnerable patients as well as healthcare workers should be provided (2, 3, 8, 42, 43). It is crucial to strengthen telemedicine and support it with appropriate governance and funding in order to be able to monitor the mental health situation post-pandemic. Supporting healthcare workers with appropriate equipment, training on telehealth and caring for their safety with respect to protection against infection and spread of infection, preventing violence and burglary in drug treatment services, pharmacies would enable robust support against a possible mental health wave post-pandemic. Prescribers and pharmacists should be warned about: possible requests to prescribe more drugs than needed to take home; excessive sales of prescription/OTC products which might be diverted and abused; and aggression toward staff. Developing multidisciplinary support platforms could be helpful in reducing the mental distress due to misinformation and teaching problem-solving strategies to cope with the pandemic (13).

AUTHOR CONTRIBUTIONS

The opinion was developed by all authors. SC drafted the first version of the manuscript with input from all authors. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 03 September 2020
doi: 10.3389/fpsyt.2020.580977

The Impact of Physical Distancing and Associated Factors Towards Internet Addiction Among Adults in Indonesia During COVID-19 Pandemic: A Nationwide Web-Based Study

Kristiana Siste[1], Enjeline Hanafi[1], Lee Thung Sen[1], Hans Christian[1], Adrian[1], Levina Putri Siswidiani[1], Albert Prabowo Limawan[1], Belinda Julivia Murtani[1] and Christiany Suwartono[2]*

[1] *Department of Psychiatry, Faculty of Medicine, Universitas Indonesia – dr. Cipto Mangunkusumo General Hospital, Jakarta, Indonesia,* [2] *Faculty of Psychology, Atma Jaya Catholic University, Jakarta, Indonesia*

OPEN ACCESS

Edited by:
Hironobu Fujiwara, Kyoto University Hospital, Japan

Reviewed by:
Kentaro Kawabe, Ehime University, Japan
Daria Piacentino, National Institutes of Health (NIH), United States

****Correspondence:***
Enjeline Hanafi
enjelinehanafi@gmail.com

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *07 July 2020*
Accepted: *18 August 2020*
Published: *03 September 2020*

Citation:
Siste K, Hanafi E, Sen LT, Christian H, Adrian, Siswidiani LP, Limawan AP, Murtani BJ and Suwartono C (2020) The Impact of Physical Distancing and Associated Factors Towards Internet Addiction Among Adults in Indonesia During COVID-19 Pandemic: A Nationwide Web-Based Study. Front. Psychiatry 11:580977. doi: 10.3389/fpsyt.2020.580977

Introduction: Physical distancing has encouraged the public to utilize the Internet for virtually all daily activities during the COVID-19 pandemic. This study aimed to assess the impact of COVID-19 on Internet addiction (IA) prevalence and analyzed the correlated factors during quarantine and pandemic.

Methods: An online survey was generated, comprising of a sociodemographic section, Internet Addiction Diagnostic Questionnaire (KDAI), Symptoms Checklist-90, and Pittsburgh Sleep Quality Index. The hyperlink was disseminated through social media, companies, and universities. Overall, 4,734 adults, (mean age 31.84 ± 7.73 years old and 55.2% males) representing all 34 provinces of Indonesia, gave valid responses.

Results: Point prevalence of IA during the COVID-19 pandemic was 14.4% in Indonesian adults. Online duration increased by 52% compared to before the pandemic. Physical distancing was not established as a risk of IA. Increased daily online duration, specific motivations, types of application, and having confirmed/suspected COVID-19 cases within the household were predictive of IA. All subscales of SCL-90 and PSQI were higher in the group with positive/suspect cases of COVID-19 within households and were correlated to higher scores of IA.

Discussion: Physical distancing alone was not associated with an increased risk of IA. The prevalence of IA during COVID-19 was higher than the previously proposed rate among Indonesian adults, which might be related to digital activities associated with COVID-19 and the popularity of virtual socializing. Furthermore, psychopathologies and sleep disruptions were related to IA occurrences and especially prevalent in groups with proximity to COVID-19. Fear of COVID-19 contraction and rampant misinformation of COVID-19 probably contributed to these factors, which potentially harbor long-term consequences.

Conclusion: The current study demonstrated a high point prevalence of IA and identified several preventable factors predictive of IA during home-quarantine and COVID-19, especially in adults with confirmed/suspected COVID-19 cases within the household. However, physical distancing did not increase the odds of IA. Public health agencies should maintain physical distancing advisory while providing adaptive psychiatric education and service.

Keywords: Coronavirus Disease 2019, internet addiction, physical distancing, psychopathology, sleep quality, Indonesia

INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) has grappled the world and presented a crisis of unprecedented magnitude. The effects are profound and far-reaching, not only on physical health but also mental health and social and financial repercussions. According to the World Health Organization (WHO), by the end of June 2020, there were more than 10 million confirmed COVID-19 cases and over 500,000 deaths worldwide (1). In Indonesia, there were about 55,000 confirmed cases, the highest in Southeast Asia, and nearly 3,000 deaths across the country as of late June 2020 (2). Though actual numbers could be much higher than that of the official reports as the testing capacity has not been brought up to speed in Indonesia (3).

To suppress further spread of COVID-19, WHO declared the importance of physical distancing by keeping a distance of at least 1 meter from each other, limit spending time in crowded places or groups, and wearing face masks (4). Concurrently, Indonesia recommended stay-at-home advice on March 15, 2020 and further implemented "large scale social restrictions", locally known as PSBB (*Pembatasan Sosial Berskala Besar*), by April 10, in response to the soaring cases of COVID-19 nationally. During PSBB, public transport, travel and public places are either restricted or closed, people are encouraged to work or study from home, and large gatherings (e.g. marriages and religious affairs) are also prohibited—all in order to limit physical or direct social contact (5).

Due to this physical distancing policy, people turn to the Internet to perform their daily routines, from studying, meeting, performing a religious activity, and socializing. Utilization of the Internet also offered ease in disseminating public advice, delivering telehealth, and sharing of data between countries. At the same time, COVID-19 has intensified dependency on Internet and overloaded the public with barrages of false news and hoaxes—"an epidemic of misinformation"—leading to the menacing image of COVID-19 and propelling a climate of anxiety and panic (6). A study on nearly 60,000 respondents in China identified 35% of the general community to demonstrate psychological distress (7) and a separate longitudinal study indicated that the psychological symptoms persisted for at least a month (8). Afflicted by the heavy mental burden and deprived of their regular coping outputs, substantial proportion of people would turn to the Internet as their coping mechanism (9). Steam, a leading game distributor, reported more than 20 million concurrent active users, the highest number in its 16-year history (10). Gao et al., found that 82% of the Chinese samples were frequently exposed to social media during the pandemic (11) and Ni et al., noticed that a third of the samples spent at least 2 h online per day for social media and COVID-19 news (12). Information overload and extended social media exposure were previously reported to increase the susceptibility towards Internet addiction (IA), loosely defined as the compulsivity, preoccupation, or dependence on the Internet regardless of the specific activity that leads to impairment and distress (13, 14).

There had yet to be any data on the current physical distancing and behavioral patterns impact on IA in Indonesia. To bridge this gap, the present study aimed to examine the relationship of physical distancing policy during the COVID-19 pandemic to the prevalence of IA and associated effects of the psychological correlates among Indonesian adults. The current study aims to ensure psychological and physical well-being during and after the COVID-19 pandemic as well as future outbreaks. Moreover, the results can contribute to developing a national-scale regulation on Internet usage and guide public health measures.

Abbreviations: PSBB, Large-scale social distancing; GTTP COVID-19, Indonesian COVID-19 Response Acceleration Task Force.

METHODS

Participants and Procedure

The authors devised an online survey using Google Form, beginning with an outline on the study's purpose, respondents criteria, and management of data; then, each respondent was asked for informed consent to participate and an author's email for correspondence was provided should queries arise. Those who did not provide consent to participate were directed to finish without answering the survey. The survey comprised of a sociodemographic section (e.g., gender, age, household income, occupations, and residence), quarantine elements (practice, location, confirmed/suspected cases within the household), and Internet usage characteristics (duration prior and during quarantine, age of first Internet usage, motives, and frequent social media applications or game genres), then followed by Internet Addiction Diagnostic Questionnaire (KDAI), Symptoms Checklist 90 (SCL-90), and Pittsburgh Sleep Quality Index (PSQI). Game genres were categorized into multiplayer online battle arena (MOBA), massively multiplayer online role playing games (MMORPG), first-person shooting (FPS), and casual games [defined as per prior study (15)], all were provided with examples. The survey in total spanned 18 pages and required about 45–55 min for completion, although duration could not be evaluated in Google Form to prevent reporting bias.

Physical distancing was defined as working/studying from home, alternating workday, and/or the physical distancing practices as per the guideline from Indonesian COVID-19 Response Acceleration Task Force (GTPP COVID-19) (16). Respondents were questioned whether they and/or any household member had been declared as COVID-19 suspect cases and/or diagnosed with COVID-19, following the descriptions provided by the GTPP COVID-19 (16), Indonesian Ministry of Health (17), and World Health Organization (18). Province of residence was categorized into whether PSBB had been implemented at the commencement of the study based on data from GTPP Covid-19 which encompassed DKI Jakarta, West Java, East Java, Central Java, Banten, West Kalimantan, North Kalimantan, Gorontalo, West Sumatera, Riau, and South Sulawesi (19). Income levels were determined based on classification by the World Bank (20).

A shortened hyperlink was generated and disseminated by the research team through social media and to the corporate secretaries of each Indonesian state-owned company and university academics between April 28 (44 days since stay-at-home notice and 18 days since PSBB) and June 1, 2020. Afterward, all respondents were suggested to pass on the survey link to others, employing a snowballing strategy. This was similar to the method adopted in a COVID-19 study among the Chinese general population (21). Enrolled respondents were (i) asked to provide emails (names were not requested) to prevent multiple responses; (ii) ≥21 years old; (iii) currently residing in Indonesia; (iv) and capable of understanding Bahasa Indonesia. Responses of non-consenting (n = 23), duplicates (n = 5), and currently not residing in Indonesia (n = 13) were removed. Identifying personal information (i.e., emails) were exclusively accessible to the research team. They were only inspected for duplicates and dropped before further data scrutiny; as such, the research team could not link the data and participant. Overall, a total of 4,734 respondents completed the survey encompassing all 34 provinces and seven islands (Java 62.7%, Sumatera 18.3%, Kalimantan 8.6%, Sulawesi 5.8%, Nusa Tenggara 2.7%, Papua 1.7%, and Maluku 0.3%) across Indonesia. The survey was part of a larger study simultaneously targeting adolescents, and 150 adult respondents mistakenly answered the Pediatric Symptoms Checklist 17 instead of SCL-90, their responses were omitted during analysis (n = 4,584).

Instruments

Internet Addiction Diagnostic Questionnaire (KDAI)

KDAI (22) was developed in Indonesia with excellent reliability (α = 0.942), sensitivity (91.8%), and negative likelihood ratio (0.11). The tool is self-administered, and consists of 7 subscales, namely, withdrawal (e.g. "I feel very disturbed if forced to stop using the Internet", 8 items), loss of control (e.g. "I forgot about time when I am on the Internet", 9 items), priority enhancement (e.g. "I cut back on doing other fun activities so I could be on the Internet", 6 items), negative consequences [e.g. "My tasks are neglected (such as homework, etc.) because I use the Internet too much", 7 items], mood modification (e.g. "My life feels more comfortable when I am on the Internet", 5 items), salience (e.g. "I keep on thinking of using the Internet even though I am currently doing other tasks", 6 items), and impairment (e.g. "I tried to limit my time on the Internet, but I failed", 3 items). Each statement is scored with a 7-point Likert scale, 0 (= not applicable), 1 (= very rarely) to 6 (= always). A score of ≥108 indicates IA (out of 264 maximum). The reliability of domains was satisfactory, Cronbach's alphas range from 0.641–0.933, and overall α = 0.979.

Symptoms Checklist 90 (SCL-90)

SCL-90 is a self-reported tool to assess psychopathological symptoms, namely: somatization, obsessive-compulsiveness, interpersonal sensitivity, depression, anxiety, phobic anxiety, hostility, paranoid ideation, psychoticism, an additional domain, and overall global symptom index (23, 24). The instrument has 90 statements scored on a 5-point Likert scale, 0 (= Never) and 4 (= Always), within the last one month. SCL-90 had been translated to Bahasa Indonesia with good validity 82.9% sensitivity and 83.0% specificity (25). Subscales consistencies were acceptable, with α ranging 0.837–0.987.

Pittsburgh Sleep Quality Index (PSQI)

The PSQI (26) is a widely utilized tool to assess sleep quality on clinical or non-clinical populations (27), the reliability in this study was α=0.845. The questionnaire has 24 items, of which 20 are multiple choices and another 4 open-ended questions. Furthermore, 5 items require the assessment of a partner or another individual on the sleeping pattern of the subject. The 19 self-answered questions on PSQI can be pooled into 7 components and each weighted between 0–3 (maximum 21), scores >5 indicate poor sleep quality. The Indonesian version of PSQI was validated with reliability of α=0.79, content validity 0.89, and specificity of 81% (28).

Data Analysis

Descriptive analyses were performed for all data, general characteristics were stratified by gender, and key sociodemographics were scrutinized against IA using logistic regression. Age was dichotomized into 21–40 and >40 years old in reference to the definition by Indonesian Association of Pediatrics (29) of adolescents as those aged 10- to 20- years old and early adulthood within developmental psychiatry perspective (30) considered as between 20 and 40 years old. The age of first Internet use was adopted from another study's observation (31) and was noted to be a significant predictor in a prior dissertation study among Indonesian adolescents (22). Duration of Internet use was categorized based on a previous research (32) definition of excessive Internet usage (>5 h) and current median of data at 10 h. Lastly, number of social media use was determined based on data median of 3. Correlations matrix between KDAI, SCL-90, and PSQI was generated by Spearman's (*rho*) correlation as data had non-normal distributions. Bootstrapping was also performed for correlation analyses and set at 5,000 samples. All statistical tests were performed on SPSS 23.0 for Windows (IBM, USA). Data were deemed significant if p <0.05 and 95% confidence interval (CI) provided where appropriate.

Ethics

The study was approved by the Institutional Ethics Committee of Faculty of Medicine, Universitas Indonesia—dr. Cipto Mangunkusumo General Hospital (Ref: KET-413/UN2.F1/ETIK/PPM/00/02/2020). Informed consent was required for all respondents.

RESULTS

Sociodemographic Profile

Characteristics of the study's subjects are presented in **Supplementary Table 1**. Over half of the samples were males (N = 2,612; 55.2%). Mean age of subjects was 31.84 ± 7.733 (Range = 21–69), and on average males were older than females. Males (Onset age = 17.78 ± 6.598) also tended to adopt the Internet later compared to female (15.92 ± 5.524). Most of our subjects had attained higher education (N = 3590; 75.8%) and are in the workforce as office workers/proprietors (N = 3627; 76.6%). Vast proportion of our population was already married (N = 2995; 63.3%). Majority of subjects (47.6%) were within the middle-upper SES bracket. About 66.8% of the subjects reported living in provinces that had not implemented the PSBB. Around 187 (3.95%) respondents acknowledged having confirmed/suspected COVID-19 cases within their households and 22.5% of them were classified as Internet addicts.

Internet usage behaviors of participants were also evaluated before and during COVID-19 pandemic. Most subjects (79.95%) perceived to have increased Internet duration during the COVID-19 pandemic and both female and male on average had an increase of 3.43 h per day comparing usages before and during COVID-19 pandemic. Amid the pandemic, 25.4% of respondents utilized the Internet for 0–5 h per day, 34.2% for 6–10 h daily, and 40.3% for ≥11 h. Almost all subjects (97.8%) first used the Internet when they were older than 8 years old. Monthly Internet expenditure among respondents was mainly over 250,000 IDR (17.72 USD at conversion rate of 14,100). Handphone was the most preferred gadget (96.2%) for accessing Internet, followed by PC/Laptop (57.8%). Main motives for using the Internet were academic/occupation-related (39.5%), social media (31.7%), seeking information (20.4%), entertainment (video, music, or reading; 5.9%), online games (1.8%), online shopping (0.4%), online pornography (0.1%), cyber-relationship (0.1%), and none for online gambling. Most frequent social media used in the study sample were *WhatsApp* (95.0%), *Instagram* (81.9%), *Facebook* (55.4%), *Telegram* (29.8%), *Twitter* (29.1%), *Line* (23.3%), *TikTok* (8.7%), and the least was *WeChat* at 1.4%. Overall, 41.8% of respondents used 4 or more social media applications. Of the respondents that play online games (47.6%), 31.0% preferred casual games, 14.1% MOBA, 2.3% MMORPG, and 0.23% FPS.

Internet Addiction and Correlated Characteristic Factors

Point prevalence of IA during COVID-19 pandemic among Indonesian adults was 14.4% (95% CI 13.4–15.5%). Bivariate analyses (See **Supplementary Table 2**) were conducted to several related factors with IA as the dependent variable. Significant variables on bivariate analysis and variables deemed potentially predictive based on past studies were included into multivariate analysis.

Multivariate analysis (**Table 1**) showed that several variables were related to IA. Group having COVID-19 confirmed/suspected cases within household had significantly higher risk to IA. Changes of Internet duration, particularly, increased online duration ≥11 h were predictive of IA. Several motives of digital activities (social media, online gaming, information seeking, and entertainment) also augmented the odds of IA. Particular social media applications (*Twitter* and *LINE*) and certain type of online games (casual games and MOBA games) were found significantly associated to IA.

Internet Addiction, SCL-90, and PSQI

Comparing scores of participants with COVID-19 confirmed/suspected cases within their households and without, the former scored on average higher across all subscales of SCL-90 and PSQI, which were statistically significant, p <0.001 (**Table 2**). Depression (9.02 ± 11.46 vs. 5.43 ± 8.06), obsessive-compulsive (7.06 ± 7.80 vs. 4.78 ± 6.17), somatization (6.83 ± 9.04 vs. 4.61 ± 6.69), and interpersonal sensitivity (6.49 ± 8.16 vs. 4.08 ± 5.86) were among the subscales with largest difference between the two groups.

Mean of the SCL-90 Global Severity Index (GSI) score was 37.24 ± 50.3 and respondents scored 5.53 ± 3.10 on average for PSQI. Other domains of SCL-90 ranged from 1.85 to 5.57 with depression having the highest score (5.57 ± 8.24). IA was correlated to the GSI and all subscales of SCL-90 positively with range of r = .249 to.320 (p < 0.001); moreover, higher score of KDAI was also correlated with higher score PSQI, r = .225 (p < 0.001). Detailed correlation matrix is shown in **Table 3**.

DISCUSSION

The present study indicated substantial IA point prevalence (14.4%) among Indonesian adults during the COVID-19 pandemic. This is, as far as the authors are aware, the first nationwide study on IA in Indonesia. A previous study on Indonesian university students (20.9 ± 2.52 years old) proposed

TABLE 1 | Multivariate analysis of variables related to Internet addiction.

Variables	B	SE	Wald	df	AOR (95% CI)
Gender (ref: Female)					
Male	-0.09	0.099	0.822	1	0.914 (0.752–1.110)
Age (ref: >40)					
21–40	0.321	0.167	3.695	1	1.379 (0.994–1.914)
Age of First Internet Use (ref: >8)					
≤ 8	0.384	0.258	2.216	1	1.468 (0.886–2.434)
COVID-19 confirmed/ suspected cases within household? (ref: No)					
Yes	0.47	0.191	6.029	1	1.600* (1.099–2.328)
Physical distancing (ref: No)					
Yes	0.04	0.103	0.152	1	1.041 (0.850–1.275)
Perceived Internet Duration Change (ref: Unchanged)					
Increased	0.512	0.134	14.582	1	1.669*** (1.283–2.171)
Decreased	0.097	0.492	0.039	1	1.102 (0.420–2.891)
Duration of Internet use during COVID-19 (ref: 0–5 h)					
6–10	0.17	0.13	1.701	1	1.185 (0.918–1.531)
≥11	0.506	0.125	16.328	1	1.658*** (1.298–2.119)
Main Motives of Internet use (ref: Academic/occupational)					
Social Media	0.411	0.109	14.248	1	1.508*** (1.218–1.866)
Online Gaming	0.682	0.287	5.65	1	1.977* (1.127–3.469)
Blogging	-18.81	40192.97	0	1	–
Information Seeking	0.335	0.125	7.207	1	1.398** (1.095–1.785)
Online Shopping	-18.799	8814.669	0	1	–
Entertainment	0.484	0.18	7.187	1	1.622** (1.139–2.311)
Cyber-relation	1.318	1.24	1.129	1	3.736 (0.329–42.451)
Pornography	0.256	1.133	0.051	1	1.292 (0.140–11.904)

(Continued)

TABLE 1 | Continued

Variables	B	SE	Wald	df	AOR (95% CI)
Number of social media used (ref: ≥ 4)					
0–3	-0.086	0.15	0.331	1	0.917 (0.684–1.230)
Social Media Apps used (ref: Do not use)					
Facebook	-0.042	0.101	0.169	1	0.959 (0.786–1.170)
Instagram	-0.12	0.136	0.781	1	0.887 (0.680–1.157)
Twitter	0.355	0.108	10.843	1	1.426*** (1.155–1.762)
LINE	0.239	0.115	4.273	1	1.270* (1.012–1.592)
WhatsApp	-0.33	0.203	2.643	1	0.719 (0.483–1.070)
TikTok	0.017	0.151	0.013	1	1.018 (0.757–1.369)
WeChat	0.082	0.391	0.044	1	1.085 (0.504–2.335)
Telegram	0.129	0.108	1.435	1	1.138 (0.921–1.407)
Frequent Game Genres (ref: Do not play games)					
MMORPG	0.277	0.274	1.022	1	1.319 (0.771–2.258)
MOBA	0.456	0.131	12.057	1	1.578*** (1.220–2.042)
FPS	0.919	0.709	1.679	1	2.507 (0.624–10.069)
Casual Games	0.217	0.102	4.55	1	1.243* (1.018–1.517)
Constant	**-2.978**	**0.35**	**72.319**	**1**	**0.051*** **
-2LL		**3,545.79**			
Nagelkerke R2		**0.067**			
Hosmer-Lemeshow		**p = .618**			
Model $\chi 2$ = 175.037, df = 30, p <.001					

**p < .05; **p ≤ .01; ***p ≤ .001.*

a rate of 3.2% for IA (33) and another study measuring Internet Gaming Disorder found 3.0% prevalence (34). To note, there was a difference of instruments utilized and subject demographics to the current study. During COVID-19 pandemic, Priego-parra et al., reported 10.2 and 0.2% of moderate and severe IA, respectively, among Mexicans (35) and Sun et al. demonstrated a rate of 4.3% of severe IA in China (36).

TABLE 2 | SCL-90 and PSQI profiles of respondents diagnosed as suspected cases or having COVID-19 confirmed cases within a household.

Variable[a]	COVID-19 Confirmed or Suspected Case		Z^b
	Yes (n = 178)	No (n = 4406)	
GSI	56.70 ± 67.26	36.45 ± 49.35	4.863***
	30.5 (9.0,82.5)	17.0 (3.0,50.0)	
Depression	9.02 ± 11.46	5.43 ± 8.06	4.339***
	4.0 (1.0,13.0)	2.0 (0.0,7.0)	
Anxiety	5.16 ± 7.58	3.24 ± 5.43	4.091***
	2.0 (1.0,6.0)	1.0 (0.0,4.0)	
Obsessive-Compulsive	7.06 ± 7.80	4.78 ± 6.17	4.447***
	4.5 (1.0,10.0)	2.0 (0.0,7.0)	
Phobic Anxiety	3.97 ± 5.54	2.46 ± 3.89	4.812***
	2.0 (1.0,5.0)	1.0 (0.0,3.0)	
Somatization	6.83 ± 9.04	4.61 ± 6.69	4.025***
	3.0 (1.0,9.0)	2.0 (0.0,6.0)	
Interpersonal Sensitivity	6.49 ± 8.16	4.08 ± 5.86	4.218***
	3.0 (0.0,9.0)	2.0 (0.0,6.0)	
Hostility	2.88 ± 3.94	1.81 ± 3.02	4.885***
	1.0 (0.0,4.0)	1.0 (0.0,2.0)	
Paranoid	3.80 ± 5.22	2.49 ± 3.99	3.709***
	1.0 (0.0,6.0)	1.0 (0.0,4.0)	
Psychoticism	5.08 ± 7.12	3.32 ± 5.52	3.756***
	2.0 (0.0,8.0)	1.0 (0.0,4.0)	
Additonal	5.51 ± 5.64	3.67 ± 4.57	4.936***
	4.0 (1.0,8.0)	2.0 (0.0,6.0)	
PSQI	6.61 ± 3.31	5.46 ± 3.08	4.508***
	6.0 (4.0,9.0)	5.0 (3.0,7.0)	

*[a]Data presented as Mean ± SD and Median (IQR); GSI, Global Severity Index; PSQI, Pittsburgh Sleep Quality Index; [b]Mann-Whitney U test; ***p ≤ .001.*

In this study, only a third of respondents were living in provinces enforcing PSBB, yet more than 70% practiced physical distancing; this is reasonable as the virus had spread nationally and stay-at-home notice was issued across the country. Recent studies have demonstrated increases in symptoms of post-traumatic distress, anxiety, depression, and physical symptoms during COVID-19 self-quarantine (7, 8). However, the current study found that the sole action of physical distancing was not a predictor of IA. It is assumed that the availability of multiple channels for maintaining social connections (37) and public education on self-management during isolation (38, 39) has dampened the risk posed by physical distancing to a certain extent. Furthermore, the methods of said physical distancing and the degree of altered routines were also variable between individuals since Indonesia did not enter a mandatory "lockdown".

The psychological disturbances were considerable in our study with respondents scoring highly in all subscales of SCL-90 (25). Moreover, the group with confirmed/suspected COVID-19 case within their households scored higher compared to the ordinary population—particularly subscales of depression, obsessive-compulsiveness, somatization, and interpersonal sensitivity. Subsequently, a significant correlation between having confirmed/suspected COVID-19 cases within household and IA was observed in this study, AOR = 1.600 (95% CI = 1.099–2.328), and our data also demonstrated significant correlations of IA with all subscales of SCL-90 (r = 0.249 to 0.320). Other studies in Spain (40, 41) and Japan (42) had also linked promixity or close contacts toward COVID-19 positive and suspect cases with increased psychological distress; although as far as the authors are aware this study is the first to demonstrate a linkage to IA.

The current and several other studies indicated that COVID-19 fear and prolonged quarantine period might have driven people to experience depressive and anxiety symptoms (7, 8, 35, 43, 44). Recreational online activities are often a mechanism to cope with anxiety and alleviate depressed mood (9). However, abusive usages may actually exacerbate anxiety and depression and reinforce the compulsion to use the Internet, developing a maladaptive coping mechanism (9, 10). PSBB encouraged people to utilize the Internet for virtually all facets of daily activities, thus exponentially increasing their Internet exposure. Our study revealed that there was a significant increase of duration of Internet usage of about 52% during COVID-19 and nearly all respondents utilized mobile phones for accessing the Internet. This finding was in line with Indonesian communication

TABLE 3 | Correlation matrix analysis between KDAI score, sub-scales of Indonesian Symptoms Checklist 90, and PSQI.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. KDAI	–												
2. GSI	0.313**	–											
3. Depression	0.303**	0.927**	–										
4. Anxiety	0.303**	0.865**	0.787**	–									
5. Obsessive-Compulsive	0.311**	0.930**	0.858**	0.781**	–								
6. Phobic Anxiety	0.256**	0.805**	0.760**	0.690**	0.737**	–							
7. Somatization	0.249**	0.858**	0.752**	0.845**	0.773**	0.678**	–						
8. Interpersonal Sensitivity	0.313**	0.911**	0.850**	0.760**	0.848**	0.705**	0.721**	–					
9. Hostility	0.301**	0.823**	0.762**	0.705**	0.773**	0.645**	0.679**	0.795**	–				
10. Paranoid	0.302**	0.570**	0.800**	0.729**	0.803**	0.677**	0.684**	0.856**	0.783**	–			
11. Psychoticism	0.320**	0.872**	0.820**	0.753**	0.816**	0.694**	0.704**	0.828**	0.752**	0.823**	–		
12. Additional	0.284**	0.902**	0.814**	0.759**	0.828**	0.711**	0.763**	0.802**	0.724**	0.754**	0.793**	–	
13. PSQI	0.225**	0.538**	0.493**	0.477**	0.505**	0.397**	0.485**	0.482**	0.442**	0.442**	0.460**	0.534**	–
Mean	66.51	37.24	5.57	3.32	4.87	2.52	4.69	4.18	1.85	2.54	3.39	3.74	5.53
SD	41.55	50.30	8.24	5.54	6.26	3.97	6.81	5.98	3.06	4.05	5.60	4.63	3.10
Median	62	17	2	1	3	1	2	2	1	1	1	2	5
IQR	45	48	8	4	7	4	6	6	2	4	5	6	5

***p < 0.01; All 95% CIs of the correlation coefficients were above 0 through bootstrapping (5,000 iterations).*

providers reports of rising broadband traffic during the pandemic (45, 46).

Additionally, this study also found that being online for over 11 h per day posed significant risk for IA. Past studies have mentioned the bidirectional relationship of time spent online and IA (47, 48). Internet duration as defined in our study, was irrespective of the specific digital activities or purposes. Therefore, further studies are required to stratify risks with respect to distinction of durations.

Apart from online duration, particular predominant motivations were found to be also related to IA. Social media and online gaming were two types of specific IA (49). Our findings affirmed association between social media, gaming, and IA. Despite their various features, all social media [e.g. *Instagram* (50), *Facebook* (51, 52), *WhatsApp* (53), *LINE* (54)] comprehensibly elicit some IA risk. The current study revealed that in our population, *Twitter* were correlated to higher odds of IA. This result could be explained by the fact that Indonesia has an enormous active *Twitter* userbase (55). In the current pandemic, Indonesia was also the second-highest based on the number of posts regarding COVID-19 topic on *Twitter* among Asia-Pacific countries (56). Social media use cannot be separated from information-seeking behavior. Motives of Internet use for information seeking was also related to IA in this research contrasting another study, which suggested no association (57). Keeping in mind, this study examined the behavior amidst the COVID-19 pandemic and people tend to desire and seek excessive information to stay updated during times of crisis (58–60). Improper information regulation regarding COVID-19 might enhance information overload, psychological stress, and risk of IA (9, 12, 59, 61).

On the analysis of psychopathology among the respondents, this study revealed that those with confirmed/suspected cases of COVID-19 within household scored almost twice as high than their counterpart in subscales of obsessive-compulsive, interpersonal sensitivity, somatization, and psychoticism. The severity of obsessive-compulsive traits which could be motivated through the thoughts of a heightened risk of coronavirus contraction leading to frequent hand-washing and other preventive measures (62), that would be reasonably heightened in individuals with confirmed/suspected COVID-19 cases within their households. Obsessive-compulsiveness tendencies are more likely to occur in Internet addicts than non-addicts. Since this group is intrusively preoccupied with the Internet, required longer timespan online, and experienced withdrawal when trying to reduce their digital life (63). Similarly, recommendations to maintain distance and avoid public transportations and gatherings might spur phobic anxiety and interpersonal sensitivity symptoms (7).

Intriguingly, somatization, and psychoticism were also considerably higher in the group with confirmed/suspected COVID-19 cases within their household and correlated to higher scores of IA. Illusive physical symptoms, observed even among the public during COVID-19 (7, 8), could be magnified among those with IA mediated partially by sleep disruptions (64, 65) and importantly, Internet addicts seemingly expressed depression as somatic manifestations (66, 67). Multiple brief psychotic cases of previously healthy individuals and absent psychiatric history had been reported as well in relation to COVID-19 (68, 69), that might be attributed to "coronaphobia" (70), the irrational fear and impression of helplessness and impending death due to exaggerated misinformation of COVID-19 (6, 71). Biologically, psychotic episodes had also been associated in people with seroreactivity to previous coronaviruses with possibility of neurotropism (72) or inflammatory damage (8). A prospective study described the persistence of problematic Internet use and frequent non-clinical psychotic events (73) and these Internet addicts were prone towards psychoticism-extraversion-neuroticism and instability in impulse control (74, 75).

Likewise, a particular game genre, i.e., MOBA, is related to IA *via* impulsivity as the key factor (76). Additionally, MOBA is growingly regarded as the more popular genre among amateur and professional gamers (76–78). Our study found that MOBA was related to IA during COVID-19 outbreak. Interestingly, mobile data use for Mobile Legend, a MOBA game currently sensational in Indonesia, has been reported to escalate during the home quarantine period (79). Other types of games, e.g. MMORPG (80) and FPS (81), are also proposed to raise the susceptibility towards IA. These might not be correlated to IA within our data due to the much older demographic, less availability of such genre in mobile devices, and decreasing popularity (76, 82). Subsequently, the present study discovered entertainment intent (e.g., watching a video, listening to the music, or reading comics/novels) to be predictive of IA during this pandemic. Binge-watching can be recognized as an abusive behavior, and the Internet reinforced the behavior through offering myriads of choices, personalized recommendations, autoplay, and socializing (e.g. comment sections and fandoms) which proliferate the addictive nature (83, 84), particularly in the times of reduced physical socializing amid COVID-19 and people turning to streaming services (9, 46).

The results of sleep quality in this study resonated with other COVID-19 studies, where fear of contracting the virus and isolation reduced sleep quality (85–87); the effect is more pronounced in subjects who had COVID-19 confirmed/suspected cases within household, as they scored higher in PSQI compared to those who reported no cases within their household. A study on COVID-19 patients uncovered insomnia as the second most diagnosed neuropsychiatric disorder (88). However, acknowledging the pervasive effects of COVID-19, other causes of worries should be recognized, such as social stigma, financial disturbances, and adversity in accessing basic needs (85). The current study established a positive correlation between scores of KDAI and PSQI (r = 0.225), indicating that apart from fear of contracting COVID-19, sleep disturbance was also related to problematic Internet use. A meta-analysis, with a majority of studies originating from Asia, asserted that Internet addicts had longer sleep latency, shorter adequate sleep time, and lower sleeping efficiency compared to their counterparts (89), in part due to the drive and preoccupation to Internet usage as well as potential inhibition of melatonin secretion due to the screens' blue-lights (90). Extensive Internet leisure activities (e.g., social media, online gaming, shopping, and gambling) had also been highlighted to curtail sleep duration (91), specifically within the period before bed (92). This translated to subjective lack of sleep quality, excessive daytime sleepiness, poor daytime functioning, and diminished self-control. Sleep deprivation is also linked to physical complaints, depression, anxiety, and suicidal tendencies (93), exacerbating the relationship between sleep quality and IA through psychological correlates. Emerging evidences pointed to the possibility of chronic neuropsychiatric sequalae (sleep disturbances and psychosis) among COVID-19 patients (88, 94) and past study highlighted sleep disturbances (60) and psychosis (72) were observed even in recovered cases of previous coronaviruses. Thus, more long-term observations will be required to astutely assess the correlation of IA, sleep perturbation, and psychotic tendencies.

The study inherently had several limitations, firstly, with its online survey methods certain respondent and reporting biases existed and the study was not be able to reach those without Internet connections. The study employed total sampling, which is inferior to random sampling. There was also an overrepresentation of the higher income bracket and particular occupational sector (office workers/proprietors), which could lead to selection bias. Self-reported instruments would also deposit additional biases, such as social desirability. The causal relationships between IA and correlates could not be established within this study due to the transversal nature.

Nonetheless, this study was the first nationwide study of IA in Indonesia and during the COVID-19 pandemic. The sample size and geographical spread were adequate to explore correlations and interactions to provide substantial evidence for national guidance. The data of this study could also be used as a comparison for future prospective studies in Indonesia.

CONCLUSION

The current study identified the rate of IA at 14.4% among the adult Indonesian population during the COVID-19 pandemic and home-isolation period. Extensive Internet duration, specific Internet motives, psychopathologies, and decreased sleeping quality were found to be correlated to IA during this pandemic, especially in group with confirmed/suspected COVID-19 cases within household. However, the act of physical distancing was not shown to increase the risk of IA. In light of these, public health bodies must maintain physical distancing recommendations and other public health measures, while consolidating and promoting mental health literacy, psychological warning signs, and adaptive psychiatric services during this tumultuous time.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Ethics Committee of Faculty of Medicine, Universitas Indonesia—dr. Cipto Mangunkusumo General Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KS and EH conceived, designed, and supervised the study. KS, EH, LS, HC, and AL contributed data or analysis tools. KS, EH, LS, HC, AL, A, LS, and BM collected the data. KS, EH, LS, HC, and CS performed the data analysis. KS, EH, LS, HC, AL, A, LS, and BM wrote the manuscript. KS and CS secured funding for the study. All authors contributed to the article and approved the submitted version.

FUNDING

This study received funding from the Ministry of Research and Technology/Centre of National Research and Innovation of Republic of Indonesia through the "*Konsorsium Riset dan Inovasi Untuk Percepatan Penanganan Corona Virus Disease 2019 (Covid-19)*" (Ref.: 106/FI/PKS-KCOVID-19.F/VI/2020). The funders had no role in the design, data collection, analysis and interpretation of data, write-up, and/or publication of this study.

ACKNOWLEDGMENTS

The authors would like to thank all the research assistants, universities, and state-owned companies in disseminating the survey.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.580977/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 03 September 2020
doi: 10.3389/fpsyt.2020.572245

Psychopathological Burden and Quality of Life in Substance Users During the COVID-19 Lockdown Period in Italy

Giovanni Martinotti [1,2†], Maria Chiara Alessi [1†], Chiara Di Natale [1], Antonella Sociali [1], Franca Ceci [1], Lorenza Lucidi [1], Elena Picutti [1], Francesco Di Carlo [1], Mariangela Corbo [1], Federica Vellante [1], Federica Fiori [3], Gaia Tourjansky [4], Gabriella Catalano [5], Maria Luisa Carenti [5], Chiara Concetta Incerti [6], Luigi Bartoletti [7], Stefano Barlati [8,9], Vincenzo Maria Romeo [10], Valeria Verrastro [11], Fabio De Giorgio [12], Alessandro Valchera [13], Gianna Sepede [1], Pietro Casella [5], Mauro Pettorruso [1] and Massimo di Giannantonio [1]*

[1] Department of Neuroscience, Imaging, Clinical Sciences, University G.d'Annunzio of Chieti-Pescara, Chieti, Italy, [2] Department of Clinical and Pharmaceutical Sciences, University of Hertfordshire, Herts, United Kingdom, [3] Department of Mental Health, ASL Lanciano-Vasto-Chieti, Chieti, Italy, [4] Pathological Addictions Treatment Division, La Promessa o.n.l.u.s., Rome, Italy, [5] Department of Mental Health and Addiction Services, ASL RM1, Rome, Italy, [6] Neurology and Neurorehabilitation Unit, Santa Lucia Foundation (IRCCS), Rome, Italy, [7] Department of Mental Health and Addiction Services, ASL Alessandria, Alessandria, Italy, [8] Department of Mental Health and Addiction Services, ASST Spedali Civili, Brescia, Italy, [9] Department of Clinical and Experimental Sciences, University of Brescia, Brescia, Italy, [10] Faculty of Psychological Sciences and Techniques, Dante Alighieri University, Reggio Calabria, Italy, [11] Department of Medical and Surgical Sciences, University "Magna Graecia" of Catanzaro, Catanzaro, Italy, [12] Division of Legal Medicine, Institute of Public Health, Catholic University of Sacred Hearth, Rome, Italy, [13] Pathological Addictions Service, Villa S. Giuseppe Hospital, Hermanas Hospitalarias, Ascoli Piceno, Italy

OPEN ACCESS

Edited by:
Giuseppe Bersani, Sapienza University of Rome, Italy

Reviewed by:
John Martin Corkery, University of Hertfordshire, United Kingdom
Marianna Mazza, Catholic University of the Sacred Heart, Italy

***Correspondence:**
Chiara Di Natale
dinatalechiara91@gmail.com

†These authors have contributed equally to this work and share first authorship

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *13 June 2020*
Accepted: *14 August 2020*
Published: *03 September 2020*

Citation:
Martinotti G, Alessi MC, Di Natale C, Sociali A, Ceci F, Lucidi L, Picutti E, Di Carlo F, Corbo M, Vellante F, Fiori F, Tourjansky G, Catalano G, Carenti ML, Incerti CC, Bartoletti L, Barlati S, Romeo VM, Verrastro V, De Giorgio F, Valchera A, Sepede G, Casella P, Pettorruso M and di Giannantonio M (2020) Psychopathological Burden and Quality of Life in Substance Users During the COVID-19 Lockdown Period in Italy. Front. Psychiatry 11:572245. doi: 10.3389/fpsyt.2020.572245

Background: Following the development of the COVID-19 pandemic, a rigid public health strategy of reduced social contact and shelter-in-place has been adopted by the Italian Government to reduce the spread of the virus. In this paper, we aim at evaluating the impact that the COVID-19 pandemic, and the relative containment measures, have had on a real-life sample of patients suffering from substance use disorders (SUDs) and/or behavioral addictions.

Methods: An anonymous questionnaire was filled out by 153 addicted patients, both outpatients and residential inpatients, recruited across Italy and highly representative of the current Italian population suffering from addictions. Psychopathological burden (anxiety and depressive symptomatology, somatization, irritability, and post-traumatic symptoms), quality of life, and craving changes in daily habits were assessed.

Results: In our sample, we found moderate rates of depression (22.9%), anxiety (30.1%), irritability (31.6%), and post-traumatic stress (5.4%) symptoms. Psychopathological burden was globally higher among residential patients. Reported levels of craving were generally low.

Discussion: This study is the first attempt to collect Italian data regarding the effects of the rigid quarantine period, during the COVID-19 pandemic, on patients suffering from a SUD and/or behavioral addictions. The presence of a moderate psychopathological burden correlated to poor quality of life and low craving scores represented the main outcomes. Long-term studies, with follow-up after the end of the restrictive measures, should be considered to implement our findings.

Keywords: substance use disorder, addiction, COVID-19, craving, psychopathology

INTRODUCTION

Following the advent of the COVID-19 pandemic, which developed between March 11, 2020 and May 3, 2020, social containment measures were implemented across Italy through a series of consecutive ministerial decrees aimed at limiting the spreading of the virus. The lockdown soon proved effective for such purposes, but at the same time, it generated an important series of consequences from both a social and an economic point of view. Social distancing, emotional isolation, complete transformation of the daily routine, abrupt adoption of an unhealthy lifestyle (sedentary lifestyle and unbalanced nutrition), and economic difficulties resulting from the interruption of work activities have thus compromised, and could continue to do so, the well-being of each individual and the entire community (1). Within the general population, problems such as feelings of frustration, aggressive behavior (2), post-traumatic stress symptoms (PTSS), depression, anxiety, insomnia, perceived stress, and adjustment disorder symptoms (ADS) have increased (3), with the consequent risk of self-medication through the abuse of alcohol and/or psychoactive substances and with a greater tendency to engage in pathological behaviors (gambling and internet addiction). It is possible that, among patients with pre-existing mental disorders, the symptomatology may flare up or worsen (with important management difficulties for the caregivers); the risk to develop suicidal ideation is also plausible for the most critical cases (1, 4, 5). The aforementioned effects in terms of mental health can be superimposed on those observed during other major epidemics/pandemics that have occurred in former times. Ebola (6), Human H7N9 Avian Flu (7), Middle East Respiratory Syndrome (MERS) (8, 9), and severe acute respiratory syndrome (SARS) (10–13) have in fact caused a real "mental health catastrophe" (12) among the affected population, above all amid the frontline workers managing the health emergency and among those who have recovered from the infection, including their relatives.

In this context, people with pathological dependencies on psychoactive substances and/or with behavioral addictions are particularly vulnerable. There is a real "collision" between SUDs and the COVID-19 infection. Moreover, drug users exposed to social risk factors, such as belonging to under-privileged social classes or, even worse, being homeless or imprisoned, are more often subject to precarious hygiene and health conditions. They are particularly susceptible to contract the infection, and, by virtue of obstructive and cardiovascular comorbidities of the ischemic-hypertensive type, they are prone to develop the disease in its most serious forms (14, 15). In patients with alcohol use disorder, the effects of the lockdown are notpredictable: social isolation, restricted freedom, and the resulting difficulties in obtaining the substance could lead to a reduction in the dysfunctional behavior. Nonetheless, an increase in withdrawal symptoms, and the possible use of DIY alcohol products, might have significant health fallouts and, potentially, even lead to death (16, 17). Among active users, a scarce availability of drugs, hence a reduction in their usage, could lead to withdrawal symptoms that are difficult to manage at home (5). Patients who are recovering from substance use experience psychological discomfort from social isolation, which might increase the risk of relapse. This alarming scenario is exacerbated by a quantitative and qualitative reduction in the addiction services' assistance and in the stretching of their services (18): For instance, recovering patients' access to support groups is prevented, and other forms of psychosocial assistance are limited as well (14). The handling of the substitution therapies for opiates addiction, in particular methadone and buprenorphine, has proven to be particularly complex, with difficulties in both supplying and distributing the aforementioned drugs (5, 14, 16, 17). These critical issues, caused by the rigid regulations that still guide the provision of replacement treatments, are similar to those documented in the past, e.g., following the terrorist attacks of September 11, 2001 on the Twin Towers and following Hurricane Katrina and Hurricane Sandy that hit the United States, respectively, in 2005 and 2012 (19). This implies a greater tendency to resort to illicit trafficking of opiates whenever the replacement drug cannot be found and increases the risk of death from possible overdose of the replacement drug, every so often dispensed to the patient in doses that are suitable to cover a greater period of time (17). Therefore, it is evident that the COVID-19 health emergency crisis collides with another important public health emergency, which is that of SUDs (14).

The aim of this study was to evaluate the impact that the COVID-19 pandemic, and the relative containment measures adopted by the Italian Government, had on patients with SUDs and/or behavioral addictions; to assess the psychopathological burden in terms of depression, anxiety, post-traumatic load; and to evaluate the relevance of craving symptoms and their correlation with psychiatric symptoms and quality of life.

MATERIALS AND METHODS

Participants and Procedure

From March 11, 2020 to May 3, 2020, throughout the whole Italian lockdown phase, we carried out a survey meant only for adult people with an ongoing and/or previous SUD and/or gambling.

Disorder (DSM-5) currently in treatment as outpatients and/or in a residency program as inpatients. Two hundred twenty-seven patients were recruited and offered the possibility to fill out the questionnaire. One hundred fifty-three patients gave their consent and completed the questionnaire. The survey was conducted in two ways: through a self-administered paper questionnaire and through an online platform where the subjects filled out the questionnaire independently using an URL (uniform resource locator) provided by the clinician during an interview. The survey was completed by each subject anonymously only after having read the information sheet and having signed the informed consent form. Various centers for recruitment were randomly selected in different regions of Italy (Abruzzi, Calabria, Lazio, Piedmont, Marche, Lombardy, and Molise) in order to guarantee an equal distribution of the sample's population around the country. In each recruitment center, a psychiatrist gave the survey to all eligible subjects. The presence of a DSM-5 diagnosis of SUD had been assessed and confirmed before the study procedures, representing an inclusion criterion of the study.

Survey *S*tructure and Measurements

The survey was organized in three sections.

In the first section, we collected anamnestic information and clinical variables that included age, gender, education level, relationship status, days spent in lockdown, primary substance of abuse, substitute and/or support treatments, pathological gambling, support by addictions services, comorbid psychiatric disorders and psychopharmacological treatment, hospitalization, and SARS-Cov-2 testing. In the second section, we asked the subjects to indicate the level of craving for the primary substance of abuse and how much their craving and habits have changed since the start of lockdown. We used a visual analogue scale (VAS), which ranged from 1 (strongly reduced) to 10 (strongly increased). We investigated the change in quality of life, the consumption of cigarettes, coffee, alcoholic drinks, cannabis, cocaine, opioids, benzodiazepines, food, and the time spent shopping online, instant messaging, and making video calls with friends/relatives on social networks, carrying out old and/or new hobbies, in sport activities, watching TV series or films, and watching pornographic material. In the third section, we investigated the psychopathological variables of interest, from the start of the lockdown to the completion of the survey. Irritability was measured using four irritability items from the Irritability depression anxiety scale (IDAS) (20); five items from the self-rating anxiety state (SAS) were employed to investigate anxiety (21). Somatic symptoms were investigated with a single question about the presence of all possible pathological conditions. The Davidson trauma scale (DTS) was adopted for the assessment of post-traumatic stress symptoms (22), and the beckdepression inventory - II (BDI-II) (23) was utilized to assess current depressive symptoms. According to the scores obtained in the scales, symptomatology was divided into two categories: minimal/mild and moderate/severe.

Statistical Analysis

Statistical analysis was performed using Statistica 8.0 (Statsoft Inc. Usa, 2007). Quantitative parameters were presented as mean ± standard deviation (SD) and qualitative parameters as number and percentage per class. Kolmogorov-Smirnov (K-S test) was used to check for the normality of distributions. Analysis of variance (ANOVA) and Duncan *post hoc* test were utilized to evaluate the differences among subgroups' means. The associations between variables were measured using Pearson's correlation. The p value was considered significant if <0.05.

RESULTS

Sample Characteristics

Most patients were males (n = 119, 77.8%); the mean age was 39.8 (± 12.3) years. At the time of questionnaire completion, the subjects had been in quarantine for an average of 47.3 (± 14.1) days. Most subjects (n = 66, 43.1%) indicated cocaine as the principal substance of abuse, followed by alcohol (n = 39, 25.5%) and THC (n = 24, 15.7%). Of the entire sample, 97 patients (63.4%) were outpatients, living at home during quarantine, while 56 (36.6%) were inpatients in residential programs. The full participants' characteristics and the substances' patterns of use are presented in **Table 1**.

Sixty-seven (43.8%) participants reported a comorbid psychiatric condition, especially mood disorders (depression and bipolar disorder) or anxiety. Sixty-three (94%) of those with comorbid psychiatric condition and 26 (30.2%) of those without a comorbid psychiatric disorder reported undergoing psychopharmacological treatment. All the information regarding the comorbid psychiatric conditions and their pharmacological treatments remained unchanged. About 10% of the patients reported a comorbid medical condition. Only one subject (0.7%) had a COVID-19 related pneumonia (**Table 2**).

Psychopathology, Quality of Life, Craving

We calculated the total score for five psychometric scales (IDAS-irritability, DTS, SAS-five items, somatization, and BDI-II) in both the entire sample and in five of the principal categories of substances/behaviors (alcohol, cocaine, gambling, THC, and heroin). ANOVA showed no significant effect on the principal substance of abuse (**Table 3**).

Each psychopathological domain was scored into two levels of severity: minimal/mild and moderate/severe. Scores are detailed in **Table 4**.

The mean level of craving was generally low (3.4), nonetheless a general low difficulty in finding the substances of abuse was reported. The level of craving was higher in outpatients (mean = 3.8) compared to inpatients (mean = 2.8, p = 0.038) (**Table 5**).

The association between the level of craving for the principal substance of abuse and the values of the psychometric scales was measured using Pearson's correlation. These data about craving will be further elaborated elsewhere. The level of significance (p = 0.05) was corrected for multiple comparisons using the Bonferroni correction: p corr = 0.05/n comparisons = 0.01. We observed a significant positive correlation between the level of craving and the mean total values of DTS, SAS, (five items) and BDI-II, and the results remained significant after Bonferroni correction (**Table 6**).

TABLE 1 | Participant's characteristics and pattern of substance use.

	Mean	SD
Age	39.8	12.3
	N	**%**
Gender		
Male	119	77.8
Female	34	22.2
Education level		
None	1	0.7
Primary school	8	5.2
Lower secondary school	36	23.5
High school	82	53.6
Bachelor's degree/Postgraduate degree	24	15.7
Relationship status		
Single	66	43.1
Widow / widower	1	0.7
Divorced	22	14.4
In a relationship	51	33.3
In a relationship but not seeing each other till the beginning of the lockdown	11	7.2
Having children		
Yes	33	21.6
No	95	62.1
	Mean	**SD**
Days spent in lockdown	47.3	14.1
	N	**%**
Quarantine violations		
Yes	26	17.0
No	123	80.4
Not in quarantine	3	2.0
Sars-Cov2 testing		
Negative	33	21.6
Positive	3	2.0
None	116	75.8
Data unavailable	1	0.7
Cigarette smoking		
No	32	20.9
Yes occasionally	12	7.8
Yes < 10 cigarettes/day	24	15.7
Yes 10-20 cigarettes/day	57	37.3
Yes > 20 cigarettes/day	27	17.6
Primary substance/behavior of abuse		
Cocaine	66	43.1
Alcohol	39	25.5
THC	24	15.7
Gambling	12	7.8
Heroin	9	5.9
Benzodiazepines	1	0.7
Ketamine	1	0.7
Psychopharmacological medications	1	0.7
Secondary substance/behavior of abuse		
Cocaine	12	7.8
Alcohol	14	9.2
THC	17	11.1
Gambling	20	13.1
Opioids	4	2.6
MDMA / Meth-amphetamines	3	2.0
Nicotine	1	0.7
Not specified	4	2.6
None	78	51.0
Gambling		
Yes	33	21.6
No	109	71.2
In the past	11	7.2

(Continued)

TABLE 1 | Continued

	Mean	SD
Days from the last use of the primary substance	95.6	81.6
	N	**%**
Followed by an Addiction Service		
Yes	93	60.8
No	60	39.2
Substitute and/or support treatments		
Methadone	11	7.2
Buprenorphine	3	2.0
Naloxone/naltrexone	4	2.6
Sodium oxybate	8	5.2
Disulfiram	1	0.7
Hospitalization		
Inpatients	56	36.6
Outpatients	97	63.4

THC: Δ9-tetrahydrocannabinol; MDMA: methylenedioxymethamphetamine.

TABLE 2 | Psychiatric comorbidity in the full sample.

	N	%
NO PSYCHIATRIC COMORBIDITY	**86**	**56.2**
• No psychopharmacological treatment	60	69.8
• Monotherapy	16	18.6
• Polytherapy	10	11.6
• Antidepressants	13	15.1
• Benzodiazepines	11	12.8
• Antipsychotics	3	3.5
• Mood stabilizers	13	15.1
WITH PSYCHIATRIC COMORBIDITY	**67**	**43.8**
• Depressive disorder	18	26.9
• Bipolar disorder	14	20.9
• Anxiety disorder	11	16.4
• Borderline personality disorder	5	7.5
• Psychotic disorder	5	7.5
• Cyclothymic disorder	2	3.0
• Obsessive compulsive disorder	2	3.0
• Attention deficit hyperactivity disorder	2	3.0
• Paranoid personality disorder	1	1.5
• Eating disorder	1	1.5
• Unspecified	6	9.0
Psychopharmacological treatment		
• No therapy	4	6.0
• Monotherapy	17	25.4
• Polytherapy	46	68.6
• Antidepressants	43	64.2
• Benzodiazepines	38	56.7
• Antipsychotics	18	26.9
• Mood stabilizers	45	67.2

When comparing inpatients versus outpatients by means of ANOVA, the IDAS (irritability) scale resulted in significantly higher levels among inpatients. Comparing dual diagnosis participants against non-dual diagnosis participants, BDI-II, DTS, and somatization scores were significantly higher among dual-diagnosis patients. VAS quality of life scored higher in the non-dual diagnosis group. Results of ANOVA tests are detailed in **Table 7**.

TABLE 3 | Results of the psychometric scales and substances/behaviors, ANOVA results.

	ValidN	IDAS -irritability		DTS		SAS -five items		SOM		BDI-II	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Alcohol	39	7.9	3.1	22.0	23.4	9.5	3.8	1.7	1.0	12.7	11.5
Cocaine	66	7.5	2.7	22.2	22.5	9.5	3.4	1.7	0.9	12.0	11.4
Gambling	12	5.7	1.2	22.3	23.0	9.1	2.5	1.3	0.5	11.8	9.8
THC	24	6.7	2.3	22.7	17.7	9.3	3.1	1.7	1.0	11.6	8.7
Heroin	9	6.8	2.4	23.8	16.5	9.6	3.0	1.8	0.7	20.3	14.8
Total	153	7.4	2.7	22.1	21.4	9.4	3.3	1.7	0.9	12.7	11.3
	df	F	p	F	P	F	p	F	p	F	p
ANOVA	4;145	2.08	0.09	0.01	0.99	0.05	0.99	0.73	0.57	1.20	0.31

THC, Δ9-tetrahydrocannabinol; BDI-II, Beck depression inventory–II; SAS–five items, Five items from the self-rating anxiety statee; DTS, Davidson trauma scale; IDAS-irritability, four irritability items from the irritability depression anxiety scale; SOM, somatization.

We found an increase of about 50% of the cases for the amount of time spent on the following daily activities: eating, instant messaging, social networking, video calls to friends/relatives, watching movies/TV shows, and sleeping. About 40% of subjects increased their online search to gather information about the ongoing pandemic.

DISCUSSION

This study collects the first Italian data regarding patients suffering from SUDs and/or behavioral addictions during the rigid quarantine period caused by the COVID-19 pandemic. The study, which includes patients recruited in seven different representative Italian regions, has the uniqueness of incorporating previously treated patients who were known by local services and who were all given a DSM-5 diagnosis of SUD. In addition, the recruited group represents a real-life sample that reflects the Italian addiction scenario (24) and was homogeneously differentiated into residential and non-residential patients, with some patients reporting a dual diagnosis and others none.

TABLE 4 | Results of the psychometric scales and ranges (cases and %).

BDI-II	
Minimal/mild (0–19)	*Moderate-severe (20–63)*
118 (77.1%)	35 (22.9%)
SAS-five items	
Minimal/mild (1–10)	*Moderate-severe (11–20)*
107 (69.9%)	46 (30.1%)
DTS	
Minimal/mild (0–67)	*Moderate-severe (68–136)*
140 (94.6%)	8 (5.4%)
IDAS-irritability	
Minimal/mild (1–8)	*Moderate-severe (9–16)*
104 (68.4%)	48 (31.6%)
SOM	
Minimal/mild (1–2)	*Moderate-severe (3–4)*
125 (82.2%)	28 (17.8%)

BDI-II, Beck depression inventory–II; SAS–five items, five items from the self-rating anxiety state; DTS, Davidson trauma scale; IDAS-irritability, four irritability items from the irritability depression anxiety scale; SOM, somatization.

The psychopathological burden observed in our sample is in line with recent international data concerning psychiatric patients, subjects with dual diagnosis, and drug addicts. The effects of quarantine on mental health have been highlighted in a recent review that evaluates the psychological distress among the quarantined people during past pandemics and epidemics (25). Many studies, based on online surveys, have shown an increase in anxiety, depression, and stress among Chinese (26–29), Italian (3, 30), and Spanish (31) people due to the COVID-19 pandemic. Our results are in line with these findings, showing relatively high rates of depression, anxiety, irritability, and post-traumatic stress symptoms among the sample. Specifically, 22.9% of our sample reported moderate/severe depressive symptoms, and 30.1% reported moderate/severe anxiety symptoms, similar to what was indicated by another Italian survey that rated 32.8% of participants as having high/very high depressive symptoms and 18.7% of them as having high/very high anxiety symptoms (30). These results show no substantial psychopathological difference between our sample and the general population. Mazza et al. reported a considerable increase in the use of telephones, social networks, and mobile apps toconnect with family and friends during the quarantine period among the Italian population. Our findings are in line with these results, showing an increase in the use of instant messaging (51.6%) and video calls (54.9%) to connect with friends and relatives among substance users as well. Moreover, we found an increase in the time spent utilizing social networks (47.7%), collecting online information about the current situation (40.5%), and watching movies or TV shows (60.1%). In our study, the level of craving resulted to be overall,

TABLE 5 | Craving visual analogue scale (VAS) in different subgroups, ANOVA results.

	N	Mean	SD
CRAVING VAS IN FULL SAMPLE	153	3.4	3
CRAVING VAS IN INPATIENTS	56	2.8	2.8
CRAVING VAS IN OUTPATIENTS	97	3.8	3.1
ANOVA results: F (1; 151) = 4.36, p < 0.05. Duncan post hoc test: Outpatient > Inpatient			

VAS, visual analogue scale.

TABLE 6 | Pearson correlations between craving and psychometric results. * = significant after Bonferroni correction (p corrected = 0.01).

	R	P
IDAS-irritability	0.01	0.99
DTS	0.24	0.003*
SAS-five items	0.22	0.006*
SOM	0.14	0.09
BDI-II	0.34	0.0001*

BDI-II, Beck depression inventory–II; SAS–five items, five items from the self-rating anxiety state; DTS, Davidson trauma scale; IDAS-irritability, four irritability items from the irritability depression anxiety scale; SOM, somatization.

lower than real-life samples of Italian patients with SUDs (32). Craving is one of the key symptoms in addicted patients, closely correlated with the prognosis and progression of the pathology (33) and lower levels could influence positively the treatment outcome (34). This unexpected result could be explained by a perceived lack of availability of the substance that interrupted the development of the craving priming and by the presence of decreased social pressure on a group of subjects that are usually excluded and stigmatized. Specific craving variations between the lockdown-period and prior times will be reported and discussed elsewhere. Craving was higher among outpatients than inpatients. This data underlines the importance of residential treatment in SUDs. In fact, numerous studies demonstrate the effectiveness of this approach in increasing the perceived quality of life and in improving executive functions and psychological distress (4, 14, 19), conditions that lead to a reduction in craving (35). Such a notion is relevant because substance craving is a known predictor of relapse after treatment for SUDs (36). Residential treatment could, therefore, be a fundamental first step in laying the foundations for subsequent long-term outpatient treatment. This is even more true if we take into account that it also causes a change in the perception that the drug addict has of himself, transitioning from a 'substance user' social identity to an 'in-recovery' identity (37). In terms of craving intensity, the benefits of the presence of strict limitations on personal freedom, including the impediment to obtain substances, combined with the benefits of carrying out intensive treatment in residential structures, are perhaps the most interesting result of our study and it has relevant therapeutic implications.

Moreover, our results underline the link between craving and quality of life, defined as the perception that the individual has regarding the effects that a disease, and its treatment, have on his physical, emotional, and social well-being (38). More than half of the cohort reported reduced quality of life during COVID-19 lockdown, and the analysis showed a negative correlation between perceived quality of life and reported craving. The association between alcohol craving and quality of life was previously studied by Herrold et al. in war veterans demonstrating that high levels of craving were associated with poor perceived quality of life, bothmentally and physically (39). At the same time, improving the quality of life, for instance, through physical exercise, can play an important role in reducing craving and, therefore, conducts of abuse (40). Several studies have demonstrated that stress, negative mood, and craving could expose addicted patients to relapse and dropout from treatment (41). These factors are important elements of vulnerability that can be correlated with each other. It is essential to recognize and treat each one of them to improve the outcome. In fact, in our analysis we found a positive correlation between craving and depressive symptoms, anxiety, and traumatic stress. These findings are in line with the study of Fatseas et al. that found an association between psychiatric distress, mood and/or anxiety disorders, and higher levels of craving (42). Moreover, Luminet et al. found strong correlations between negative affect and craving in alcohol-dependent patients. In their study, an increase in depressive symptoms was related to increased levels of craving in women (43). It is necessary to look for the association between craving and psychopathological conditions because it could present useful information for a successful treatment. Specific attention to these clinical parameters could be the basis for a specific strategy to be employed in those populations exposed to the pandemic and to its associated restrictions and could open new scenarios based on possible preventive interventions. In lockdown period, the role of telepsychiatry acquires great importance for careful monitoring of the patient's clinical and psychopathological conditions in order to prevent relapses (44). Through telematic interview, the clinician can also supervise the patient's family environment, trying to understand if it provides the patient with enough support.

This study has some limitations: 1) the absence of a long-term follow-up, potentially useful to highlight the consequences of the lockdown; 2) in a part of the sample, the survey was completed online directly by the patient without proper verification by the clinician; and 3) the assessment of craving, which has always been complex and sometimes difficult to interpret, was carried out with a visual analogue scaling and not with more structured scales.

Long-term studies, with follow-up at the end of the restrictive measures and after the full development of the psychopathological experience caused by the pandemic and by its socio-economic consequences, may clarify the true impact of the COVID-19 pandemic on those subjects affected by SUDs. Meanwhile, thanks to this study being conducted with a sample of Italian drug addicts, it was possible to identify a moderate psychopathological burden

TABLE 7 | ANOVA results comparing dual diagnosis and non-dual diagnosis participants.

Psychometric scale	Dual-diagnosis subsample	Non dual-diagnosis subsample	F	p
IDAS-irritability (mean ± SD)	7.7 ± 2.8	7.2 ± 2.8	1.12	0.292
DTS (mean ± SD)	30.1 ± 24.5	16.4 ± 16.6	16.67	0.000
BDI-II (mean ± SD)	17.2 ± 12.8	9.4 ± 8.7	19.62	0.000
SAS-five items (mean ± SD)	10.1 ± 3.9	9.1 ± 2.7	3.623	0.059
SOM (mean ± SD)	1.9 ± 1	1.5 ± 0.9	5	0.027
VAS quality of life (mean ± SD)	3.9 ± 2.3	4.8 ± 2.5	5.09	0.026

BDI-II, Beck depression inventory–II; SAS-five items, five items from the self-rating anxiety state; DTS, Davidson trauma scale; IDAS-irritability, four irritability items from the irritability depression anxiety scale; SOM, somatization; VAS, visual analogue scale.

correlated with poor quality of life and craving scores. The latter were overall low, especially among patients who are hospitalized in residential structures, opening interesting questions in terms of treatment strategies.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GM, MA, AS, and CN contributed to conception and design of the study. MC, GT, GC, MLC, CI, LB, SB, VR, VV, FG, AV, and PC contributed to the recruitment of the sample and the organization of the article's sections. MP, MA, and FDC organized the database. GS and FDC performed the statistical analysis. MA, AS, CN, FC, LL, EP, FF, and FV wrote sections of the manuscript. MP, GM, and MG performed the critical revision and approved the article. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

This study was partly found by the European Project entitled 'Analysis, Knowledge dissemination, Justice implementation and Special Testing of Novel Synthetic Opioids' – JUST-2017-AG-DRUG.

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Conflict of Interest: GM has been a consultant and/or a speaker and/or has received research grants from Angelini, Doc Generici, Janssen, Lundbeck, Otsuka, and Pfizer. MG has been a consultant and/or a speaker and/or has received research grants from Angelini, Janssen, Lundbeck, Otsuka, Pfizer, and Recordati.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer, JC, declared a shared affiliation, though no collaboration, with one of the authors, GM, to the handling editor.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 25 September 2020
doi: 10.3389/fpsyt.2020.571084

Stress, Anxiety, and Change in Alcohol Use During the COVID-19 Pandemic: Findings Among Adult Twin Pairs

Ally R. Avery[1], Siny Tsang[1], Edmund Y. W. Seto[2] and Glen E. Duncan[1]*

[1] *Department of Nutrition and Exercise Physiology, Washington State University, Spokane, WA, United States,* [2] *Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, WA, United States*

The novel coronavirus (COVID-19) has impacted the lives of people worldwide since being declared a pandemic on March 11, 2020. Social restrictions aimed at flattening the curve may be associated with an increase in stress and anxiety, which may increase the use of alcohol as a coping mechanism. The objective of this study was to examine if stress and anxiety were associated with changes in alcohol use in a sample of adult twins. Twins allowed us to control for genetic and shared environmental factors that would confound the alcohol - mental health relationship. Twins (N = 3,971; 909 same-sex pairs) from the Washington State Twin Registry (WSTR) completed an online survey examining several health-related behaviors and outcomes and their self-reported changes due to COVID-19. About 14% of the respondents reported an increase in alcohol use. We found an association between both stress and anxiety and increased alcohol use, where twins with higher levels of stress and anxiety were more likely to report an increase in alcohol consumption. The associations were small and confounded by between-family factors and demographic characteristics. However, there was no significant difference in stress or anxiety levels between non-drinkers and those who reported no change in alcohol use. Our findings suggest that individuals' mental health may be associated with changes in alcohol use during the COVID-19 pandemic.

Keywords: novel coronavirus, alcohol use, perceived stress, anxiety, social restriction, twins

OPEN ACCESS

Edited by:
Hironobu Fujiwara,
Kyoto University Hospital, Japan

Reviewed by:
Modesto Leite Rolim Neto,
Universidade Federal do Cariri, Brazil
Mauro Ceccanti,
Sapienza University of Rome, Italy

***Correspondence:**
Ally R. Avery
ally.avery@wsu.edu

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *09 June 2020*
Accepted: *07 September 2020*
Published: *25 September 2020*

Citation:
Avery AR, Tsang S, Seto EYW and Duncan GE (2020) Stress, Anxiety, and Change in Alcohol Use During the COVID-19 Pandemic: Findings Among Adult Twin Pairs. Front. Psychiatry 11:571084. doi: 10.3389/fpsyt.2020.571084

INTRODUCTION

The novel coronavirus (COVID-19) has impacted the lives of people worldwide since being declared a pandemic on March 11, 2020 (1). Social restrictions have been put in place to flatten the curve, including the closure of schools, parks, and non-essential businesses[1]. These restrictions may have been successful in slowing the spread of new infections. However, the impact of social isolation and lockdown measures may exacerbate mental health problems such as stress and anxiety, which, in turn, may increase alcohol use as a coping mechanism.

[1] The definition of essential business and/or service differs across countries and local governments.

There is an extensive literature on the use of alcohol as a coping mechanism in response to stressful life events at the micro level, such as divorce (2), unemployment (3, 4), and social isolation (5), and at the macro level, such as terrorist attacks (6–9), natural disasters (10–13), and economic recessions (3, 14–16). These studies consistently found an increase in alcohol use, specifically heavy drinking, among individuals exposed to stressful or traumatic events. As alcohol reduces the body's stress response and emotional memory (17), individuals may consume alcohol to remedy stressful memories related to traumatic events. Longitudinal studies of individuals exposed to a single traumatic event, such as a terrorist attack, found that post-traumatic stress symptoms were associated with an increase in alcohol use over time (7, 9, 13).

Only a handful of studies have investigated the use of alcohol in response to virus outbreak-related stress and anxiety. Among hospital employees in China exposed to the 2003 SARS-CoV outbreak, being quarantined and working in a high-risk location were significantly associated with more alcohol use, with 6% of respondents reporting using alcohol to cope with negative feelings (18). A survey of adults living in Hong Kong during the 2003 SARS-CoV outbreak found that 6.8% of adults reported an increase in alcohol use due to SARS (19).

Regarding the current COVID-19 pandemic, concerns have been raised about the potential risk of increased alcohol consumption due to increased stress (20–22) and social distancing (21). Among US Amazon MTurk workers, those with higher levels of COVID-19–related anxiety were more likely to use drugs and/or alcohol as a coping strategy (23). Among a sample of 4,276 university students in the US surveyed at the end of March 2020, those with more symptoms of depression and anxiety reported a greater increase in alcohol consumption compared to those with fewer symptoms (24). Although increases in alcohol consumption were associated with higher levels of anxiety, depression, and stress symptoms among a sample of 1,491 anonymously surveyed Australian adults in April 2020 (25), a different study among 4,462 Australian adults conducted around the same time found that only depression and stress, but not anxiety, were indicators of a reported increase in alcohol use (26). To date, no studies have examined changes in alcohol use during COVID-19 in a genetically informed sample of adults.

The objective of this study was to examine whether stress and anxiety was associated with perceived changes in alcohol use over the short-term in response to the COVID-19 outbreak and its mitigation strategies in a community-based sample of adult twins primarily residing in the US. We hypothesized that stress and anxiety would be associated with increased alcohol use as a coping strategy. Specifically, we expected that individuals with higher stress and anxiety levels would be more likely to increase the use of alcohol. On the other hand, we expected that those with lower stress and anxiety levels would be more likely to report a decrease in the use of alcohol or report no use of alcohol.

METHODS

Participants

A total of 3,971 individuals from the Washington State Twin Registry (WSTR) completed an online survey examining several health-related behaviors and outcomes and their self-reported changes due to COVID-19 mitigation, administered between March 26 and April 5, 2020. The survey was sent to 12,173 individuals registered and active in the WSTR; the individual response rate was 32.8% and the pair-wise response rate was 21.2%[2]. The WSTR is a community-based Registry of twin pairs primarily recruited through Washington State Department of Licensing (DOL) records. Details regarding the recruitment procedures of the WSTR and additional information are reported elsewhere (27–29). This study was reviewed and approved by Washington State University Institutional Review Board.

Both monozygotic (MZ, identical) and dizygotic (DZ, fraternal) twins participated in the study. The current sample included 909 same-sex twin pairs (77% MZ, 23% DZ). Zygosity was determined using five questions in the WSTR enrollment survey asking about childhood similarity. Compared to biological zygosity indicators, the survey items correctly classify zygosity with at least 95% accuracy (30, 31).

Measures

Change in Alcohol Use

Participants responded to a series of questions, "Compared to a few weeks ago (i.e., prior to the spread of COVID-19), and thinking only about the past 7 days, please indicate whether you have made changes in the following behaviors." Several activities and behaviors were assessed. For the current study, we utilized their responses to the "consume alcohol" activity, with four possible response categories: doing more, doing the same, doing less, and do not do.

Perceived Stress

We used the 10-item Perceived Stress Scale [PSS; (32)] to assess participants' stress levels. Participants were asked about their feelings and thoughts in the last 2 weeks with five response categories; 0, never; 1, almost never; 2, sometimes; 3, fairly often; 4, very often. A total PSS score (range = 0 to 40) can be obtained by summing across all scale items, with higher scores indicating higher levels of stress.

Anxiety

The six-item anxiety subscale in the Brief Symptom Inventory [BSI; (33)] was used to assess anxiety. Participants were asked to indicate how much discomfort each problem has caused them during the past 2 weeks including today on a five-point Likert-type scale (0 = Not at all; 1 = A little bit; 2 = Moderately; 3 = Quite a bit; 4 = Extremely). A total anxiety score (range = 0 to 24) was computed by summing across all items, where higher scores reflect higher levels of anxiety.

[2] Response rates in the current study were comparable to prior WSTR survey-based studies (~32% and 21% individual and pair-wise response rate, respectively, across 13 unique studies). Demographic characteristics of the current respondents were like those in the full WSTR (data available upon request).

Covariates

Participants' age and sex were included as covariates in the statistical analyses. Age referred to individuals' age at which they completed the survey; it was computed based on the reported date of birth. Sex was self-reported as male or female.

Statistical Analysis

In order to examine whether the odds of change in alcohol use is associated with mental health, we performed the following comparisons separately for perceived stress and anxiety: (i) do not use versus use more, (ii) do not use versus use the same, (iii) do not use versus use less, (iv) use the same versus use more, and (v) use the same versus use less.

We first used the classical twin model to decompose the variances of perceived stress, anxiety, and the change in alcohol use into additive genetic (A), shared environmental (C), and non-shared environmental (E) components (34). The A variance components represent the additive effect of genes, with correlation $r = 1.0$ between MZ twins (who share 100% of their genetic sequence) and $r = 0.5$ between DZ twins (who, on average, share 50% of their segregating genes). The C variance components represent common environmental experiences that make members of the same family more similar; they correlate at $r = 1.0$ for both MZ and DZ twins. The E variance components represent non-shared environmental experiences and do not correlate between twins. Measurement error is also included in the E variance components.

We next used phenotypic regression models to examine the association between mental health and change in alcohol use (**Figure 1**). Change in alcohol use was regressed on mental health (i.e., perceived stress or anxiety), estimating the observed association between mental health and change in alcohol use (b_p in **Figure 1**). b_p reflects the phenotypic association between mental health and change in alcohol use, without including genetic or shared environmental confounds.

The models were then re-estimated including estimates of b_A and b_C, respectively controlling for genetic and shared environmental confounds, in the estimation of the phenotypic effect (**Figure 1**). These are referred to as quasi-causal models; the logic and associated statistical methods are described in (35). The b_A and b_C regression paths from perceived stress to change in alcohol use were initially estimated with large standard errors, reflecting a high degree of correlation between the additive genetic (A) and shared environmental (C) components of stress and insufficient power to differentiate between these sources of covariation. b_A and b_C paths from perceived stress to change in alcohol use were subsequently constrained to be the same, meaning that the total between-family effect was estimated instead of individual between-family components. A final set of models were performed by including participants' age and sex as covariates. Perceived stress and anxiety were both square root transformed as the two variables are positively skewed.

Descriptive statistics were provided for both the full sample and the same-sex twins sample, whereas twin analyses were performed only on the same-sex twins sample. Descriptive statistics were performed in the statistical program R 3.5.3 (36). All latent variable path analyses were conducted using the computer program Mplus v. 8.1 (37). The alpha level for testing hypotheses was set to 0.05. Twin-based regression models are generally saturated; the only source of reduced fit involves incidental issues such as differences between twins arbitrarily assigned as Twin 1 and Twin 2 within pairs. All reported models fit the data closely using standard "goodness of fit" tests.

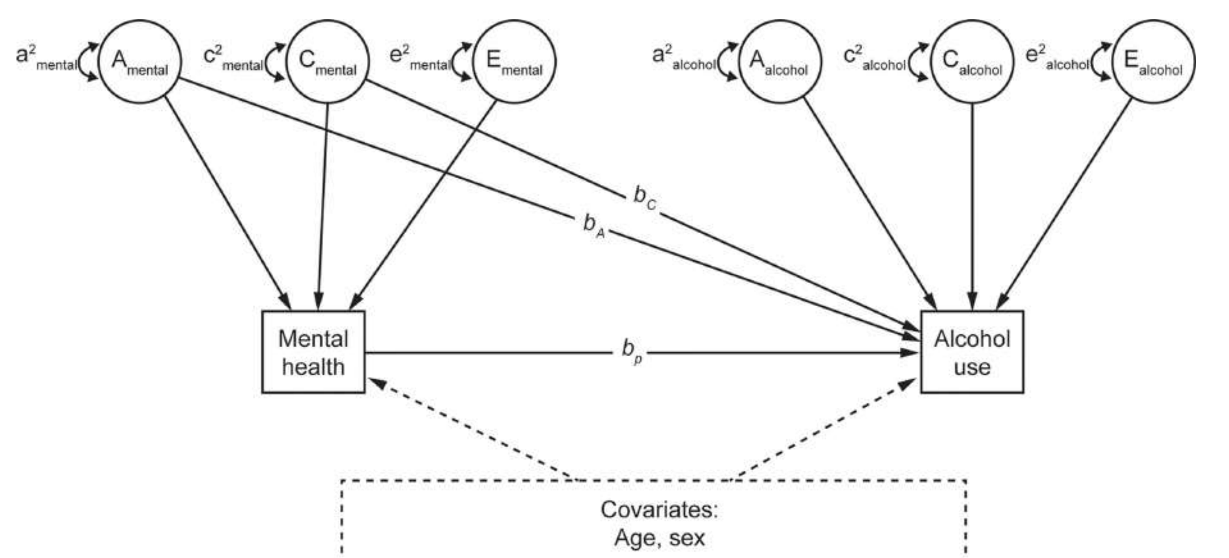

FIGURE 1 | Quasi-causal twin model, controlling for age and sex. A: additive genetic component; C: shared environmental component; E: unique environmental component; b_A and b_C: amount of residual variance of mental health attributable to the genetic and shared environment, respectively; b_p: phenotypic association. Mental health refers to perceived stress or anxiety, in separate models.

RESULTS

Descriptive Statistics

Descriptive statistics for select demographic characteristics, perceived stress, anxiety, and the proportion of participants with varying changes in alcohol use for the full sample and among same-sex twin pairs are shown in **Table 1**. Most of the participants reported either not using alcohol (35.5% and 36% in full sample and same-sex twins sample, respectively) or using about the same amount (39.4% and 38.3% in full sample and same-sex twins sample, respectively), whereas smaller proportions reported using more (14.3% and 15.3% in full sample and same-sex twins sample, respectively), and even smaller proportions reported using less alcohol (~10% in full sample and same-sex twins sample). The distributions of stress and anxiety levels, by different changes in alcohol use, are presented in **Figure 2**.

TABLE 1 | Descriptive statistics of select demographic characteristics, self-report change in alcohol use, perceived stress, and anxiety.

	Full sample (n = 3,989)	Same-sex twin pairs (n = 909 pairs)
Age	50.4 (*16.0*)	49.9 (*16.0*)
Gender		
Men	1,125 (30.8%)	444 (24.4%)
Women	2,746 (69.2%)	1,374 (75.6%)
White	3,793 (95.5%)	1,738 (95.6%)
Zygosity		
MZ	2,385 (60.1%)	1,400 (77.0%)
DZ	1,586 (39.9%)	418 (23.0%)
Change in alcohol use (%)		
Do not use	1,382 (35.5%)	643 (36.0%)
Use more	556 (14.3%)	274 (15.3%)
Use the same	1,533 (39.4%)	685 (38.3%)
Use less	424 (10.9%)	185 (10.4%)
Perceived stress	12.3 (*7.2*)	12.6 (*7.2*)
Anxiety	3.6 (*3.6*)	3.8 (*4.0*)

Means (standard deviations) are presented for continuous variables. Frequencies (proportions) are presented for categorical variables.

Univariate Twin Models

Twin correlations for perceived stress and anxiety, as well as tetrachoric twin correlations for the five change in alcohol use comparisons are presented in **Table 2**. The standardized biometric variance components for the variables are also shown; variance component estimates that were negative were subsequently set to zero. There was substantial non-shared environmental variance for perceived stress (61%), whereas the genetic (A: 23%) and shared environmental (C: 16%) variance were much smaller and not significantly different from zero. The univariate decomposition of anxiety showed a combination of genetic (A: 42%) and non-shared environmental (E: 58%) variance. For the three comparisons with the do not use group, the non-shared environmental variance, though small, was significantly different from zero (E: 10%, 29%, and 40% for comparing against use more, use the same, and use less, respectively). On the other hand, the additive genetic and shared environmental variance in these three comparisons were estimated with large standard errors, which may suggest unstable estimates and/or insufficient power. The use the same vs. use more comparison showed a combination of shared (C: 53%) and non-shared environmental (E: 47%) variance. There was substantial non-shared environmental variance (E: 81%) in the use the same vs. use less comparison, with a very small proportion of the variance due to additive genetic variance (A: 19%).

Perceived Stress and Change in Alcohol Use

Do Not Use vs. Use More

We found a significant phenotypic association between stress and change in alcohol use (b_p = .314, OR = 1.37, p <.001; **Table 3A**). Twins who had higher levels of stress were more likely to report using more alcohol than report not using alcohol. When between-family confounds were controlled in the quasi-

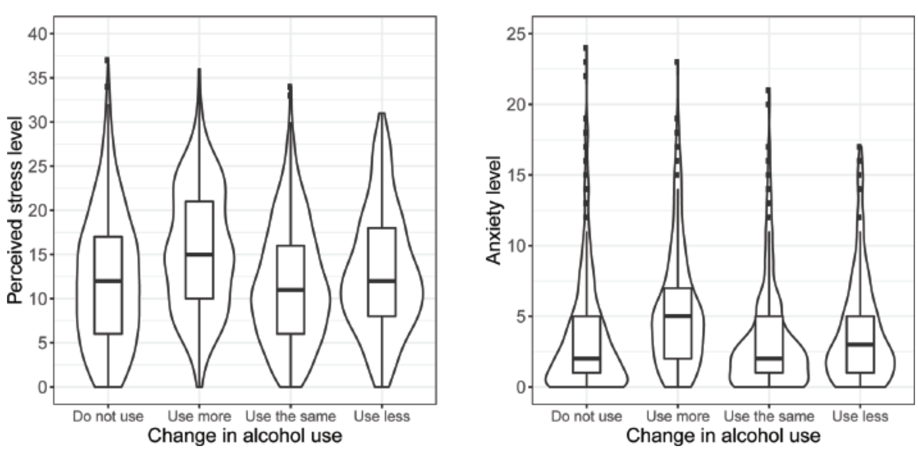

FIGURE 2 | Stress and anxiety levels by self-reported change in alcohol use (same-sex twin pairs).

TABLE 2 | Twin correlations and standardized variance components for negative emotions, and changes in alcohol use among same-sex twin pairs.

	*r*MZ	*r*DZ	a^2	c^2	e^2
Perceived stress	**.39 (.03)**	**.27 (.06)**	.23 (.13)	.16 (.12)	**.61 (.03)**
Anxiety	**.42 (.03)**	**.21 (.02)**	**.42 (.03)**	–	**.58 (.03)**
Change in alcohol use[a]					
Do not use vs. use more	**.90 (.04)**	**.57 (.16)**	**.65 (.32)**	.25 (.31)	**.10 (.04)**
Do not use vs. use the same	**.71 (.05)**	**.46 (.12)**	.50 (.26)	.21 (.25)	**.29 (.05)**
Do not use vs. use less	**.60 (.10)**	.36 (.28)	.48 (.59)	.12 (.56)	**.40 (.10)**
Use the same vs. use more	**.53 (.07)**	**.53 (.07)**	–	**.53 (.07)**	**.47 (.07)**
Use the same vs. use less	.19 (.13)	.09 (.06)	.19 (.13)	–	**.81 (.13)**

Standard errors are presented within parentheses. rMZ, monozygotic twin correlations; rDZ, dizygotic twin correlations. a^2, c^2, and e^2: standardized biometric variance components obtained from classical twin model decomposing the variance of the phenotype into additive genetic, shared environment, and non-shared environment variance, respectively.
[a]Tetrachoric correlations are presented here due to the dichotomous nature of the comparisons. Bolded numbers indicate estimates that are statistically significant at $p < .05$.

causal model, the association was reduced and became non-significant (b_p = .107, OR = 1.11, p = .067), suggesting that between-family effects confounded the association between stress and change in alcohol use. Results were similar after further controlling for age and sex (b_p = .116, OR = 1.12, p = .062).

As shown in **Figure 3A**, there was an overall association between stress and change in alcohol use. Twin pairs where both members reported using more alcohol (rightmost bar in both panels) had higher average stress levels when compared to twin pairs where both members reported not using alcohol (leftmost bar in both panels). However, there was no substantial difference in stress levels among twin pairs discordant in alcohol use (i.e., one member of the pair with increased alcohol use and the other member with no alcohol use, middle two bars in both panels).

Do Not Use Versus Use the Same

We found no evidence of an association between stress levels and the odds of not using alcohol versus using the same amount (**Table 3A**). Results were similar in the phenotypic model (b_p = −.010, OR = .99, p = .762), the quasi-causal model (b_p = −.065, OR = .94, p = .141), and the final model controlling for age and sex (b_p = −.066, OR = .94, p = .148).

Do Not Use Versus Use Less

There was no association between stress levels and the odds of not using alcohol versus using less alcohol (**Table 3A**). Results were similar in the phenotypic model (b_p = .076, OR = 1.08, p = .134), the quasi-causal model (b_p = .106, OR = 1.11, p = .171), and the final model controlling for age and sex (b_p = .115, OR = 1.12, p = .149).

Use the Same Versus Use More

There was a significant phenotypic association between stress and change in alcohol use (b_p = .373, OR = 1.45, p <.001; **Table 3B**). Twins with higher levels of stress were more likely to report an increase in alcohol use rather than similar alcohol use. When between-family confounds were controlled in the quasi-causal model, the association was attenuated but remained significant (b_p = .203, OR = 1.23, p = .002). Results remained consistent after further controlling for age and sex (b_p = .216, OR = 1.24, p = .002).

We illustrate these associations in **Figure 3B**. Twin pairs who were concordant on more use (i.e., both members reported

TABLE 3A | Unstandardized parameter estimates for phenotypic and biometric models estimating the effects of self-report change in alcohol use on perceived stress.

	Do not use vs. use more			Do not use vs. use the same			Do not use vs. use less		
	Est	**OR [95% CI]**	***p***	**Est**	**OR [95% CI]**	***p***	**Est**	**OR [95% CI]**	***p***
Phenotypic model									
b_p	.314	1.37 [1.24, 1.51]	<.001	−.010	.99 [.93, 1.06]	.762	.076	1.08 [.98, 1.19]	.134
Quasi-causal model									
b_A	.461	1.59 [1.17, 2.16]	.003	.121	1.13 [.90, 1.42]	.300	−.064	.94 [.67, 1.31]	.704
b_C	.461	1.59 [1.17, 2.16]	.003	.121	1.13 [.90, 1.42]	.300	−.064	.94 [.67, 1.31]	.704
b_p	.107	1.11 [.99, 1.25]	.067	−.065	.94 [.86, 1.02]	.141	.106	1.11 [.95, 1.30]	.171
Quasi-causal model (with covariates)									
b_A	.142	1.15 [.74, 1.80]	.534	.128	1.14 [.82, 1.58]	.443	−.106	.90 [.56, 1.45]	.661
b_C	.142	1.15 [.74, 1.80]	.534	.128	1.14 [.82, 1.58]	.443	−.106	.90 [.56, 1.45]	.661
b_p	.116	1.12 [.99, 1.27]	.062	−.066	.94 [.86, 1.02]	.148	.115	1.12 [.96, 1.31]	.149
Age	−.230	.79 [.73,.86]	<.001	−.050	.95 [.90, 1.0]	.081	.007	1.01 [.93, 1.08]	.855
Sex (F)	.253	1.29 [.98, 1.68]	.065	−.132	.88 [.73, 1.06]	.166	−.085	.92 [.72, 1.16]	.481
RMSEA [90%CI]		.019 [0,.041]			.017 [0,.040]			.012 [0,.038]	

Phenotypic model does not include controls for between-pair confounds, whereas quasi-causal model include controls for between-pair confounds. Perceived stress is square root transformed; age is divided by 10.
OR, odds ratio; b_A, amount of variance in perceived stress attributable to additive genetic influences; b_C, amount of variance in perceived stress attributable to shared environmental influences; b_P, phenotypic association between predictor and outcome; RMSEA, root mean square error of approximation.

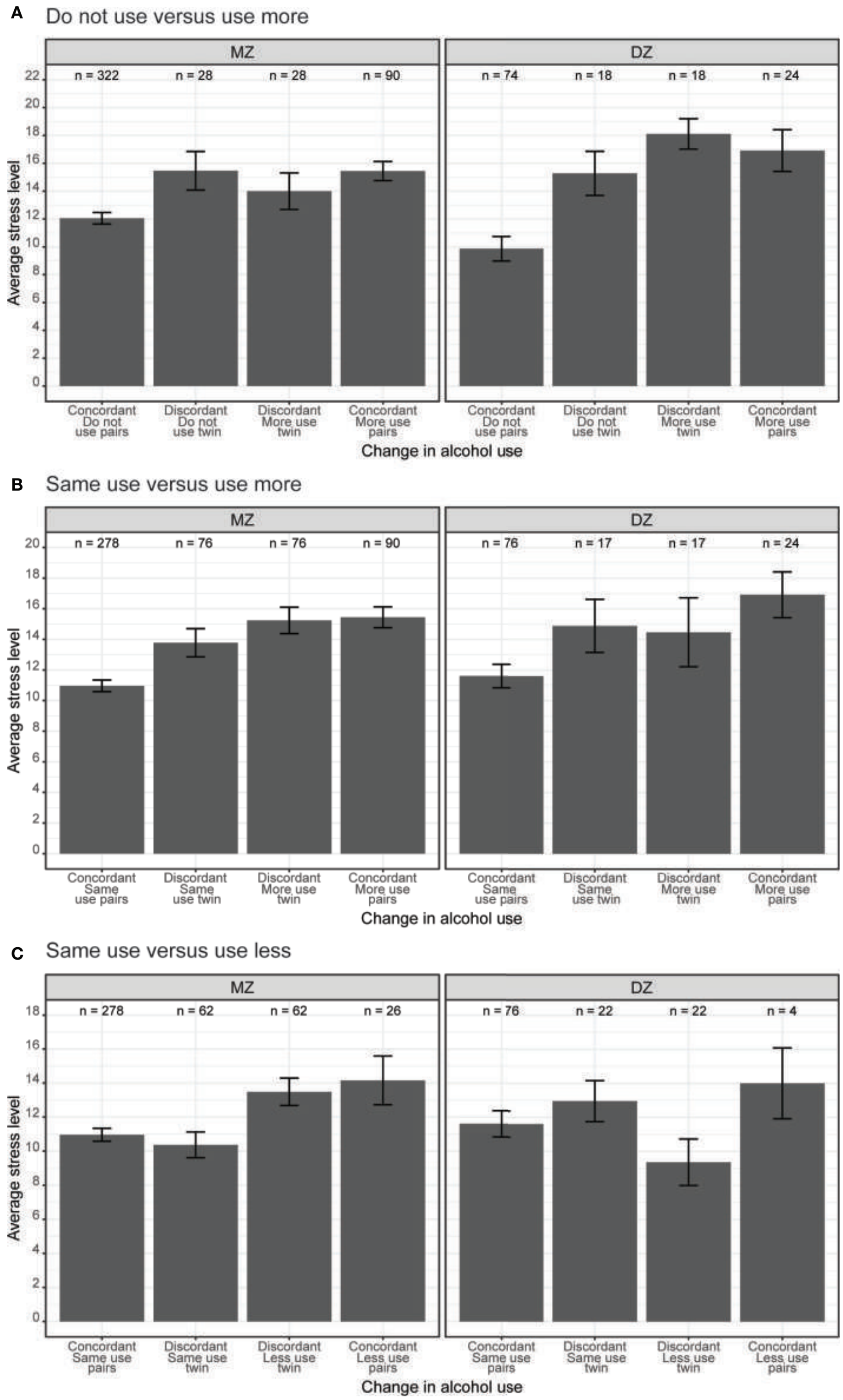

FIGURE 3 | **(A)** Do not use versus use more, **(B)** Same use versus use more, **(C)** Same use versus use less. Average perceived stress levels between twin pairs concordant and discordant in change in alcohol use among same-sex MZ and DZ twin pairs. Error bars denote standard errors.

TABLE 3B | Unstandardized parameter estimates for phenotypic and biometric models estimating the effects of self-report change in alcohol use on perceived stress.

		Use same vs. use more			Use same vs. use less		
		Est	OR [95% CI]	p	Est	OR [95% CI]	p
Phenotypic model							
	b_p	.373	1.45 [1.32, 1.60]	<.001	.103	1.11 [1.0, 1.22]	.038
Quasi-causal model							
	b_A	.382	1.47 [1.07, 2.00]	.017	−.188	.83 [.59, 1.17]	.288
	b_C	.382	1.47 [1.07, 2.00]	.017	−.188	.83 [.59, 1.17]	.288
	b_p	.203	1.23 [1.08, 1.39]	.002	.191	1.21 [1.03, 1.43]	.022
Quasi-causal model (with covariates)							
	b_A	.078	1.08 [.69, 1.70]	.735	−.244	.78 [.48, 1.28]	.332
	b_C	.078	1.08 [.69, 1.70]	.735	−.244	.78 [.48, 1.28]	.332
	b_p	.216	1.24 [1.08, 1.43]	.002	.202	1.22 [1.03, 1.45]	.019
	Age	−.180	.84 [.77,.90]	<.001	.056	1.06 [.98, 1.14]	.142
	Sex (F)	.369	1.45 [1.13, 1.85]	.003	.025	1.03 [.82, 1.28]	.825
RMSEA [90%CI]			.018 [0,.041]			.025 [0,.045]	

Phenotypic model does not include controls for between-pair confounds, whereas quasi-causal model include controls for between-pair confounds. Perceived stress is square root transformed; age is divided by 10.

OR, odds ratio; b_A, amount of variance in perceived stress attributable to additive genetic influences; b_C, amount of variance in perceived stress attributable to shared environmental influences; b_P, phenotypic association between predictor and outcome; RMSEA, root mean square error of approximation.

drinking more; rightmost bar in each panel) had higher average stress levels than concordant same use twin pairs (i.e., both members reported drinking the same amount; leftmost bar in each panel). Among discordant MZ twins (left panel), members of the pair who reported using more alcohol (third bar from the left) had slightly higher stress levels as compared to their co-twins who reported using the same amount of alcohol (second bar from the left). There was no observable difference in stress levels among discordant DZ twins (middle two bars in right panel). As between-pair confounds are controlled within MZ twin pairs, this offers robust evidence for a quasi-causal association between stress levels and change in alcohol use, specifically between same versus increased alcohol use.

Use the Same Versus Use Less

We found a significant phenotypic association between stress and change in alcohol use (b_p = .103, OR = 1.11, p = .038; **Table 3B**). Twins with higher stress levels were more likely to report a decrease in alcohol use instead of similar alcohol use. This association remained statistically significant after controlling for between-family confounds (b_p = .191, OR = 1.21, p = .022), and further controlling for age and sex (b_p = .202, OR = 1.22, p = .019).

The phenotypic association between stress levels and change in alcohol use is illustrated in **Figure 3C**. Twin pairs who were concordant on less use (i.e., both members reported drinking less; rightmost bar in each panel) had higher average stress levels than concordant same use twin pairs (i.e., both members reported using same amount of alcohol; leftmost bar in each panel). We observed the same association within pairs of MZ twins discordant for alcohol use – members of the pair who reported drinking less alcohol had substantially higher stress levels than their co-twins who reported drinking the same amount of alcohol (middle two bars in left panel). Within pairs of discordant DZ twins, the average stress levels were higher among members of the pair who reported dinking the same amount of alcohol than their co-twins who reported drinking less alcohol (middle two bars in the right panel). This difference between MZ and DZ discordant twin pairs reflects the genetic confounds, as the between-pair confounds are controlled within discordant MZ twins, and within-pair difference between discordant DZ twins also includes the genetic difference between them.

Anxiety and Change in Alcohol Use

Do Not Use Versus Use More

There was a significant phenotypic association between anxiety and change in alcohol use (b_p = .351, OR = 1.42, p <.001; **Table 4A**). Twins with higher levels of anxiety were more likely to report using more alcohol than report not using alcohol. When additive genetics confounds were controlled in the quasi-causal model, the association was reduced and became non-significant (b_p = .119, OR = 1.13, p = .135), suggesting that between-family effects confounded the association between stress and change in alcohol use. Results remained similar after further controlling for age and sex (b_p = .139, OR = 1.15, p = .086).

The phenotypic association between anxiety levels and change in alcohol use is illustrated in **Figure 4A**. The average anxiety levels were substantially higher among concordant more use twins (i.e., both members of the pair reported using more alcohol; rightmost bars in both panels) than concordant do not use twins (i.e., both members of the pair reported not drinking; leftmost bars in both panels). However, there was no observable differences in anxiety levels within twin pairs discordant in alcohol use (i.e., one member of the pair with increased use of alcohol and the other member reported not using alcohol, middle two bars in both panels).

Do Not Use Versus Use the Same

We found no evidence of an association between anxiety levels and the odds of not using alcohol versus using the same amount (**Table 4A**). Results were similar in the phenotypic model (b_p = −.006, OR = .99, p = .884), the quasi-causal model (b_p = −.047, OR = .95, p = .386), and the final model controlling for age and sex (b_p = −.046, OR = .96, p = .131).

TABLE 4A | Unstandardized parameter estimates for phenotypic and biometric models estimating the effects of self-report change in alcohol use on anxiety.

	Do not use vs. use more			Do not use vs. use the same			Do not use vs. use less		
	Est	OR [95% CI]	p	Est	OR [95% CI]	P	Est	OR [95% CI]	p
Phenotypic model									
b_p	.351	1.42 [1.29, 1.56]	<.001	–.006	.99 [.92, 1.07]	.884	.087	1.09 [.99, 1.20]	.086
Quasi-causal model									
b_A	.444	1.56 [1.10, 2.21]	.013	.076	1.08 [.85, 1.36]	.521	.090	1.09 [.78, 1.23]	.599
b_p	.119	1.13 [.96, 1.32]	.135	–.047	.95 [.86, 1.06]	.386	.038	1.04 [.88, 1.23]	.660
Quasi-causal model (with covariates)									
b_A	.178	1.19 [.77, 1.86]	.430	.092	1.10,.81, 1.48]	.549	.138	1.15 [.76, 1.74]	.518
b_p	.139	1.15 [.98, 1.35]	.086	–.046	.96 [.86, 1.06]	.388	.038	1.04 [.88, 1.22]	.649
Age	–.238	.79 [.72,.86]	<.001	–.042	.96 [.91, 1.01]	.131	–.014	.99 [.92, 1.06]	.682
Sex (F)	.228	1.26 [.95, 1.67]	.114	–.134	.87 [.72, 1.06]	.168	–.070	.93 [.72, 1.21]	.592
RMSEA [90%CI]		.026 [0,.046]			.012 [0,.037]			.015 [0,.039]	

Phenotypic model does not include controls for between-pair confounds, whereas quasi-causal model include controls for between-pair confounds. Perceived stress is square root transformed; age is divided by 10.

OR, odds ratio; b_A, amount of variance in perceived stress attributable to additive genetic influences; b_C, amount of variance in perceived stress attributable to shared environmental influences; b_P, phenotypic association between predictor and outcome; RMSEA, root mean square error of approximation.

Do Not Use Versus Use Less

There was no association between anxiety levels and the odds of not using alcohol versus using less alcohol (**Table 4A**). Results were similar in the phenotypic model (b_p = .087, OR = 1.09, p = .086), the quasi-causal model (b_p = .038, OR = 1.04, p = .660), and the final model controlling for age and sex (b_p = .038, OR = 1.04, p = .649).

Use the Same Versus Use More

There was a significant phenotypic association between anxiety and change in alcohol use (b_p = .385, OR = 1.47, p <.001; **Table 4B**). Twins with higher levels of anxiety were more likely to report an increase in alcohol use rather than similar alcohol use. When additive genetics confounds were controlled in the quasi-causal model, the association was attenuated and became non-significant (b_p = .147, OR = 1.16, p = .080), suggesting that between-family effects confounded the association between anxiety and change in alcohol use. However, we found a significant phenotypic association (b_p = .175, OR = 1.19, p = .041) when age and sex were included in the model.

The main effect of anxiety on change in alcohol use is shown in **Figure 4B**; the average anxiety levels were higher among concordant more use twin pairs (i.e., both members of the pair reported using more alcohol; rightmost bar in both panels) than concordant same use twin pairs (i.e., both members of the pair reported using same amount of alcohol; leftmost bar in both panels). When comparing twin pairs discordant in alcohol use (i.e., one member of the pair using more alcohol, and their co-twin using same amount of alcohol), there was no substantial differences in anxiety levels (middle bars in both panels).

Use the Same Versus Use Less

There was a small phenotypic association between anxiety and change in alcohol use (b_p = .098, OR = 1.10, p = .045; **Table 4B**). Twins with higher stress levels were more likely to report a decrease in alcohol use instead of similar alcohol use. This association was reduced and became non-significant after controlling for additive genetics confounds (b_p = .073, OR = 1.08, p = .412), and age and sex (b_p = .073, OR = 1.08, p = .408).

As shown in **Figure 4C**, MZ twin pairs where both members reported using less alcohol (rightmost bar in left panel) had higher levels of anxiety, compared to MZ twins where both members reported using the same amount of alcohol (leftmost bar in left panel). This association was reduced among concordant DZ twin pairs (right panel). The average anxiety levels were similar among discordant twin pairs, regardless of alcohol use (middle two bars in both panels).

DISCUSSION

Results of this study showed a significant association between stress and anxiety levels and increased alcohol use. Twins with higher levels of stress and anxiety were more likely to report an increase in alcohol consumption, instead of no alcohol consumption. These phenotypic associations were no longer significant after controlling for between-family confounds, suggesting that the associations were mediated by between-family factors. Stress and anxiety levels did not have a substantial impact on whether twins report no versus similar amount of alcohol consumption, or no versus reduced alcohol consumption.

Among twins who drink, higher levels of stress were associated with higher odds of increased versus same alcohol use. This association was robust after controlling for between-family effects: members of the pair with higher levels of stress were more likely to drink more than their co-twins with lower levels of stress. Contrary to our expectation, twins with higher levels of stress were also more likely to report decreased, rather than same, alcohol consumption. This phenotypic association remained significant after controlling for between-family confounds, meaning that members of the pair with higher levels of stress were more likely to drink less than their co-twins with lower stress levels. Similar associations were observed

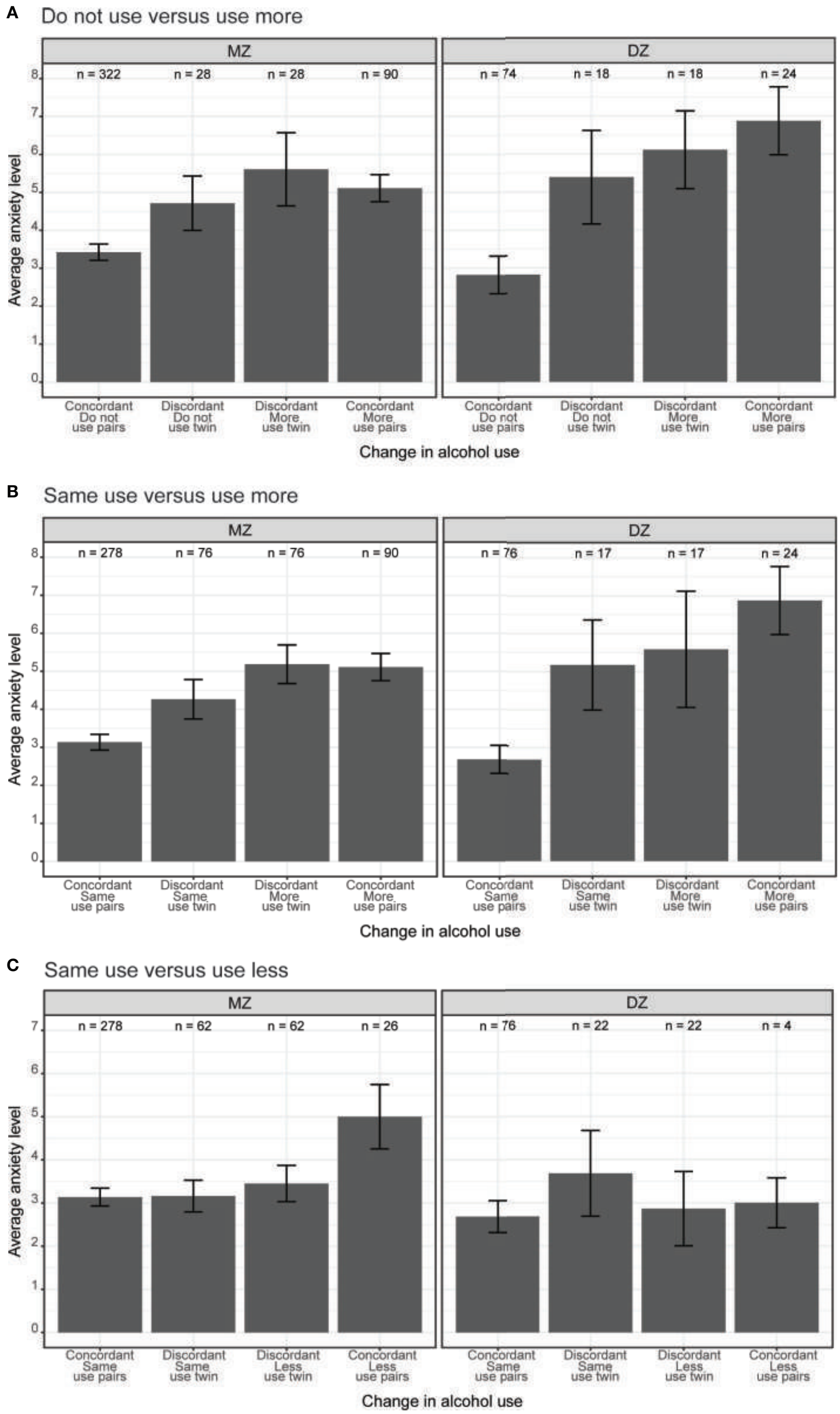

FIGURE 4 | **(A)** Do not use versus use more, **(B)** Same use versus use more, **(C)** Same use versus use less. Average anxiety levels between twin pairs concordant and discordant in change in alcohol use among same-sex MZ and DZ twin pairs. Error bars denote standard errors.

TABLE 4B | Unstandardized parameter estimates for phenotypic and biometric models estimating the effects of self-report change in alcohol use on anxiety.

		Use same vs. use more			Use same vs. use less		
		Est	OR [95% CI]	p	Est	OR [95% CI]	p
Phenotypic model							
	b_p	.385	1.47 [1.34, 1.61]	<.001	.098	1.10 [1.00, 1.21]	.045
Quasi-causal model							
	b_A	.457	1.58 [1.11, 2.26]	.012	.047	1.05 [.74, 1.48]	.790
	b_p	.147	1.16 [.98, 1.37]	.080	.073	1.08 [.90, 1.28]	.412
Quasi-causal model (with covariates)							
	b_A	.173	1.19 [.76, 1.85]	.441	.087	1.09 [.71, 1.67]	.685
	b_p	.175	1.19 [1.01, 1.41]	.041	.073	1.08 [.91, 1.28]	.408
	Age	−.207	.81 [.75,.88]	<.001	.019	1.02 [.95, 1.09]	.575
	Sex (F)	.364	1.44 [1.11, 1.87]	.006	.054	1.08 [.91, 1.28]	.654
RMSEA [90%CI]			.027 [0,.047]			.022 [0,.043]	

Phenotypic model does not include controls for between-pair confounds, whereas quasi-causal model include controls for between-pair confounds. Perceived stress is square root transformed; age is divided by 10.
OR, odds ratio; b_A, amount of variance in perceived stress attributable to additive genetic influences; b_C, amount of variance in perceived stress attributable to shared environmental influences; b_P, phenotypic association between predictor and outcome; RMSEA, root mean square error of approximation.

between anxiety levels and change in alcohol use, though the relationships were confounded by between-family effects.

Our study showed that 14.3% of the respondents reported an increase in alcohol consumption, which is comparable with existing studies that reported an increase in alcohol use among individuals exposed to the SARS outbreak (6, 7). These two studies further showed that stress related to the outbreak was linked to increased alcohol consumption. Although the cross-sectional nature of the data in this study precludes us from drawing conclusions regarding the direction of the association, we also showed that stress and anxiety levels are linked to increased alcohol consumption. The current study further showed that stress and anxiety levels associated with the COVID-19 outbreak may have an acute impact on individuals—an increase in alcohol consumption was reported only 2 weeks after the WHO declared the COVID-19 outbreak a pandemic (1). Although alcohol use may be an effective coping strategy in the short term (38), persistent increased alcohol consumption may turn into problematic behaviors, such as alcohol dependence and/or abuse. With prior studies showing increased alcohol use shortly after (7), and up to three years (6) after the SARS outbreak, it would be important to investigate the extent to which the current COVID-19 pandemic may be associated with increased alcohol use in the long term. Considering that almost every country in the world has been affected by the COVID-19 outbreak, it is essential that strategies are put in place to prevent problematic alcohol use behaviors. Longitudinal studies would provide additional information about the changes in alcohol consumption as the world recovers from the pandemic, and determine if specific personality and/or health factors are associated with whether individuals return to their normal amount of consumption or continue to be dependent on alcohol.

Strengths and Limitations

The timeliness of the survey is one of the biggest strengths of the current study. The survey was administered during a 2-week period in late March and early April 2020, less than a month after the COVID-19 was declared a pandemic by the World Health Organization (1). We were able to assess the immediate impact of the COVID-19 pandemic and the corresponding social restrictions on stress and anxiety levels, as well as changes in alcohol use in a relatively large sample of adult twins.

The current study asked participants to report their perceived change in alcohol use, providing a subjective assessment of the extent to which alcohol use has changed or remained the same. Although the subjective assessment may suffer from response bias (e.g., individuals may be reluctant to report increased use of alcohol), slightly more participants reported an increase in alcohol use (~15%) than a decrease in alcohol use (~10%), suggesting that twins in our sample may not necessarily be reluctant to report an increase in alcohol use. As it is not possible to accurately assess participants' alcohol use prior to the COVID-19 pandemic, individuals' perceived change in alcohol use may reasonably reflect their actual changes in alcohol use. Additionally, the WSTR is planning to conduct follow-up studies to examine how individuals' mental health and everyday behaviors change in response to the ease of social restriction measures. When data from the longitudinal studies becomes available, we will be able to investigate the extent to which alcohol use changes over time, and whether perceived change in alcohol use corresponds to individuals' actual change in alcohol use during this time.

We recognize that the current study may potentially suffer from self-selection bias. Although the response rate for this study was comparable to prior WSTR studies, only about one-third of the individuals registered in the WSTR completed the survey. It is possible that individuals who responded to our survey invitation were less stressed and/or anxious, as reflected by the relatively low stress (M = 12.6 out of a maximum of 40) and anxiety (M = 3.8 out of a maximum of 24) levels in the current study. We examined survey results of 2,000 individuals who completed a prior WSTR survey within one year of this study. There was no statistically significant difference in alcohol use as measured by the Alcohol Use Disorders Identification Test (AUDIT-C) (39) ($b = -.01$, $SE = .04$,

[3] Some individuals who participated in the current study did not complete another survey within the past year.

p = .715), perceived stress (b = .11, SE = .06, p = .063), or anxiety (b = −.02, SE = .05, p = .641) between individuals who participated in the current study (N = 1,384)[3] and those who did not (N = 616). These results suggest that participants in the current study may not be a particularly low stress/anxiety or low alcohol consumption group of individuals prior to the pandemic, as compared to those who did not participate in this study. Nonetheless, with no current available information on non-responders, we are unable to speculate whether individuals who did not participate in the current study had higher (or lower) levels of stress and anxiety, and whether their alcohol consumption had changed or remained unchanged during this time period. We are also unable to determine whether similar associations between mental health and alcohol use would be replicated among other samples with higher levels of stress and anxiety, or samples from other populations.

CONCLUSION

The current study investigated the extent to which individuals' stress and anxiety levels were associated with self-reported change in the amount of alcohol use. We found that twin pairs with higher levels of stress and anxiety were more likely to report an increase in alcohol use rather than no alcohol use or a similar amount of alcohol use. Those with higher stress and anxiety levels were also more likely to report a decrease in alcohol use instead of a similar amount of alcohol use. Most of these associations were small and confounded by between-family factors (genetic and shared environment factors) and demographic characteristics, such as age and sex. Results from the current study suggest that individuals' mental health may be associated with changes in alcohol use during this stressful time as people navigate through the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because: data is provided by the Washington State Twin Registry after acceptance of a manuscript proposal with a signed data access agreement. Requests to access the datasets should be directed to www.wstwinregistry.org.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Washington State University Institutional Review Board. The ethics committee waived the requirement of written informed consent for participation.

AUTHOR CONTRIBUTIONS

All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by a grant from the National Institute of Health (grant number R33ES024715).

ACKNOWLEDGMENTS

This project was conducted with support from the Washington State Twin Registry. We wish to thank the twins for taking part in the Registry.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

OPINION
published: 23 October 2020
doi: 10.3389/fpsyt.2020.584462

Consequences of COVID-19 Lockdown on the Misuse and Marketing of Addictive Substances and New Psychoactive Substances

Annagiulia Di Trana[1], Jeremy Carlier[1,2], Paolo Berretta[3], Simona Zaami[2†] and Giovanna Ricci[4†]*

[1] Unit of Forensic Toxicology, Section of Legal Medicine, Department of Excellence of Biomedical Sciences and Public Health, Polytechnic University of Marche, Ancona, Italy, [2] Unit of Forensic Toxicology, Section of Legal Medicine, Department of Anatomical, Histological, Forensic, and Orthopedic Sciences, Sapienza University of Rome, Rome, Italy, [3] National Centre on Addiction and Doping, National Institute of Health, Rome, Italy, [4] Medico Legal Section, School of Law, University of Camerino, Macerata, Italy

Keywords: New Psychoactive Substances, social isolation, COVID-19, SARS-CoV-2, early warning advisory systems, socio-economic crisis

OPEN ACCESS

Edited by:
Ornella Corazza, University of Hertfordshire, United Kingdom

Reviewed by:
Amira Guirguis, Swansea University, United Kingdom
Attilio Negri, University of Milan, Italy

****Correspondence:***
Annagiulia Di Trana
a.ditrana@pm.univpm.it

†These authors have contributed equally to this work

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *17 July 2020*
Accepted: *28 September 2020*
Published: *23 October 2020*

Citation:
Di Trana A, Carlier J, Berretta P, Zaami S and Ricci G (2020) Consequences of COVID-19 Lockdown on the Misuse and Marketing of Addictive Substances and New Psychoactive Substances. Front. Psychiatry 11:584462. doi: 10.3389/fpsyt.2020.584462

INTRODUCTION

Since the first outbreak of SARS-CoV-2 (severe acute respiratory syndrome-coronavirus-2) in China in December 2019, the infection has rapidly spread all over the world. This new virus has caused many cases of Coronavirus disease 2019 (COVID-19), a potentially fatal respiratory syndrome (1). Due to its global diffusion, the World Health Organization rapidly issued an international warning and declared a worldwide pandemic in March 2020. Currently, most countries are experiencing COVID-19 outbreaks with new infections and fatalities every day and all over the world (2). Due to the mode of transmission of the virus via droplets or direct contact, governments were compelled to adopt restrictive strategies to contain the pandemic and preserve the public health (2, 3). These interventions include limited international mobility, temporary closure of non-essential businesses and more stringent measures like social distancing or complete isolation for prolonged periods. Therefore, this unprecedented crisis has seriously impacted the global economy and people's daily life.

The market of addictive substances has been impacted from the production to the distribution, modifying consumption patterns. An increased consumption of cannabis products and benzodiazepines was reported due to the general feeling of stress caused by the pandemic and associated restrictions, while a decrease in the demand of stimulants was observed due to the inaccessibility of usual recreational settings (4). Moreover, drug misuse may have shifted toward alternative substances and home-made New Psychoactive Substances (NPS) (5–7), which consist of molecules, like pharmaceutical drug analogs, research chemicals and prescription drugs eliciting the psychoactive effects of common illicit addictive drugs or prescription pharmaceuticals (8, 9). The current situation is complex due to the heterogeneity of policies applied in diverse countries and the drugs involved. In this concern, the drug market is constantly monitored by international agencies, such as the United Nation Office on Drug and Crime (UNODC), the European Monitoring Centre on Drugs and Drug Addiction (EMCDDA) and Europol, which collaborate to form a crucial network to prevent the emergence of new dangerous trends.

In this article, the authors critically discuss the most recent data on the impact of COVID-19 on the illicit trafficking of substances and the possible developments of NPS trends in the near future. The authors also draw the attention on the essential role of international networking against drug misuse, especially in times of global crisis.

IMPACT OF INTERNATIONAL RESTRICTIONS ON DRUG PRODUCTION, TRADE AND MARKET

The anti-COVID-19 restrictive measures have impacted the drug production in a different manner depending on the substance.

The cultivation of natural drugs is usually conducted in different regions of the world during different periods of the year, depending on the climate. Accounting for 84% of the world production, Afghanistan is the main producer of opium in the Golden Crescent, where poppy is usually harvested between March and June (10). However, the travel restrictions adopted this year have impeded the recruitment of poppy lancers from other regions, and the workforce shortage slowed down harvesting, leading to a partial loss of the production (5). In other countries such as Myanmar, opium harvesting was completed but a decrease in the number of customers was reported (10). Furthermore, the closure of Myanmar borders may have affected the import of acetic anhydride, impacting the production of heroin. Meanwhile, other factors have affected the cultivation of cocaine, which is mainly conducted in Colombia (70% of the global cultivation), Peru (20%), and Bolivia (10%) (10). Since coca leaves can be harvested throughout the year, the anti-COVID-19 measures have not impacted harvesting in those countries. However, the law enforcement pressure hike during the COVID-19 pandemic and the shortage of essential chemical precursors, such as permanganate salts, and gasoline resulted in the reduction of the production of cocaine, especially in Colombia (5). To date, the production of cocaine seems to be less affected in Peru, but the price reductions suggest that large quantities of drugs were stockpiled (5). Since cannabis products are often locally produced and distributed through short supply chains, the production and distribution of cannabis has not suffered due to the global restrictions (5, 6, 11).

A different pattern was observed for synthetic drugs, whose production is less related to the geographical location, and probably because clandestine manufacturing laboratories need less workforce. Amphetamine-type stimulants [i.e., methamphetamine, amphetamine and methylenedioxymethamphetamine (MDMA)] are the most commonly used synthetic drugs, and the bulk production is concentrated in few countries only. According to recent data, laboratories manufacturing synthetic drugs are mainly located in North America (84%), followed by Europe and Asia (10). It is noteworthy that the production of synthetic drugs strictly depends on the availability of chemicals, usually imported from China. Therefore, international travel restrictions and the disruption of raw material production may pose a problem. In fact, a decrease in the availability of synthetic drugs was reported in various countries (e.g., amphetamine in Czech Republic, Lebanon and Syria, and fentanyl and methamphetamine in Mexico) (5, 6).

Drug availability also depends on trafficking routes. The complete interruption of air traffic especially affected the export of synthetic drugs from South East Asia and Oceania. Cocaine trade was less impacted by air travel disruption, due to the use of the maritime route (5, 6). Furthermore, cocaine export from South America is usually conducted by yacht and other modified boats. Air trafficking may have been replaced by postal distribution, wherever it is possible. Maritime trafficking may also have been preferred to bypass COVID-19-related land controls. In this concern, South-Eastern Asian heroin trafficking has shifted from land to maritime transportation across the Indian Ocean. The highest impact of the global trade disruption is expected for the substances that are usually transported along with licit goods, such as heroin and synthetic drugs (5, 10). In recent years, specialized websites have appeared on the darknet as an alternative way to obtain illegal products. Even though several markets have closed since 2018, the darknet still plays a key role in the worldwide diffusion of NPS (6, 12, 13). Although the drugs found on the darknet represent 0.2% of the retail sales in western countries, a sharp increase of the darknet drug trade was reported in Europe during the first 3 months of 2020 (10, 11). According to a preliminary study, cannabis-related products are the most sold merchandises through specialized darknet websites in Europe (6, 11).

As a result, the drug market has been affected differently at retail and bulk levels. A shortage of several types of drugs and a reduction of their purity was reported in many countries. For example, heroin completely disappeared from street markets in Czech Republic. Conversely, bulk distribution appeared more heterogeneous, with a decrease in seizures in several countries including Italy, Niger, and Central Asia, but an increase in other countries such as Iran and Morocco (5, 6, 10). However, this discrepancy may depend on the local anti-Covid-19 restrictions and the difference in commitment to enforce these restrictions.

DISCUSSION

During this year, the SARS-CoV-2 pandemic has posed various challenges to the population. Fear, stress, and anxiety have affected people all over the world, exacerbating latent psychiatric and psychological disorders (14). Furthermore, the general feeling of uncertainty is fueled by the probable economic crisis that will result from the disruption of non-essential businesses in most countries (15). Fragile categories such as people with drug use disorder suffer from the life-style changes, posing additional public health concerns (16).

Besides, the anti-COVID-19 restrictive measures modified the drug offer and altered substance misuse patterns. Drug-related phenomena like the drugs-and driving and drug parties are expected to decrease (17, 18). Due to high addiction liability, we suppose that the global shortage of heroin may have forced regular users to take other substances with similar effects, such as fentanyl analogs. Moreover, the low quantity of heroin available may have been adulterated with other psychotropic molecules to obtain more potent mixtures at cheaper costs (7, 19). In our opinion, the production of new NPS and NPS use are also expected to increase due to several factors. Firstly, the disruption of the marketing of specific chemical precursors may have forced drug manufacturers to find alternatives, as observed with "Sisa," a drug that emerged onto the Greek market during the economic crisis of 2010 (20). Secondly, the decrease in the importation of chemical precursors may have favored the domestic manufacture of domestic precursors, as observed with mephedrone in Russia (10). Another important factor to consider is the increase of law enforcement controls that are not suited for the detection of new uncontrolled molecules. Recently, the intentional misuse of prescription drugs to induce psychotropic effects has spread among people with substance use disorder. The most common misused molecules include gabapentinoids, fentanyl analogs, approved antipsychotics, antidepressants and performance-enhancing drugs (21). For this reason, the diversion of prescription drugs like benzodiazepines, opioids and cognitive enhancers is expected to increase due to higher availability (22–24).

Local governments should implement effective measure to prevent those trends that could worsen the state of public health systems. As suggested by Zaami et al., the continuation of drug treatment services along with the implementation of psychiatric and psychological assistance to people with drug use disorder should be ensured to reduce harm (16). To date, a constructive international network is continuously working to monitor the drug market (15, 16).

Since its establishment in 2007, the UNODC combats drug misuse and illicit trafficking through research, guidance and support to governments (25). Common international treaties such as The Single Convention on Narcotic Drugs of 1961 and the Convention on Psychotropic Substances of 1971 were issued by the UNODC and are regularly incremented. Following the emergence of the alarming phenomenon of NPS, the UNODC Early Warning Advisory (EWA) was launched in 2013. The first aim of EWA is to monitor, analyze and report the trends of psychotropic substances that are not included in the above-mentioned international conventions (26). The base of the successful work of the UNODC EWA is the tight collaboration with national and regional agencies and governmental entities (26).

The EMCDDA is a partner of UNODC EWA and coordinates the European network against NPS. In 1997, the Early Warning System (EWS) was implemented under Joint Action 97/396/JHA as a response to the growing NPS concern (27). To EWS is based on a multidisciplinary network comprising several agencies, such as EMCDDA, Europol, the European Medicines Agency (EMA) and 30 national early warning systems. Each national agency operates according to the most recent Regulation (EU) 2017/2101 that establishes a common risk-assessment procedure and a shared three-step approach to respond to NPS (27). In this framework, EMCDDA collects and analyzes national data on NPS emergences, seizures and poisonings to compile a biannual report. Data are also shared with UNODC for a more comprehensive analysis. The European national systems are independent and each state is responsible for its functioning. In Italy, the National Early Warning System (SNAP) on NPS is managed by the National Centre on Addiction and Doping of National Institute of Health (ISS). In this concern, an online platform was developed to allow collaborating centers to spread across the territory to promptly transmit NPS-related information. In addition, EMCDDA data on NPS are reported to SNAP to ensure information sharing between European countries (28).

This capillary network has proved necessary to constantly monitor the new trends of the NPS erratic market. However, many of the current tools for monitoring drug issues at national and international levels are old and may be not effective to capture the complexity of the new drug market. In this concern, the international community should implement more powerful instruments to preserve public health, especially in critical situations such as the COVID-19 pandemic.

AUTHOR CONTRIBUTIONS

All authors equally contributed to the conceptualization, preparation, and revision of the paper.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 30 October 2020
doi: 10.3389/fpsyt.2020.574676

Depression, Environmental Reward, Coping Motives and Alcohol Consumption During the COVID-19 Pandemic

Matthew D. McPhee[1*], *Matthew T. Keough*[2], *Samantha Rundle*[1], *Laura M. Heath*[1], *Jeffrey D. Wardell*[2,3,4] and *Christian S. Hendershot*[1,3,4,5]

[1] Department of Psychology, University of Toronto, Toronto, ON, Canada, [2] Department of Psychology, York University, Toronto, ON, Canada, [3] Institute for Mental Health Policy Research and Campbell Family Mental Health Research Institute, Centre for Addiction and Mental Health, Toronto, ON, Canada, [4] Department of Psychiatry, University of Toronto, Toronto, ON, Canada, [5] Department of Pharmacology and Toxicology, University of Toronto, Toronto, ON, Canada

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Edited by:
Fernando Barbosa,
University of Porto, Portugal

Reviewed by:
Samuel F. Acuff,
University of Memphis, United States
Reinout W. Wiers,
University of Amsterdam, Netherlands
Abby Braitman,
Old Dominion University,
United States

****Correspondence:***
Matthew D. McPhee
matthew.mcphee@mail.utoronto.ca

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *20 June 2020*
Accepted: *28 September 2020*
Published: *30 October 2020*

Citation:
McPhee MD, Keough MT, Rundle S, Heath LM, Wardell JD and Hendershot CS (2020) Depression, Environmental Reward, Coping Motives and Alcohol Consumption During the COVID-19 Pandemic. Front. Psychiatry 11:574676. doi: 10.3389/fpsyt.2020.574676

Background: Increases in the incidence of psychological distress and alcohol use during the COVID-19 pandemic have been predicted. Behavioral theories of depression and alcohol self-medication theories suggest that greater social/environmental constraints and increased psychological distress during COVID-19 could result in increases in depression and drinking to cope with negative affect. The current study had two goals: (1) to examine self-reported changes in alcohol use and related outcomes after the introduction of COVID-19 social distancing requirements, and; (2) to test hypothesized mediation models to explain individual differences in self-reported changes in depression and alcohol use during the early weeks of the COVID-19 pandemic.

Methods: Participants ($n = 833$) were U.S. residents recruited for participation in a single online survey. The cross-sectional survey included questions assessing environmental reward, depression, COVID-19-related distress, drinking motives, and alcohol use outcomes. Outcomes were assessed via retrospective self-report for two timeframes in the single survey: the 30 days prior to state-mandated social distancing ("pre-social-distancing"), and the 30 days after the start of state-mandated social distancing ("post-social-distancing").

Results: Depression severity, coping motives, and some indices of alcohol consumption (e.g., frequency of binge drinking, and frequency of solitary drinking) were significantly greater post-social-distancing relative to pre-social-distancing. Conversely, environmental reward and other drinking motives (social, enhancement, and conformity) were significantly lower post-social distancing compared to pre-social-distancing. Behavioral economic indices (alcohol demand) were variable with regard to change. Mediation analyses suggested a significant indirect effect of reduced environmental reward with drinking quantity/frequency via increased depressive symptoms and coping motives, and a significant indirect effect of COVID-related distress with alcohol quantity/frequency via coping motives for drinking.

Discussion: Results provide early cross-sectional evidence regarding the relation of environmental reward, depression, and COVID-19-related psychological distress with alcohol consumption and coping motives during the early weeks of the COVID-19 pandemic. Results are largely consistent with predictions from behavioral theories of depression and alcohol self-medication frameworks. Future research is needed to study prospective associations among these outcomes.

Keywords: COVID-19, SARS-CoV-2, social distancing, alcohol, mental health, stress, depression

INTRODUCTION

In the first 8 months of the COVID-19 pandemic, there have been over 27 million confirmed and presumptive cases of the COVID-19 infection globally (1). Attempts to curtail the spread of the virus have included localized approaches (e.g., contact tracing, quarantine) and large-scale population directives [e.g., social distancing and shelter-in-place requirements; (2)]. Given the broad socioeconomic and health impacts of the pandemic, increased incidence of psychological distress and mental health disorders are among the anticipated consequences of the COVID-19 pandemic [e.g., (3–5)]. Past evidence that societal crises (e.g., economic recessions; natural disasters) were followed by increases in mental health and substance use problems (6), and preliminary evidence of elevated levels of depression and anxiety during the COVID-19 pandemic [e.g., (7–9)], have led to calls for research to evaluate mental health outcomes during the COVID-19 pandemic.

Initial data are consistent with potential increases in alcohol consumption during the COVID-19 pandemic. For example, increased alcohol sales [e.g., (10)], elevated rates of harmful alcohol use in COVID-19 epicenters [e.g., (11)], and altered patterns of alcohol consumption [e.g., based on remote breath alcohol concentration data; (12)] have been reported. The Canadian Centre on Substance Use and Addiction (CCSA) reported that ∼1 in 5 individuals who consume alcohol reported increases in alcohol consumption relative to the period prior to the pandemic, although the majority did not report an increase in alcohol consumption (13). These findings are consistent with predictions that circumstances surrounding the pandemic may lead to increases in consumption for some people, but no change or decreases for others (4), making it important to understand factors coinciding with increases in consumption.

Of numerous contextual factors that could increase risk for alcohol use during the pandemic, changes in psychological distress and mental health symptoms are important considerations. The unprecedented consequences of COVID-19, including widespread unemployment and lost income, health-related concerns, and mandated social isolation are likely risk factors for increases in depression and other forms of psychological distress among the general population. Behavioral theories of depression posit that reductions in access to environmental/social rewards, and/or increases in reward-limiting stimuli (i.e., environmental suppressors) predict risk for depression (14, 15). Measures designed to assess access to environmental reward have been developed, and evidence supports the relation between diminished environmental reward and elevated severity of depression [e.g., (16–19)]. By design, population-based approaches to virus control have imposed significant environmental and contextual constraints for large portions of the population, resulting in widespread changes to daily routines and social interactions. By way of constraining daily routines and reducing access to typical sources of social or environmental reinforcement, strict social distancing measures may increase the risk for psychological distress and/or depressive symptoms for some individuals.

Stress and negative affect are primary risk factors for increases in alcohol consumption among drinkers, and for relapse among those who have cut down or quit drinking (20). Increases in negative affect, including depression symptoms and/or generalized distress in response to challenges surrounding the pandemic, might lead to increases in alcohol consumption. As a result, some have predicted a drastic increase in alcohol relapse among vulnerable populations (10). It follows that environmental constraints related to social distancing measures might indirectly result in increased alcohol consumption, by way of increases in depression or psychological distress. Perhaps consistent with these predictions, research during the SARS epidemic found that almost one third (31.2%) of individuals quarantined had positive screens for depression (21), and among hospital employees, alcohol use disorder symptoms were positively associated with having been quarantined and working in a high-risk location (22).

Additional factors influencing drinking context or drinking opportunities could have implications for the incidence of unhealthy alcohol consumption during the COVID-19 pandemic. Solitary drinking (i.e., use of alcohol alone vs. in social contexts) is positively associated with greater incidence of alcohol-related problems (23, 24). Notably, frequency of solitary drinking (compared to drinking in social contexts) is positively predicted by severity of depressive symptoms (25). To the extent that environmental constraints may limit social drinking opportunities and increase depression symptoms, solitary drinking is likely to increase under social distancing conditions. Additionally, changes in drinking contexts (e.g., bar closures) may call for studying alternative indices of alcohol motivation, such as alcohol demand. Alcohol demand refers to the reinforcing potential of alcohol based on hypothetical resources (e.g., economic) that an individual would allocate to obtain alcohol (26). Greater alcohol demand is associated with alcohol-related problems and alcohol consumption (27, 28). Importantly, dynamic changes in demand have been observed in response to stress manipulations (29), and alcohol demand in solitary contexts predict problems associated with alcohol use beyond alcohol demand in social contexts (30). Together, these results suggest the importance of considering change in alcohol demand as an outcome during the COVID-19 pandemic.

Drinking for negative reinforcement reasons (i.e., to reduce negative affect) plays a central role in stress-related alcohol use, and is associated with significantly increased risk for alcohol problems (31). According to the Self-Medication Hypothesis (32, 33) drinking to cope with negative affect (i.e., coping motives) is a critical mediator between situational increases in negative affect and subsequent increases in alcohol use and associated problems. The self-medication hypothesis has also been used to explain the relationship between depression and alcohol use/problems [reviewed in (34)]. Evidence further suggests a mediating role of coping motives in the association of peritraumatic distress and alcohol-related problems [e.g., (35)]. While coping motives are central to the self-medication hypothesis, other domains of drinking motives include enhancement motives (i.e., drinking to enhance positive mood), social motives (e.g., affiliation with peers) and conformity motives [e.g., peer pressure; (36, 37)]. Notably, coping motives uniquely predict heavier drinking and related alcohol problems when controlling for other domains (31, 38).

While motives for alcohol consumption are often studied as static phenomena and assessed at one point in time, some studies suggest that drinking motives are subject to dynamic change [e.g., (39, 40)]. As a consequence of social (e.g., reduced interpersonal contact) and environmental (e.g., closure of public drinking venues) changes associated with the COVID-19 pandemic, changes in specific reasons for drinking are likely to occur, at least for some individuals. For instance, if social distancing requirements constrain environmental reward, increased psychological distress or depression [e.g., (41, 42)] might result in escalations in coping motives for drinking and ultimately increased alcohol use. Similarly, increased severity of fear and anxiety specifically related to COVID-19 might predict escalations in negative reinforcement drinking, consistent with the self-medication hypothesis and with past research [e.g., (43)].

Evidence from other public health crises supports these possibilities. Following the 2003 SARS outbreak, Maunder et al. (44) found that maladaptive coping was associated with self-reported increases in alcohol use among health-care workers. Additionally, in hospital employees, endorsement of using alcohol to cope with the SARS outbreak was positively related to alcohol use disorder symptoms (22). This research is limited, however, to samples directly impacted by the disease (e.g., healthcare workers, those in quarantine) and there is a paucity of research in general samples. Of note, early research published in the COVID-19 pandemic has also highlighted differences in psychological response to the pandemic associated with race. For example, Fitzpatrick et al. (45) found greater levels of COVID-19 related fear in Asian and Hispanic participants, relative to their counterparts. The psychological impact of the pandemic on non-majority groups is potentially further exacerbated by pre-existing disparities in mental health, disproportionate impact of the virus on minority groups, and discrimination (46, 47). Information on changes in psychological distress and related outcomes (e.g., depression, substance use) during the COVID-19 pandemic, and their association with race, may be used to direct intervention efforts in this and future public health crises.

The current study had two primary aims. First, following recommendations to study changes in substance use and associated risk factors during the COVID-19 pandemic (4), we aimed to assess self-reported differences in mood, environmental reward, drinking motives, and alcohol outcomes (e.g., quantity/frequency, solitary drinking; alcohol demand) in the period immediately preceding widespread social distancing measures, as compared to the period when these measures were in place. Exploratory analyses also examined whether any of these outcomes differed as a function of self-identified racial group. The second aim was to examine perceived changes in coping motives and depression symptoms as accounting for the relation between perceived change in environmental reward and psychological distress with alcohol consumption during the COVID-19 pandemic. A cross-sectional design using a single online survey assessment was employed to test these aims. Based on self-medication theory (32) and behavioral theories of depression [e.g., (15)], two primary hypotheses were tested. First, we predicted that individual differences in environmental reward during COVID-19 would predict severity of depressive symptoms, which would in turn predict coping motives and alcohol consumption. Second, we predicted that COVID-19-related psychological distress would predict greater endorsement of coping motives, which would in turn predict greater quantity/frequency of alcohol consumption.

METHODS

Participants

Participants were U.S. residents recruited from Amazon's Mechanical Turk (MTurk) between May 12, 2020 and May 23, 2020. A total of 1,854 individuals were screened for participation. Potential participants viewed a description of the survey before electing to participate. Interested participants followed a link from MTurk to an external survey on the Qualtrics platform. Although there has been debate as to the quality of data collected from MTurk participants, past research has documented that it is both a reliable and valid platform for data collection for both the general public population (48–50) as well as those with past history of substance use disorders (51). Participants were first screened for eligibility and, if eligible, were provided an information page and asked to confirm or decline participation. After screening for eligibility and data quality (see below), a total of 833 participants were retained for analysis.

Inclusion criteria for the study included: (a) self-reported age 21+ years (b) self-reported proficiency in reading and comprehending English; (c) current state of residence with implemented mandatory social distancing procedures, and; (d) self-reported consumption of alcohol on >1 occasions per month, on average, in the past year. Exclusion criteria for the study included a reported history of COVID-19 infection in the 90 days preceding the assessment (to mitigate the effects of COVID-19 infection on alcohol consumption patterns).

Additionally, participants residing in states with no mandatory social distancing (e.g., shelter-in-place or equivalent) protocol at the time of data collection were excluded from recruitment; this information was obtained from respective state government websites. The following states were excluded from recruitment: Arkansas, Iowa, Nebraska, North Dakota, Oklahoma, South Dakota, Utah, and Wyoming.

Procedures

Eligible participants were asked to complete a brief survey (duration: ∼20–30 min) that contained three distinct sets of items. The first set of items queried demographic characteristics, past-year drinking history, and psychological distress (including emotional and physiological reactions) attributed to COVID-19. The first set also included the Centers for Disease Control and Prevention definition of social distancing to ensure a standardized operational definition across all participants. Participants then proceeded to the second set of questionnaires that assessed drinking motives, alcohol use and related outcomes, depressive symptoms, and environmental reward. Before starting the second set of questions, participants were provided with specific instructions to anchor their replies to the 30 days immediately preceding the start date of state-mandated shelter-in-place (or equivalent) protocol: "In the one-month period prior to the start of the state-mandated shelter in place protocol…" Therefore, the second set of questions provided data on the outcomes of interest pre-social-distancing. Survey timeframes were individualized based on the individual's current state of residence; start dates for social distancing orders (obtained from State Government websites) were piped in to the participant's survey based on their current residence. To standardize instruction sets, the actual start date and timeframe instruction were repeated at the start of each question.

After completing the second set of items, participants proceeded to the third set of questionnaires. The items included in the third set were identical to those provided in the second set. However, before starting the third set of questions, participants were provided with specific instructions to anchor their replies to the 30 days immediately following the start of the state-mandated shelter-in-place (or equivalent): "In the 30 days immediately after the start of the state-mandated shelter-in-place protocol". Consequently, the third set of items provided data on the outcomes of interest post-social-distancing. Because some states were in the process of 're-opening' at (or soon after) the start of data collection, it was important to anchor responses to the 30-day period after the start of the mandate, rather than the past 30 days.

Five attention-check questions were interspersed throughout the survey as a means of detecting random responding. Additionally, two questions appeared at the end of the survey asking the participant to confirm that they: (1) answered the questions honestly, and (2) paid attention to the questions. These attention checks have been utilized in past research completed via MTurk (49, 50). Participant data were excluded if the participant incorrectly responded to >1 attention checks, in order to control for random responding. Upon completion of the Qualtrics survey, participants were compensated \$2.50 (USD), which is comparable to the recommended \$2/hour rate (52). Upon completion of the survey, participants were granted a custom qualification within MTurk that restricted them from completing the survey more than once.

Measures

Alcohol Use Disorders Identification Test (AUDIT)

The AUDIT is a 10-item scale assessing hazardous alcohol use, symptoms of dependence, and harmful alcohol use in the past year (53). Seven of the ten items are scored on a 4-point scale (response options differ by question structure). The remaining three items are scored on a 3-point scale. A systematic review (54) identified numerous studies that supported sound psychometric properties of the AUDIT, including test-retest reliabilities of 0.6 to 0.84 and an average Cronbach's alpha of 0.80. Internal consistency in the current sample was 0.89. Because total AUDIT score was included as a descriptor for the sample characteristics, AUDIT scores were not anchored to the aforementioned time intervals.

Modified Peritraumatic Distress Inventory (PDI)

The PDI is a 13-item scale assessing peritraumatic distress, defined as the emotional and physiological distress experienced by an individual after a traumatic event (55). Items on the scale (e.g., "I felt helpless to do more") were scored on a 5-point scale from 1 (*not at all true*) to 5 (*extremely true*). The original PDI instructions were altered to specifically capture distress attributed to COVID-19 (e.g., "Please rate the extent to which you have experienced each of the following items during (or immediately after) the COVID-19 pandemic."). Although exposure to stress surrounding COVID-19 does not constitute experience of a traumatic event per se, the PDI was selected for the purpose of implementing a previously developed measure of emotional distress and physiological arousal secondary to ongoing or recent events (55). As such, this modified measure provided a structured assessment of distress attributable to the ongoing pandemic. Previous reports on the PDI have demonstrated good internal consistency, test-retest reliability, and convergent and divergent validity of the measure (55). Internal consistency of the current sample was 0.94. Consistent with past research, the overall score on this measure is the mean response across all 13 items.

Alcohol Consumption

Indices of recent alcohol use were assessed with the National Institutes on Alcohol Abuse and Alcoholism (NIAAA) Recommended Alcohol Questions[1]. The items are as follows: (1) "how often did you usually have any kind of drink containing alcohol?"; (2) "how many alcoholic drinks did you have on a typical day when you drank alcohol?"; (3) "what is the largest number of drinks containing alcohol that you drank within a 24-h period?"; (4) "how often did you drink this largest number of drinks?," and; (5) "how often did you have 5 or more (males) or 4 or more (females) drinks containing alcohol within a 2-h period." The latter item provides the operational definition of a "binge" drinking episode used in the present study. An additional

[1] https://www.niaaa.nih.gov/research/guidelines-and-resources/recommended-alcohol-questions

item was included to query the amount of time participants typically spend consuming alcohol per day, with options ranging from 1 (0 h) to 7 (10+ h).

Solitary Drinking Frequency

Questions on drinking context were adapted from those reported in Keough et al. (24). These questions were originally adapted from Cooper's (56) drinking contexts measure. A single item was used to assess relative frequency of solitary drinking in the specified 1 month period: "when you drank alcohol, how much of that time was spent drinking while you were by yourself relative to when socializing with other people either in-person or virtually." Response options ranged from 1 ("100% by yourself"), 2 (90% by yourself, 10% with other people) to 10 (10% by yourself, 90% with other people"), 11 ("100% with other people"). An additional item was used to assess relative frequency of social drinking in in-person relative to virtual contexts: "when you drank alcohol while socializing with other people, how much of that time was spent with other people in-person relative to being virtually." Response options ranged from 1 (100% in person), 2 (90% in person, 10% virtual) to 10 (10% in person, 90% virtual), 11 (100% virtual).

Alcohol Purchase Task (APT)

The APT is a hypothetical commodity purchase task that provides quantitative indices of demand for alcohol (57). Participants were asked to indicate how many drinks they would consume at the following prices: \$0, \$0.50, \$1.00, \$1.50, \$2.00, \$2.50, \$3.00, \$4.00, \$5.00, \$6.00, \$7.00, \$8.00, \$9.00, \$10.00, \$11.00, \$12.00, \$13.00, \$14.00, and \$15.00. Participants were instructed that all drinks were administered as "standard" sizes (equivalent to one standard drink), that they could not stockpile drinks for a later time (i.e., all requested drinks must be consumed), and that they did not drink before and cannot drink after [adapted from (58)]. Five scores can be generated from the APT that reflect the latent facets of alcohol demand: intensity (consumption when alcohol is free); breakpoint (the first price that reduces alcohol consumption to 0); Omax (maximum expenditure for alcohol); Pmax (the price associated with the maximum expenditure), and elasticity (sensitivity of consumption across increasing prices of alcohol) (57). Test-retest reliability of the scores of the APT have been previously reported to range between $r = 0.58$ to $r = 0.91$, depending on the index being scored (59). The APT has also demonstrated predictive validity for the quantity of drinks consumed among college students at 1-month follow-up and alcohol problems at 6-month follow-up (60). Convergent validity has also been demonstrated between the APT and self-report measures of drinking quantity and alcohol related problems (27).

Nonsystematic APT data were identified using a 3-criterion algorithm proposed by Stein et al. (61). Briefly, this algorithm detects cases that violate the trend (non-negligible reduction in consumption as price increases), bounce (less than a 10% incidence of local price-to-price increases in consumption), and reversals from zero (non-zero consumption following two consecutive zero consumption) criteria. Benchmarks (i.e., cases with <0.025 log-unit reductions in consumption across prices; >10% incidence of bounce, and; any reversals from zero) were implemented as described by Stein et al. (61). Any cases where at least one of these criteria were violated (for pre- or post-social distancing) were excluded from APT analyses. Freely available scoring software in R ("beezdemand") was used to estimate the observed values of intensity, breakpoint, OMax, and Pmax as well as the derived value for elasticity across prices (62). Indices of demand were derived using the exponentiated approach, as outlined by Koffarnus et al. (63).

Drinking Motives Questionnaire—Revised (DMQ-R)

The DMQ-R is a 20-item questionnaire that assesses motives to consume alcohol (56). Items are scored on a 5-point scale from 1 (*almost never*) to 5 (*almost always/always*). The measure has 4 subscales: social (e.g., "Because it helps you enjoy a party"), coping (e.g., "To forget your worries"), conformity (e.g., "Because your friends pressure you to drink"), and enhancement [e.g., "Because it gives you a pleasant feeling"; (56)]. In the present study, responses were anchored to a 30-day timeframe. Of primary interest was the coping subscale score, however, all 4 subscales were scored and included in statistical models (as described in Analytical Plan). The DMQ-R has demonstrated good to excellent test-retest reliability, internal consistency, and predictive validity for concurrent drinking frequency and quantity and alcohol-related problems among a sample of undergraduate students (37). Internal consistency of the four DMQ subscales in the current sample ranged from 0.84 to 0.95 across both assessed timeframes.

Patient Health Questionnaire (PHQ)-9

The PHQ-9 is a widely used 9-item self-report measure of depression severity (64). Participants are asked to rate how often they are bothered by the specific item, ranging from 0 (*not at all*) to 3 (*nearly every day*). To address the aims of this study we adjusted the instructional set to assess a 30-day timeframe, rather than the traditional 14-day timeframe. A single severity score for each timeframe, derived by summing responses to all 9 items, was used as the primary outcome (64). A systematic review of the PHQ-9 has reported sound psychometric properties of the measure, including internal reliability, test-retest reliability, and convergent validity with other measures of depression (65). Internal consistency in the current sample was 0.94 and 0.93 for the pre- and post-social distancing timeframes, respectively.

Reward Probability Index (RPI)

The RPI is a self-report scale designed to measure the availability of response-contingent positive reinforcement (reward probability) as well as the presence of aversive stimuli (environmental suppressors) in an individual's environment (66). The RPI accomplishes this with a 20-item scale scored on a 4-point Likert scale from 1 (*strongly disagree*) to 4 (*strongly agree*). Two subscale scores can be derived: reward probability (e.g., "I feel a strong sense of achievement") and environmental suppressors (e.g., "Changes have happened in my life that have made it hard to find enjoyment"). Subscale scores are obtained by summing the scores on 10 constituent items. The 10 items that contribute to the environmental suppressors subscale are reverse scored before being summed. As such, higher scores on these two subscales represent greater reward probability and fewer environmental suppressors, respectively. A single total score was also obtained by summing the two subscale scores. Higher scores on this aggregate score represent both increased access to environmental reward and decreased presence of environmental suppressors. The RPI has previously demonstrated high internal consistency, test-retest reliability, convergent validity and discriminant validity (66). Internal consistency for the total scale in the current sample was 0.90 and 0.88 for the pre- and post-social distancing timeframes, respectively.

COVID-19 Impact and Perception

For descriptive purposes, questions were developed to estimate the impact of COVID-19 on individuals' income and employment; participants were provided with 8 response options ranging from 1 ("*My income/employment has increased*") to 8 ("*I have lost 100% of my income/employment*"). Similarly, a non-standardized question assessing worry secondary to COVID-19 was included where participants were asked to indicate how worried they are about COVID-19 ranging from 1 ("*not worried at all*") to 7 ("*extremely worried*"). These outcomes were included to illustrate the sample characteristics and impact of COVID-19 specifically.

Analysis Plan

Prior to analysis, all variables were assessed for univariate normality and the presence of outliers. All variables were normally distributed. Univariate outliers were defined as data points that fell outside of ±3.29 SD of the mean. Outliers were only observed on the RPI scale and APT. These outliers were deemed to be valid points of data but were nonetheless winsorized to ±3.29 SD to reduce their extreme influence on analyses (67). Multiple imputation was used to address missing data (assumed missing at random).

To address aim 1 of examining self-reported differences in outcomes as a function of timeframe (pre- and post-social distancing), paired samples *t*-tests were conducted to determine whether observed scores on the specified outcomes of interest were significantly different post-social-distancing compared to pre-social-distancing. Independent samples *t*-tests were then conducted to determine whether any of the specified outcomes differed as a function of race (as an exploratory analysis). Because our sample was predominantly white (65.5%), we computed a binary variable to compare white participants with non-white participants for the pairwise comparisons.

To address aim 2 of assessing the indirect effect of environmental reward and psychological distress on alcohol consumption through depression and coping motives, an index of alcohol consumption was derived by taking the product of typical alcohol consumption frequency and quantity, NIAAA recommended questions 1 and 2 (68). This index ("alcohol QF") was derived for both pre-social-distancing and post-social-distancing timeframes; higher scores on this index are indicative of greater levels of alcohol consumption. The post-social-distancing alcohol QF score served as our primary outcome in our mediation models. However, because we observed significant pre-social-distancing to post-social-distancing differences in frequency of binge drinking and frequency of solitary drinking, we ran additional exploratory models with these specified as the outcome of interest.

To test the mediation hypotheses, mediation effects were examined using Hayes' (69) PROCESS macro for SPSS. To address the first hypothesis, we modeled the indirect effect of post-social-distancing environmental reward (RPI total score) on post-social-distancing alcohol QF through post-social-distancing depression severity (PHQ) and post-social-distancing coping motives (DMQ-R coping motive subscale). We included pre-social-distancing alcohol QF, depression, and coping motives as covariates in the mediation model in order to examine associations among post-social-distancing variables *relative to* pre-social-distancing levels. To assess hypothesis 2, we modeled the indirect effect of COVID-19-related distress (PDI) on post-social-distancing alcohol QF through post-social-distancing coping motives. Consistent with hypothesis 1, we included pre-social-distancing alcohol QF and coping motives as covariates. Pre-social-distancing social, enhancement, and conformity motive scores (DMQ-R) were included as covariates in all mediation models. This facilitated the examination of the unique role of coping motives as a mediator. Sex and race were also included as covariates in all mediation models. A mediation effect was deemed to be significant if the indirect effect's 95% bias-corrected bootstrap confidence interval did not contain 0.

RESULTS

Sample and Demographics

After screening for eligibility and agreement to participate, 1,127 participants proceeded to the survey. Of the 727 participants who were excluded, 5 participants did not agree to participate after reading the information statement and 722 did not meet one or more eligibility criteria. After screening for inattention, 833 cases were retained for analyses. The final sample was mostly male (64.7%) with an average age of 40.76 (SD = 10.65) years. Reported racial backgrounds included White (65.5%); Black or African American (14.9%); Asian or Asian American (6.7%); Hispanic or Latino (6.2%); Alaska Native or American Indian (0.6%); Native Hawaiian or other Pacific Island (0.1%), or more than one identified racial background (1.8%). Most participants were not students (61%) and reported an average household income of $50,000-$70,000 per year. On average, participants reported living with 2.37 others (66.1% with family). **Table 1** provides a summary of additional sample characteristics.

Self-Reported Change (Pre-social-distancing vs. Post-social-distancing) in Primary Outcomes

Pairwise comparisons of pre-social-distancing and post-social-distancing outcomes are presented in **Table 2**. A conservative Bonferroni correction was applied to mitigate false positive findings in the context of multiple comparisons. Findings were interpreted as significant at a threshold of $p < 0.002$.

TABLE 1 | Sample Characteristics.

	M (SD)/%
AUDIT Total score—past year (*SD*)	10.49 (8.13)
Frequency of past-year drinking	
Every day	15.80%
5 to 6 times per week	16.30%
3 to 4 times per week	24.60%
twice a week	22.40%
once a week	13.00%
2 to 3 times per month	7.80%
Living arrangement	
With family	66.1%
Live alone	22.9%
With roommate	8.6%
Other	1.9%
Number of residents in household (*SD*)	2.37 (1.49)
Income change due to COVID	
Increased	4.3%
No change	41.7%
Reduced up to 10%	12.7%
Reduced by 10–25%	19.1%
Reduced by 25–50%	11.4%
Reduced by 51–75%	4.2%
Reduced by more than 75%	2.0%
100% income loss	4.3%
Change in hours working due to COVID	
Working the same # hours	43.9%
Working more hours	13.2%
Working fewer hours	34.2%
On leave, terminated or quit	8.5%
COVID-related worry (*SD*)	4.69 (1.67)
PDI Total Score - anchored to COVID (*SD*)	1.19 (0.93)

AUDIT, Alcohol use disorders identification test. PDI, Peritraumatic Distress Inventory (anchored to COVID-19).

Consistent with hypotheses, participants reported greater severity of depressive symptoms post-social-distancing, as well as reported lower total RPI score post-social-distancing. Overall, participants reported typical quantities, frequency, and time spent drinking (NIAAA item 1 and 2) post-social-distancing that were commensurate with pre-social-distancing values. However, participants reported significantly more binge episodes post-social-distancing. As predicted, participants endorsed significantly higher coping motives post-social-distancing compared to pre-social-distancing. Conversely, participants endorsed significantly lower social, conformity, and enhancement motives for drinking post-social-distancing relative to pre-social-distancing. Additionally, participants reported significantly more frequent solitary drinking (but also more virtual social drinking) post-social-distancing compared to pre-social-distancing.

Screening of data for the APT resulted in a final sample of 629 cases with valid pre-and post-social-distancing data for alcohol demand. Results for alcohol demand varied by demand index. Intensity of demand, elasticity across prices, breakpoint, and price associated with maximum expenditure (Pmax) did not differ from pre- to post-social-distancing. Together, these suggest that alcohol consumption at no cost, sensitivity of alcohol consumption to increases in price, price associated with zero consumption, and the point at which individual demand transitions from inelastic to elastic, respectively, were consistent across timeframes. Maximum expenditure was found to be higher post-social-distancing compared to pre-social distancing. Increased expenditure suggests that participants had a higher maximal response output post-social-distancing compared to pre-social distancing. Together these results might suggest there are subtle changes to some facets of alcohol demand.

The results of the independent samples t-tests to explore differences in outcome as a function of race are presented in **Table 2** (see footnote). Non-white participants reported less frequent alcohol consumption post-social-distancing and greater typical quantity of alcohol consumed pre-social-distancing. At pre-social-distancing, non-white participants reported higher frequency of binge consumption, greater environmental suppression, and reduced environmental reward probability relative to white participants. Non-white participants also reported greater environmental suppression post-social-distancing and higher endorsement for all drinking motives subscales at both timepoints. Not reported in the table, non-white participants reported higher levels of COVID-19-related distress and greater severity of depressive symptoms at both timepoints ($p < 0.002$ for both outcomes). Finally, non-white participants scored higher on one index of alcohol demand (breakpoint) at pre-social-distancing. The remaining measures did not differ by race (all $p > 0.002$).

Indirect Association of Environmental Reward With Alcohol Use via Severity of Depressive Symptoms and Coping Motives

A summary of the direct and indirect effects for all mediation models conducted in the study can be found in **Table 3**. The results of the sequential mediation model examining the indirect effect of post-social-distancing environmental reward on post-social-distancing alcohol QF through severity of post-social-distancing depressive symptoms and post-social-distancing coping motives (controlling for pre-social-distancing values) are presented in **Figure 1**. There was a significant indirect effect of environmental reward (total RPI score) on alcohol QF via severity of depressive symptoms and coping motives. Specifically, lower levels of reward probability predicted greater severity of depressive symptoms; greater severity of depressive symptoms, in turn, predicted higher levels of coping motives; higher levels of coping motives subsequently predicted increases in alcohol QF. Significant unique indirect effects of total RPI score with alcohol QF were also observed through depression and coping motives, in the directions specified above. There was no significant direct effect of environmental reward on alcohol QF. Regarding covariates, race ($b = -1.727$, $SE = 0.684$, $t = -2.523$, $p = 0.012$), pre-social distancing coping motives ($b = -1.295$, $SE =$

TABLE 2 | Paired Samples *t*-test Statistics.

Outcome	Pre-social-distancing *M (SD)*	Post-social-distancing *M (SD)*	*t*	*p*
Alcohol QF	17.35 (14.45)	17.38 (13.83)	−0.070	0.944
NIAAA: Frequency	5.19 (1.59)	5.18 (1.79)[†]	0.231	0.818
NIAAA: Quantity	3.16 (2.09)[‡]	3.15 (1.95)	0.075	0.940
NIAAA: Time	2.63 (0.94)	2.69 (1.08)	−2.039	0.042
NIAAA: Max drinks	4.02 (1.94)	3.95 (2.01)	1.560	0.119
NIAAA: Binge frequency	2.85 (1.97)[‡]	3.00 (2.03)	−3.220	**0.001**
RPI: Reward probability	33.95 (5.68)	30.23 (6.60)	18.823	**<0.001**
RPI: Environmental suppressors	26.53 (6.82)[†]	25.67 (6.53)[†]	6.088	**<0.001**
RPI: Total	60.40 (9.94)[†]	55.89 (9.61)	16.771	**<0.001**
DMQ: Social motives	2.71 (1.12)[‡]	2.08 (1.20)[‡]	19.239	**<0.001**
DMQ: Coping motives	2.38 (1.09)[‡]	2.49 (1.12)[‡]	−5.356	**<0.001**
DMQ: Enhancement motives	2.82 (1.00)[‡]	2.73 (1.03)[‡]	4.095	**<0.001**
DMQ: Conformity motives	1.91 (1.10)[‡]	1.79 (1.13)[‡]	6.507	**<0.001**
PHQ: Total	6.58 (6.99)[‡]	7.49 (7.01)[‡]	−7.683	**<0.001**
Solitary drinking frequency	6.73 (3.29)	5.14 (3.52)	16.169	**<0.001**
Virtual drinking frequency	3.83 (3.42)[‡]	5.36 (3.91)[‡]	−12.188	**<0.001**
APT: Intensity	8.61 (27.74)	7.34 (10.23)	1.425	0.155
APT: Breakpoint	9.89 (4.54)[‡]	9.72 (4.65)	2.245	0.025
APT: Omax	21.43 (22.04)	23.93 (27.55)	−4.624	**<0.001**
APT: Pmax	7.25 (3.88)	7.10 (3.79)	1.441	0.150
APT: Elasticity	0.026 (0.21)	0.076 (1.04)	−1.509	0.132

NIAAA, National Institute on Alcohol Abuse and Alcoholism (questions from 5-item set); RPI, Reward Probability Index; Items that contribute to the environmental suppressors subscale of the Reward Probability Index are reverse-scored. DMQ, Drinking Motives Questionnaire; APT, Alcohol Purchase Task; Statistical significance threshold set at 0.002 to correct for family wise error.
[†]Mean score for white participants significantly greater than non-white mean score ($p < 0.002$).
[‡]Mean score for non-white participants significantly greater than white mean score ($p < 0.002$).
Bolded values $p < 0.002$.

TABLE 3 | Indirect and Direct Effects for hypothesized mediation models.

	Outcome: Post-social-distancing alcohol QF					
	b	*SE b*	*LLCI*	*ULCI*	*t*	*p*
Mediation Model 1						
Direct Effect (Reward Probability Index)	0.051	0.051			1.011	0.312
Indirect Effects						
Depression severity (PHQ)	−0.060	0.024	−0.108	−0.014		
Coping motives (DMQ-R)	−0.054	0.015	−0.087	−0.027		
Sequential effect	−0.024	0.008	−0.041	−0.010		
Mediation Model 2						
Direct Effect (COVID-related distress)	0.901	0.503			1.789	0.074
Indirect Effect (Coping motives)	0.805	0.209	0.436	1.256		

Mediation model 1: indirect effect of environmental reward on alcohol use sequentially through severity of depressive symptoms and coping motives. PHQ, Patient Health Questionnaire; DMQ-R, Drinking Motives Questionnaire—Revised. Mediation model 2: indirect effect of COVID-related distress on alcohol use through coping motives. Confidence intervals presented here are 95% bias-corrected bootstrap estimates.

0.649, $t = -1.995$, $p = 0.046$), pre-social distancing enhancement motives ($b = 0.959$, $SE = 0.454$, $t = 2.110$, $p = 0.035$), and pre-social distancing alcohol QF ($b = 0.656$, $SE = 0.023$, $t = 27.858$, $p < 0.0001$) all significantly predicted variance in the post-social-distancing alcohol QF outcome. No other covariates were statistically significant predictors of post-social-distancing alcohol QF (all $p > 0.05$).

Results of the exploratory sequential mediation analysis with frequency of binge drinking specified as the outcome were consistent with the primary model. There was a significant

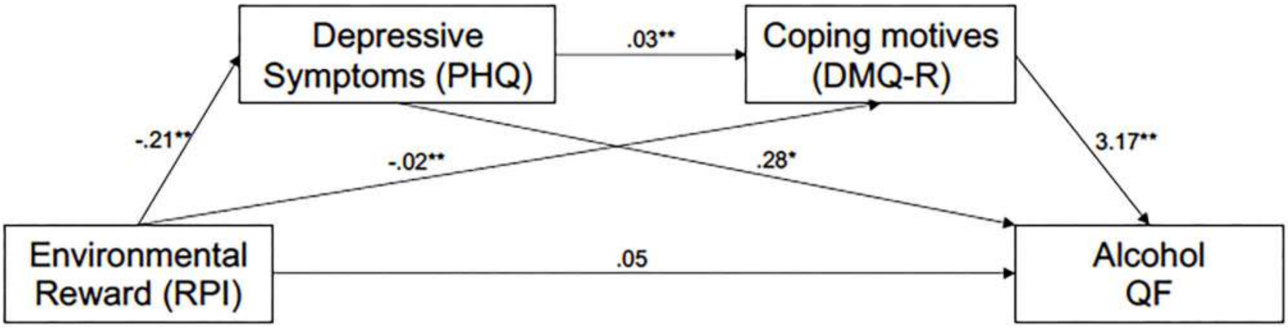

FIGURE 1 | Sequential indirect effect of environmental reward on alcohol QF through severity of depressive symptoms and coping motives. *$p < 0.05$, **$p < 0.01$. RPI, Reward Probability Index; PHQ, Patient Health Questionnaire; DMQ-R, Drinking Motives Questionnaire—Revised; Alcohol QF, measure of alcohol quantity/frequency (see Analysis Plan). All variables shown in the model correspond to post-social-distancing scores. Environmental reward indirectly significantly predicted alcohol QF through three unique paths: sequentially through depressive symptoms then coping motives; coping motives only, and; depressive symptoms only. Path coefficients are unstandardized *b* values. Sex and race were included as demographic covariates. Pre-social-distancing covariates included: environmental reward probability, depressive symptoms, motives (coping, enhancement, conformity, social), and alcohol QF.

indirect sequential effect of environmental reward on binge frequency through severity of depression and coping motives ($b = -0.003$, $SE = 0.001$, 95% bootstrap CI [−0.005, −0.001]). There was also a unique indirect effect of environmental reward on binge frequency through coping motives ($b = -0.007$, $SE = 0.002$, 95% bootstrap CI [−0.011, −0.003]) but not through depressive symptoms ($b = -0.007$, 0.004, 95% bootstrap CI [−0.014, 0.001]). Consistent with the first model, there was no direct effect of environmental reward on binge frequency ($p > 0.05$). Conversely, there were no significant indirect effects in the exploratory model with frequency of solitary drinking specified as the primary outcome (all bootstrap CIs contained zero). However, there was a significant direct effect of environmental reward on frequency of solitary drinking ($b = 0.082$, $SE = 0.015$, $t = 5.585$, $p < 0.0001$).

Indirect Association of COVID-19-Related Distress With Alcohol Use via Coping Motives

The results of the mediation model examining the indirect effect of COVID-19-related distress on typical alcohol consumption quantity and frequency through coping motives (controlling for pre-social-distancing values) are presented in **Figure 2**. There was a significant indirect effect of post-social-distancing COVID-19-related distress on post-social-distancing alcohol QF through coping motives (**Table 3**). Specifically, higher levels of COVID-19-related distress predicted greater levels of drinking to cope that, in turn, predicted greater alcohol QF. The direct effect of COVID-19-related distress on alcohol QF was not significant, suggesting a full mediation of the effect. Regarding covariates, pre-social-distancing enhancement motives ($b = 0.960$, $SE = 0.451$, $t = 2.127$, $p = 0.034$), race ($b = -1.616$, $SE = 0.679$, $t = -2.379$, $p = 0.018$), and pre-social-distancing alcohol QF ($b = 0.659$, $SE = 0.024$, $t = 28.11$, $p < 0.0001$) significantly predicted post-social-distancing alcohol QF. None of the other covariates reached the threshold of statistical significance (all $p > 0.05$).

For the exploratory analyses examining binge and solitary drinking, we first conducted the mediation analysis with post-social-distancing frequency of binge drinking specified as the outcome. There was a significant indirect effect of COVID-related distress on binge frequency through coping motives ($b = 0.093$, $SE = 0.029$, 95% bootstrap CI [0.043, 0.155]). The direct effect of COVID-related distress on binge frequency was not significant ($p > 0.05$) suggesting a full mediation of the effect. Finally, we ran the mediation analysis with post-social-distancing with frequency of solitary drinking specified as the outcome. There was a significant indirect effect of COVID-related distress on frequency of solitary drinking through coping motives ($b = -0.090$, $SE = 0.048$, 95% bootstrap CI [−0.189, −0.001]). Specifically, greater levels of COVID-related distress predicted higher levels of coping motives, which in turn predicted greater frequency of solitary drinking. There was no significant direct effect of COVID-related distress on solitary drinking frequency ($p > 0.05$) suggesting a full mediation of the effect.

DISCUSSION

The primary aims of this study were to estimate self-reported changes in alcohol consumption, depression, environmental reward and drinking motives during COVID-19, and to test theoretically based mediation models involving these outcomes. Regarding the first aim, we observed inconsistency in the magnitude and direction of self-reported change across alcohol measures. For example, participants reported a greater frequency of binge drinking, but no change in the quantity and frequency of alcohol use. Self-reported changes in alcohol demand indices were also variable, with some indices suggesting no change (e.g., intensity, elasticity) and others supporting change (e.g., maximum expenditure). Overall, however, these results are consistent with predictions of individual differences in the

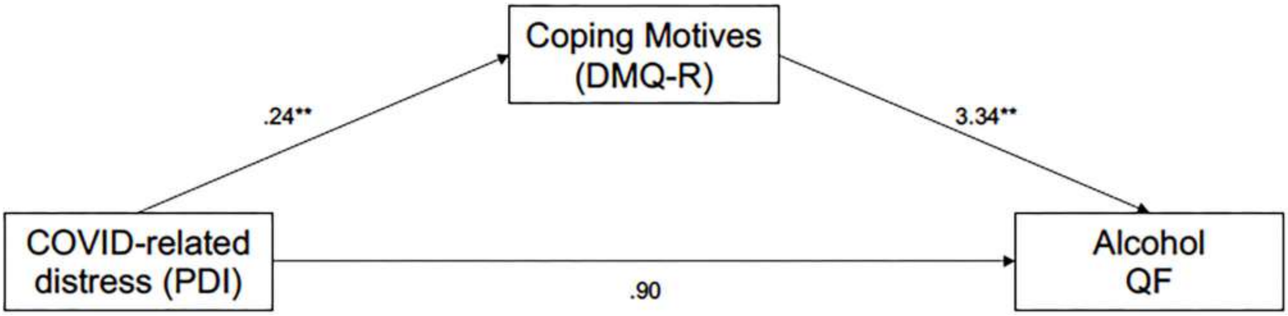

FIGURE 2 | Indirect effect of COVID-related distress on alcohol QF through coping motives. $^{**}p < 0.01$. PDI, Peritraumatic Distress Inventory; DMQ-R, Drinking Motives Questionnaire—Revised; Alcohol QF, measure of alcohol quantity/frequency (see Analysis Plan). Post-social-distancing coping motives and post-social-distancing alcohol QF are shown in the model. COVID-related distress was not anchored to a specific timeframe. The indirect effect of COVID-related distress on alcohol QF through coping motives was significant. Path coefficients are unstandardized *b* values. Sex and race were included as demographic covariates. Pre-social-distancing covariates included: motives (coping, enhancement, conformity, social), and alcohol QF.

presence and direction of changes in alcohol use (4) and suggest variability in the presence and magnitude of alcohol use indices in the context of social distancing related to COVID-19 [e.g., (11)].

We also found evidence of greater severity of depressive symptoms, lower levels of environmental reward and higher levels of environmental suppressors post-social-distancing compared to pre-social-distancing. These findings are in keeping with the behavioral theory of depression suggesting that restrictions in access to environmental and social rewards increase risk of depression [e.g., (16)], and with past research that documented an increased incidence of depression in individuals quarantined during the SARS epidemic (21). We also found that self-reported frequency of negative reinforcement drinking motivated by internal contexts (i.e., coping) increased from pre- to post-social-distancing timeframes, as hypothesized. Conversely, positive reinforcement drinking motives (i.e., enhancement, social) and negative reinforcement motives related to external social contexts (i.e., conformity) decreased post-social-distancing relative to pre-social-distancing. Contextual factors surrounding COVID-19 (i.e., social distancing) may contribute to these observed changes in motivations for alcohol consumptions. It is intuitive that externally-motivated reasons for drinking might decrease during periods of social distancing. Similarly, greater negative reinforcement motives for drinking are intuitive in the context of observed higher negative affect observed post-social-distancing compared to pre-social-distancing.

Notably, exploratory analyses showed that race was significantly associated with many of our predictors (environmental reward, depressive symptoms, motives) and some alcohol use outcomes. Generally, non-white participants seemed to be at higher risk for higher drinking levels, riskier drinking patterns, and greater affective distress, when compared to white participants. Because we did not design our study to examine race- and demographic-based differences (e.g., we did not comprehensively assess socioeconomic status), we cannot make meaningful inferences about these differences. Moreover, the aggregation of non-White participants into a single group precludes the examination of differences between non-white groups and limits any nuanced conclusions concerning the association of race with the outcomes reported here. Nonetheless, these data are in keeping with predicted disparities in mental health outcomes for marginalized groups [e.g., (70)] and are consistent with reports of racial and ethnic-based health disparities during the COVID-19 pandemic (71). Ultimately, the data reported here emphasize the need for additional research to more closely examine how race and other demographic factors have impacted and will continue to impact individuals' response to the COVID-19 pandemic and associated mental health outcomes.

In addition to examining mean-level differences, we also tested theory-based mediation models to examine predictors of alcohol use during the COVID-19 pandemic. In the context of behavioral theory of depression and self-medication theories, the first set of mediation models tested environmental reward as an indirect predictor of alcohol QF post-social-distancing through severity of depressive symptoms and drinking to cope. Results suggested that: (1) lower levels of environmental reward predicted greater severity of depressive symptoms; (2) greater severity of depressive symptoms predicted higher levels of coping motives, and; (3) higher coping motives, in turn, predicted greater levels of alcohol consumption. In addition to the total sequential mediation effect, both severity of depressive symptoms and drinking to cope also independently mediated the effect between environmental reward and alcohol QF. The second mediation model, derived from the self-medication model, examined coping motives as a mediator of the relationship between COVID-19-related distress (secondary to COVID-19) and alcohol use post-social-distancing. The data supported our hypothesis for both typical alcohol QF: (1) higher levels of COVID-19-related distress predicted greater levels of coping motives that, in turn; (2) predicted higher levels of alcohol use post-social-distancing. In exploratory analyses, the results of the two mediation models replicated using post-social-distancing frequency of binge drinking at the primary outcome. Collectively these results are generally consistent with the behavioral theory of depression and self-medication hypothesis, where restrictions in environmental reward predict increases in the severity of depression (15, 16) and drinking to cope is hypothesized to mediate the relationship between negative affect (e.g., depression) and alcohol use (32, 33).

Because coping motives only partially mediated the hypothesized effects, it remains likely that other factors not assessed here also predict relative change in alcohol use during the COVID-19 pandemic. For example, we found that pre-social-distancing enhancement motives (i.e., drinking to enhance positive states) was significantly related to both alcohol consumption and frequency of binge drinking. While this finding was somewhat unanticipated, enhancement motives are typically strong predictors of alcohol consumption (31). Exactly how changes in motives—and other constructs—predict relative change in alcohol use during the COVID-19 pandemic is an important question for future research.

Other theoretical frameworks, notably behavioral theories of choice, might also provide insight into the data presented here. For example, behavioral economic theories of substance use disorders posit that the decision to use or abstain from a drug is the result of a joint influence of internal motivational states and availability of alternative reinforcers in the environment (72). Human research provides confirmatory evidence of the inverse relationship between availability of alternate reinforcers and alcohol use/problems [e.g., (73–75)]. In the context of social-distancing due to the COVID-19 pandemic, it is possible that changes in alcohol use and alcohol demand are directly influenced by changes in availability of alternative reinforcers. However, as highlighted in a recent review the RPI does not explicitly measure substance-free reinforcement (76) and so the present data cannot be parsimoniously interpreted within choice theory frameworks. Nonetheless, behavioral theories of choice are likely well-suited to studying the effects of mandated social distancing on substance use and in reconciling the discordant results of changes in alcohol demand reported here. Future research based on such theories is warranted.

In our additional exploratory models, we also found that frequency of solitary drinking post-social-distancing was not predicted by COVID-related distress or depressive symptoms. We did, however, observe a significant indirect effect of COVID-related distress on solitary drinking frequency through coping motives, and a direct effect of environmental reward on solitary drinking frequency post-social-distancing. Regarding the latter, lower levels of post-social-distancing environmental reward were associated with greater frequency of solitary drinking. This pattern of results suggest that differences in external contextual factors, in addition to select internal context factors (i.e., COVID-19 related distress through alcohol motives), are relevant for predicting solitary drinking in the context of COVID-19 emergency measures. This finding is in partial agreement with other recent research examining alcohol use in the context of COVID-19. Specifically, in another study of alcohol use during the early stages of the pandemic, living alone (an external context factor) predicted increased solitary drinking, whereas internal context factors did not (77). Because past research has demonstrated that increased frequency of solitary drinking predicts increases in alcohol-related problems (24, 78) it is imperative to understand which specific environmental factors during COVID-19 may elevate individuals' risk to develop this pattern of drinking.

Ultimately, one significant implication of these findings is to highlight factors that may be associated with risk for elevated rates of alcohol use disorders during the pandemic. Such risk factors include, for example, the elevated frequency of binge drinking and solitary use of alcohol post-social distancing compared to pre-social distancing. Both binge drinking and the use of alcohol in solitary contexts are considered risky patterns of alcohol use, in part due to their relation to future alcohol-related problems [e.g., (24, 79)] To the extent that interventions mitigate constrained environmental reward secondary to social distancing, they might have beneficial effects in preventing escalations in alcohol consumption and the increased frequency of risky drinking patterns. Behavioral activation (BA) interventions represent an appealing option, as they are effective in targeting both depressive symptoms and substance use (80). Moreover, such interventions can effectively be delivered remotely, via smartphone technology, enhancing the potential utility to a broader population [e.g., (81)]. In the context of COVID-19, the implementation of a BA-oriented intervention is therefore not only theoretically justified, but has the potential for feasible wide-spread implementation. Smartphone-based interventions that incorporate coping-skills training, psychoeducation, and related interventions have also been developed [e.g., (82)] that might be useful as adjunct therapy for individuals whose changes in alcohol use are driven by coping-related motives. Future research will be required to determine the efficacy and utility of such interventions in these contexts.

There are key limitations of the present research that should be noted. First, our research employed a cross-sectional approach that required participants to selectively report on two distinct timeframes, which may introduce bias. For example, a negative retrieval bias may selectively enhance accessibility of negatively-valanced events for some individuals [e.g., (83)]. Similarly, simple demand characteristics of the questionnaire due to the timeframe instructional set (i.e., anchor of items batteries to pre-social-distancing and post-social-distancing) might provoke unintentional bias and unduly influence individuals' responses (84). Second, the use of a cross-sectional approach precludes any inference about causality or changes over time. Third, sample representativeness and participant eligibility criteria restricts generalization of results to the general population. For example, we selected participants based on a minimum frequency of past-year drinking history and an age >21 years old. As a result, we cannot extend conclusions about findings from this sample to individuals with less frequent patterns of drinking, those abstaining from alcohol, underage drinkers, those with remote histories of alcohol use, or alcohol naïve individuals who started drinking during the pandemic or immediately prior. More broadly, our use of a convenience sample from MTurk limits generalizations to the general population due to sample representativeness. Future research will be essential to address these limitations to confirm the replicability and generalizability of the findings reported here.

Despite these limitations, our results provide initial evidence for factors related to changes in alcohol consumption during COVID-19. Some results are consistent with predictions of increased incidence of alcohol use disorders following the easement of social distancing procedures, at least in certain vulnerable subgroups [e.g., (10)]. Such knowledge can inform public health initiatives to curb harmful use of alcohol and may provide clinicians with useful knowledge concerning both risk and protective factors for alcohol use during the present, and future, pandemics. Prospective research will be needed to replicate the results reported here, and to establish the long-term consequences of these changes observed during the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Toronto Health Sciences Research Ethics Board. All participants read an informational statement and indicated agreement to participate in the study in accordance with institutional requirements and national legislation.

AUTHOR CONTRIBUTIONS

MM and CH conceived the idea for the research project and developed the primary hypotheses tested in this study. MM, CH, SR, LH, and MK contributed to the design of the study protocol. MM and SR completed data collection under the supervision of CH. MM, CH, MK, and JW contributed to statistical analyses and interpretations of data. MM, CH, and SR contributed to writing drafts of the manuscript. MM, CH, SR, LH, MK, and JW provided feedback on drafts of the manuscript and approved the final version. All authors contributed to the article and approved the submitted version.

FUNDING

This research was supported by the Canada Research Chairs Program.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 02 November 2020
doi: 10.3389/fpsyt.2020.587455

Heightened Levels of Maladaptive Daydreaming Are Associated With COVID-19 Lockdown, Pre-existing Psychiatric Diagnoses, and Intensified Psychological Dysfunctions: A Multi-country Study

Eli Somer[1], Hisham M. Abu-Rayya[1,2], Adriano Schimmenti[3], Bariş Metin[4], Reut Brenner[1], Erika Ferrante[3], Buse Göçmen[4] and Alessia Marino[3]*

[1] School of Social Work, University of Haifa, Haifa, Israel, [2] School of Psychology and Public Health, La Trobe University, Melbourne, VIC, Australia, [3] Faculty of Human and Social Sciences, Kore University of Enna, Enna, Italy, [4] Psychology Department, Üsküdar University, Istanbul, Turkey

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***Correspondence:**
Eli Somer
somer@research.haifa.ac.il

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 26 July 2020
Accepted: 30 September 2020
Published: 02 November 2020

Citation:
Somer E, Abu-Rayya HM, Schimmenti A, Metin B, Brenner R, Ferrante E, Göçmen B and Marino A (2020) Heightened Levels of Maladaptive Daydreaming Are Associated With COVID-19 Lockdown, Pre-existing Psychiatric Diagnoses, and Intensified Psychological Dysfunctions: A Multi-country Study. Front. Psychiatry 11:587455. doi: 10.3389/fpsyt.2020.587455

The COVID-19 pandemic has been spreading globally since December 2019, bringing with it anxieties, mortal risk, and agonizing psychological suffering. This study aimed to explore the relationship between maladaptive daydreaming (MD)—an addictive mental behavior to vivid fantasy associated with distress and functional impairment—and forced COVID-19 pandemic-related self-isolation and quarantine. Previous literature indicated that individuals employ MD for the regulation of distress and boredom, wish fulfillment, and entertainment experiences. The literature on the impact of the COVID-19 pandemic on mental health identifies a flareup in psychological difficulties in the general population. In this study we explored the associations between the pandemic threat and mental health indices among individuals with MD. We surveyed 1,565 adults from over 70 countries who responded to calls for participants posted in online MD communities and other general social media sites. Probable MD was determined based on an empirically derived cut-off score on a pertinent measure. After controlling for sociodemographic variables, a series of MANCOVAs, followed by *post-hoc* ANCOVAs, revealed that individuals with probable MD who were observing lockdown restrictions reported having spent more time in fantasy, experienced more intense and vivid daydreaming, and had a stronger urge to daydream than other participants. Similar statistical procedures indicated that, individuals with probable MD who reported pre-existing anxiety and depression disorders described a greater urge to daydream due to the pandemic and greater difficulty to control this addictive behavior. Compared to individuals with likely normal daydreaming, individuals with suspected MD reported more pandemic-attributed deterioration on a wide array of psychological distress indices. Our data show that the current worldwide pandemic threat is connected with an elevated intensity of this addictive form of mental activity, and that MD is associated with the exacerbation of psychological distress and dysfunction rather than with beneficial regulation of the experienced stressor.

Keywords: COVID-19, maladaptive daydreaming, fantasy, social distancing, self-isolation, quarantine

INTRODUCTION

The COVID-19 Threat

The coronavirus disease 2019 (COVID-19) outbreak has evolved into a major global public health threat. According to the World Health Organization (WHO), as of 15 October 2020, 38,002,699 confirmed cases and 1,083,234 deaths have been reported in 216 countries and territories (1). The reported medical symptoms of COVID-19 are mostly respiratory and typically involve a dry cough, fever, fatigue, and loss of appetite, smell, and taste (2). Some patients develop acute respiratory distress syndrome that can become fatal in the most severe cases (3). COVID-19 has also been shown to affect other tissues, including the central nervous system (4–6). The coronavirus spreads mainly through respiratory droplets produced when an infected person coughs, sneezes, or talks. These droplets can land in the mouths or noses of people who are nearby, may be inhaled into the lungs or transferred to the facial cavities by touch with a contaminated hand. Spread is more likely when people are in close contact with one another, within about six feet or about two meters (7).

To break the chain of transmission of the coronavirus, the WHO has issued specific hygiene and social distancing guidelines (8) that have been implemented in most countries. In an attempt to minimize physical contact among people, many governments moved to close all places of socializing such as restaurants, bars, cafes, malls, theaters, and fitness centers, and even stopped public transportation. As the contagion rates peaked, authorities in numerous localities enforced a lockdown—a more stringent step involving a complete stoppage of any sort of public movement except essential services—a step that was escalated sometimes into a curfew, in anticipation of family gatherings during major holidays (9). Social distancing measures have included: (1) *self-quarantine*, a procedure imposed on individuals arriving from a country that has reported cases of coronavirus, or suspect they might have been infected by a COVID-19 positive person, and consequently have had to avoid human contact for 14 days while being observed for signs of the illness; and (2) *isolation* for those who have been tested positive or have developed symptoms. At the peak of the outbreak, when data for the study was collected, large portions of the population in most countries were forced to practice self-isolation under government lockdown orders.

Psychological Consequences of COVID-19 on the General Population

The consequences of globally imposed precautionary measures of involuntary social distancing on mental health are complex. Community lockdown and broad compulsory isolation of citizens in the face of a mortal threat can generate a broad sense of existential uncertainty leading to a deterioration of health indices (10) impulsive shopping (11), and posttraumatic distress (12, 13). This can be intensified if extended family members need to be separated, and by uncertainties about disease spread and at-risk groups, an insufficient supply of elementary essentials, economic losses, ambiguous communications by the government (14–16), and rumors circulating in the social media (17).

Up to 38% of the general population affected by the pandemic restrictions seem to have experienced psychological distress (18). Individuals impacted by the COVID-19 threat may experience intense fear and anxiety (19) due to uncertainty about their state of health and develop obsessive-compulsive symptoms, such as repeated disinfecting, handwashing, and temperature checks (20), sleep disturbances (21), phobic anxiety and interpersonal sensitivity (22), and posttraumatic distress. Research indicates a positive correlation between the intensity of these outcomes and the duration of quarantine (23, 24).

The post-lockdown psychological effects include socioeconomic concerns and psychological symptoms associated with financial damages (14). Furthermore, stigmatization and societal rejection of quarantined and infected individuals have manifested in avoidance, suspicion, and discrimination (14). A recent meta-analysis indicated that the pooled prevalence of anxiety and depression in COVID-19 affected areas were 33% (95% confidence interval: 28–38%) and 28% (23–32%), respectively (25), illustrating the widespread morbid mental health consequences of the pandemic.

Psychological Consequences of COVID-19 on Individuals With Pre-existing Mental Health Conditions

During periods of community threat, people with mental health disorders in general, and anxiety disorders in particular, are more vulnerable to a decline in their mental well-being (26). Individuals with pre-existing psychiatric disorders have a higher susceptibility to stress and therefore, could react more intensely to the COVID-19 threat, resulting in relapses or worsening of the pre-existing mental health problems (27). Indeed, persons with both preexisting physical and mental health conditions showed higher levels of anxiety (28) and depression following the pandemic declaration with the disease threat having a more distressing effect among patients with affective disorders (29–31). Gobbi et al. (32) demonstrated the significant worsening of psychiatric conditions as a result of the COVID-19 pandemic in a global sample of psychiatric patients. At least 50% of the assessed psychiatric patients showed elevated general psychological disturbance, risk for PTSD, and depression. During the peak of the COVID-19 pandemic, when strict lockdown measures were undertaken, psychiatric patients scored significantly higher than controls on measures of posttraumatic stress, depression, and anxiety (33). More than a quarter of these patients reported PTSD-like symptoms and moderate to severe insomnia. Furthermore, mental health patients were significantly more likely to report worries about their physical health, anger, impulsivity, and suicidal ideation (33).

The evidence concerning how people cope with the mental health outcome of the coronavirus threat is scarce. Beyond adherence to social distancing recommendations, respondents in one study distracted themselves by surfing the internet, listening to music, being active in meditation and prayer, and seeking social support (34). Acceptance and self-distraction were the most frequent coping strategies among participants with disabilities and chronic conditions (35).

Substance and behavioral addictions are often utilized by individuals to regulate their emotional distress. According to Khantzian's self-medication hypothesis (36), substance addiction functions as a compensatory means to regulate emotional pain, dysphoria, anxiety, and stress, a hypothesis that was supported by empirical evidence (37). Similar support to the self-medication hypothesis has also been found for behavioral addictions, such as gambling (38) and gaming disorder (39). What is the impact of the COVID-19 threat on addictive disorders?

Psychological Consequences of COVID-19 on Individuals With Addictive Disorders

In recent commentaries scholars have expressed concerns that the current pandemic could increase the extent and severity of some addictive disorders (40–42). They suggested that the stressful measures imposed on the population to control the spread of the coronavirus could exacerbate some risk factors for the initiation, maintenance, and relapse of addictive behaviors. They also argued that the stress associated with social distancing is liable to increase the risk of resorting to substance use and behavioral addictions. Similar concerns were raised by Henry et al. (43) and McCann Pineo and Schwartz (44) who warned that the interaction of the COVID-19 pandemic with the U.S. opioid epidemic could have an overwhelming psychological impact on persons with substance use disorders.

Since broad disasters were prospectively associated with accelerations of alcohol use (45, 46), it is plausible that the current pandemic would also be linked with elevated substance and non-substance abuse (47). Accumulating evidence shows that COVID-19 distress was associated with elevated alcohol (48, 49) and other substance use (50). Experts [e.g., (27, 51)] have argued that the concept of addiction should not be restricted to the ingestion of substances. The literature suggests that behavioral addictions share several common features with substance addictions, such as natural history, phenomenology, or tolerance, supporting the inclusion of Addiction and Related Disorders in the *Diagnostic and Statistical Manual of Mental Disorders – fifth edition* [DSM-5; (52)]. This category includes non-substance-related disorders and pathological gambling. Moreover, internet gaming disorder was included in Section III of the DSM-5 as a condition for further study. Internet gaming disorder was said to originate as a coping mechanism against stress (53), and stress reduction was identified as an important motivational driver of excessive online gaming (54, 55). In a recent study, about half of the studied student sample reported that their gaming behavior had increased during the COVID-19 lockdown period and that gaming behavior was associated with examination-related stress (56). COVID-19 distress was also associated with elevated smartphone use (57), problematic gambling (58, 59) and Internet use (60).

In the current research, we wished to examine the relationship between COVID-19-related lockdown measures and a compulsive, potentially addictive, form of fantasy immersion called maladaptive daydreaming.

Maladaptive Daydreaming

Despite its rewarding properties, the emerging disorder of maladaptive daydreaming (MD) can create dependency and distress and impairs important areas of functioning (61, 62). MD can serve numerous purposes, including active self-entertainment, a distraction from boredom, fantastical wish fulfillment, and self-soothing of emotional pain (63). Previous research demonstrated that persons recovering from substance use disorder (SUD) are more prone to engage in MD, thereby suggesting that both MD and SUD may share etiological and phenomenological characteristics (64).

This form of compulsive fantasy also shares similarities with some non-substance addictive behaviors, such as internet gaming disorder. Both could be considered escapist rewarding behaviors that cause intense craving for extension and repetition (62, 65). In fact, from a biobehavioral perspective, MD is characterized by a domain-specific compulsivity that has been recently posited as the principal psychopathological feature of addictive disorders (66). People with MD (maladaptive daydreamers, MDers) can absorb themselves daily in highly vivid daydreaming episodes lasting many hours. MD is characterized by an intense sense of presence that can generate powerful emotions. To maintain their daydreaming, many MDers feel a need to employ stereotypical movements [e.g., rocking or pacing; (61)]. Because MD sometimes involves vocalizations, gesturing, and kinesthesia, many need to protect their privacy when engaging in this mental activity. Social interactions require focusing attention resources on the outside. Socializing is, therefore, incompatible with MD, which drives some individuals to seek solitude for their daydreaming behavior. COVID-19 social isolation requirements may therefore intensify MD in two possible ways. First, in line with the function of other addictions, MD may also arguably be utilized for distress regulation (63, 67). Hence, according to the self-medication hypothesis (36), MD is likely to intensify during lockdown, especially as social isolation provides MDers with greater opportunities for the privacy needed to engage in this mental activity. Second, MDers who practice social isolation are likely to have fewer social obstacles to aid them in the control of MD, consequently weakening control over their mental habit. In line with these speculations, we hypothesized that:

H1: During COVID-19, self-isolation and self-quarantine would be positively associated with increased MD indices among MDers: time spent daydreaming (DD), the intensity of DD, the vividness of DD, and urge to DD; and would impede pre-COVID-19 efforts to restrain MD.

Previous data demonstrated that MD has a high likelihood of comorbidity with several mental disorders (68). Research has shown that concurrent mental problems can increase the likelihood of any addictive behavior to arise or intensify [e.g., (69)] and that addictive disorders and mood disorders often co-occur and display a negative reciprocal process (70). The indication that MD is not a mere intense variation of normal daydreaming comes also from its association with other mental disorders. We, therefore, hypothesized that:

H2: Compared to probable MDers without pre-pandemic mental health diagnoses, probable MDers with reported diagnoses would report a greater pandemic-related urge to daydream, more time spent in DD mode, higher intensity of DD, intensified vividness of DD, and a pandemic-related impedance of their pre-COVID-19 efforts to restrain MD.

Research has linked MD with a worsening of psychosocial distress amongst MDers [e.g., (62, 71)]. If MD were a helpful coping mechanism during the current pandemic, we would expect it to be associated with improved psychological wellbeing. However, if MD is a detrimental addictive behavior, we expect it to be ineffective as a means of coping and to co-occur with a myriad of unfavorable psychological and behavioral outcomes. Assuming that MD functions like an addictive disorder, we hypothesized that:

H3: Compared to non-MDers, probable MDers would report worsened pandemic-related deterioration on a wide array of psychosocial parameters: the ability to concentrate, life satisfaction, worries about the future, obsessions, compulsive habits, social anxiety, loneliness, depression, boredom, mental exhaustion, anger, emptiness, happiness, self-worth, and ability to maintain household chores.

MATERIALS AND METHODS

Participants

Participants were recruited online. Invitations to take part in this study were posted on six English language Facebook communities, on one Italian and one Turkish Facebook community, all dedicated to MD peer support. Each MD Facebook community had between 400 and 2,000 members. Additionally, we sent email invitations to about 2,000 members of an English language MD email list. We also posted our invitation on a Reddit MD community hosting over 44,000 members. In an effort to recruit non-MDers, the authors circulated the call for participants in their own social media and email lists, asking readers to reshare the invitation. No reward was offered to participants. The sample for this study was comprised of 1,565 adults. Eight hundred seventy-two respondents (55.7%) met an evidence-based criterion for probable MD [i.e., MD = M $\geq$50 on the 16-item Maladaptive Daydreaming Scale, (68, 72)], and the rest ($n = 693$) were identified as non-MDers. MD scores of respondents with probable MD ranged between 50 and 100 ($M = 70.74$, $SD = 11.02$) and of those without probable MD ranged between 0 and 49.75 ($M = 24.22$, $SD = 14.16$). Respondents were residents of over 70 different countries (e.g., Australia, Canada, Egypt, France, Germany, Italy, Israel, Jordan, Japan, Kenya, Lebanon, Malaysia, Mexico, Morocco, The Netherlands, Norway, Philippines, Qatar, Romania, Russia, Saudi Arabia, Singapore, Spain, Sweden, Turkey, USA, UK). The countries most prevalent in our sample were the USA (22.9%), Italy (22.7%), Turkey (15.1%), UK (6.3%), and Canada (3.4%). Respondents' ages ranged between 18 and 80 years, with MDers being relatively younger than non-MDer respondents ($M = 25.52$, $SD = 8.35$; $M = 36.37$, $SD = 15.11$; respectively; $t_{(1562)} = 18.01$, $p < 0.001$). The MD and non-MD samples were predominantly female (77.9 and 75.5%, respectively). While no epidemiological data exist with regard to the sex ratio in MD, the disproportionate representation of women in our sample was in line with previous studies in the field (e.g., 65). Both groups were fairly well educated, with a tendency for probable MDers to have relatively less education compared to non-MDers ($\chi^2_{(2)} = 172.56$, $p < 0.001$). The majority of probable MDers (65.83%) have completed either a bachelor's/post-graduate's degree or were studying toward such a degree, compared to 85.71% of their controls.

Study Procedure

This study was approved by the Human Research Ethics Committee at the University of Haifa. In March 2020, the first author contacted the administrators of a large online English language MD community requesting assistance in rapidly developing a survey on the psychological sequelae of the COVID-19 pandemic among MDers. The administrators recruited 10 members of the community to serve as a focus group (73). The first author subsequently sent the group a list of possible effects of the extended social distancing measures and threats associated with the coronavirus. The original items on the suggested measure were from the literature on population reactions to threat [e.g., (12)], were based on the researcher's familiarity with MD, and were adapted to the coronavirus pandemic situation. The focus group discussed the list online over several days and provided the researchers with feedback that included modifications and suggested item additions. The final measure was designed to provide data for several studies conducted by the authors and included a few additional psychological scales.

The call for participants was posted on various online English, Italian, and Turkish MD community groups and was propagated by the researchers and the respondents on their respective social media networks. Only participants who were 18 years or older were included in the study. Potential participants were invited to visit an online informed consent form. After providing electronic consent, respondents were directed to online electronic surveys that took them between 15 and 20 min to complete. The survey was available in either English, Italian, or Turkish. Translation from the English source to Italian and Turkish was conducted by three native Italian and two native Turkish members of the research team. Data were collected between mid-April and mid-May 2020, a period in which the stay-at-home orders were still enforced globally.

Measures

Respondents completed online self-report questionnaires, which included the following measures.

Demographics

Information was sought on participants' age, gender, country of residence, and education (elementary/junior/high school, bachelor's degree/student, post-graduate degree/student).

Behaviors During the Pandemic

Respondents were asked two binary (Yes/No) questions seeking information on whether they were required to practice certain preventive measures related to the pandemic lockdown. The target practices were defined to the respondents as follows: (1) self-isolation is employed when one is sick with symptoms of COVID-19 and is told by a health care provider to separate oneself from others, including from the people in the household, to the greatest extent possible, to prevent the spread of the virus; and (2) self-quarantine is taken to prevent the spread of a contagious disease like COVID-19 by asking people who were exposed to infected others to stay at home, a hotel room or a provided accommodation, and not leave for the period required to quarantine. No visitors are allowed into the quarantined home except for people who usually live in the household.

Maladaptive daydreaming. We employed Somer et al.'s (68) 16-item Maladaptive Daydreaming Scale (MDS-16) to gauge respondents' maladaptive daydreaming. A sample item is: 'Some people feel distressed or concerned about the amount of time they spend daydreaming. How distressed do you currently feel about the amount of time you spend daydreaming?' Respondents selected their responses on an 11-point Likert scale ranging from 0 to 100%, to indicate their daydreaming level. The MDS-16 demonstrated excellent internal reliability in the present study, with Cronbach's α =0.95.

Mental Health Diagnoses

Respondents were asked to indicate one or more mental health diagnoses assigned to them previously by their mental health professional. The list included "attention-deficit/hyperactivity disorder," "social anxiety disorder," "other anxiety disorders," "obsessive-compulsive disorder," "major depression," and an open-ended "other mental health diagnoses" option.

COVID-19-Related Change in Daydreaming (DD) Indices

On a scale ranging from minus 10 (*extremely less*) to plus 10 (*extremely more*), with zero indicating the situation before the outbreak of the COVID-19 pandemic, respondents were required to rate the effects the COVID-19 pandemic on the (1) amount of time spent in DD, (2) intensity of DD, (3) vividness of DD, and (4) urge to DD.

COVID-19-Related Change in DD Control

Respondents were asked a binary (Yes/No) question about whether they were attempting to control their DD before the start of the COVID-19 pandemic. If answered in the affirmative, they were invited to indicate the degree to which the pandemic had impeded their restraining efforts on an 11-point Likert scale ranging from 0 (*not at all*) to 10 (*very much*).

COVID-19-Related Change in Psychosocial Functioning

On a scale ranging from minus 10 (*extremely worse*) to plus 10 (*extremely better*), with zero indicating the situation before the outbreak of the COVID-19 pandemic, the respondents were required to mark their current psychological condition on the following dimensions: the ability to concentrate, life satisfaction, worries about the future, obsessions, compulsive habits, social anxiety, loneliness, depression, boredom, mental exhaustion, anger, emptiness, happiness, self-worth, and ability to maintain household chores.

RESULTS

H1: Self-isolation, Self-quarantine, DD Indices, MD Control

Controlling for gender, age, and education, Multivariate Analysis of Covariance (MANCOVA), followed by *post-hoc* ANCOVAs, was used to test differences in DD indices between probable MDers who were required to self-isolate or quarantine during the COVID-19 pandemic and probable MDers who were not required to take such actions. As hypothesized, the analyses indicated that reported DD indices were higher among suspected MDers who were required to self-isolate [$F_{(4,863)} = 3.27$, $\Lambda = 0.98$, $p = 0.01$] or self-quarantine [$F_{(4,863)} = 5.23$, $\Lambda = 0.97$, $p < 0.001$]. As shown in **Table 1**, *post-hoc* ANCOVAs revealed that MDers who self-isolated or self-quarantined reported more time spent in DD, experienced intensified DD, and had a stronger vividness experience of and urge to DD.

The sub-MDer sample who were attempting to control their DD before the COVID-19 pandemic started ($n = 433$), reported that the COVID-19 pandemic impeded their restraining efforts to some degree, $t_{(431)} = 2.02$, $p = 0.044$, $M = 5.40$, $SD = 4.14$ (using the scale midpoint = 5 as a reference in the analysis). However, ANCOVA did not reveal any difference between MDers who practiced self-isolation or self-quarantine and those who did not in their perceived impediment of restraining efforts. Therefore, the hypothesized relationship between self-isolation or quarantine and impediment of pre-pandemic MD restraining efforts was not supported.

H2: Mental Health Comorbidities, DD Indices, and MD Control

Major depression was reported by 26.1% ($n = 226$) of our respondents, social anxiety disorder was reported by 23.1% ($n = 200$) of our respondents, 25.1% ($n = 217$) reported having other anxiety disorders, 16.3% ($n = 141$) of our MDer sample stated that they had attention-deficit/hyperactivity disorder, 10.3% ($n = 89$) had obsessive-compulsive disorder, and 21.8% (n = 189) reported other mental health diagnoses. The relationships between mental health comorbidities and DD indices were tested using a series of MANCOVA, where the comorbidity acted as the between-subjects factor while controlling for age, gender, and education. This was followed by *post-hoc* ANCOVAs.

The comorbidity of MD with social anxiety disorder or other anxiety disorders was associated with higher DD indices

TABLE 1 | *Post-hoc* ANCOVA results of the relationships between self-isolation/quarantine and DD indices.

	Yes (n = 326)		No (n = 546)					
	Mean	**SD**	**Mean**	**SD**	$F_{(1,866)}$	p	*95%CI*	d
Self-isolation during the COVID-19 pandemic								
Time spent in DD	5.04	4.36	4.31	4.28	4.53	0.03	0.05–1.21	0.17
Intensity of DD	4.24	4.46	3.40	4.07	7.02	0.008	0.20–1.35	0.20
Vividness of DD	3.62	4.32	2.59	4.06	11.23	0.001	0.40–1.54	0.25
Urge to DD	4.89	4.43	4.00	4.16	8.12	0.004	0.26–1.43	0.20
	Yes (n = 419)		**No (n = 453)**					
	Mean	**SD**	**Mean**	**SD**	$F_{(1,866)}$	p	*95%CI*	d
Self–quarantine during the COVID−19 pandemic								
Time spent in DD	5.14	4.22	4.07	4.36	7.47	0.006	0.22–1.35	0.25
Intensity of DD	4.32	4.07	3.15	4.32	12.11	0.001	0.44–1.56	0.28
Vividness of DD	3.60	4.20	2.40	4.10	14.64	<0.001	0.53–1.64	0.29
Urge to DD	5.02	4.26	3.70	4.21	16.84	<0.001	0.62–1.76	0.31

ANCOVA controlled for age, gender, and education; DD, Daydreaming; p, p–value; CI, Confidence interval of the difference; d, Cohen's d.

[$F_{(4,856)} = 3.10$, $\Lambda = 0.99$, $p = 0.027$; $F_{(4,856)} = 2.72$, $\Lambda = 0.99$, $p = 0.029$, respectively]. Likewise, the comorbidity of MD with major depression or other mental health diagnoses was associated with higher DD indices [$F_{(4,856)} = 4.70$, $\Lambda = 0.98$, $p = 0.002$; $F_{(4,856)} = 5.45$, $\Lambda = 0.98$, $p < 0.001$, respectively]. As shown in **Table 2**, *post-hoc* ANCOVAs revealed that higher levels of DD intensity were associated with social anxiety diagnosis and other mental health diagnoses; an increased urge to DD was associated with social anxiety diagnosis, other anxiety disorders, major depression, and other mental health disorders. All other associations were statistically non-significant. Thus, the hypothesized relationship between comorbidity and DD indices was partially confirmed.

To test the relationships between mental health comorbidities and impediment of restraining MD efforts among the MDer sample, ANCOVAs were conducted on the sub-MDer sample who were trying to control their DD before the COVID-19 pandemic started ($n = 433$). Age, gender, and education were the covariates. Those who indicated a major depression diagnosis reported that their efforts ($M = 6.40$, $SD = 3.73$) were hampered due to the pandemic [$F_{(1,421)} = 6.26$, $p = 0.01$, Cohen's $d = 0.31$], more than the impediment levels ($M = 5.20$, $SD = 4.09$) reported by those who did not have major depression. Likewise, higher levels of impeded efforts ($M = 6.22$, $SD = 3.06$) were reported by those who had other anxiety disorders [$F_{(1,421)} = 3.71$, $p = 0.049$, Cohen's $d = 0.25$], compared to the reported impediment levels ($M = 5.29$, $SD = 4.25$) by those without other anxiety disorders. Thus, the hypothesized relationship between comorbidity and MD restraining efforts was also partially confirmed.

H3: Comparisons Between MDers and non-MDers Across Psychosocial Dysfunctions

MANCOVA and a series of *post-hoc* ANCOVAs controlling for age, gender, and education were also employed here to test differences between the MDer and non-MDer groups. In support of the third hypothesis, psychosocial indicators emerged as different between the MDer and non-MDer groups, $F_{(15,1485)} = 19.50$, $\Lambda = 0.88$, $p < 0.001$. As shown in **Table 3**, MDers' self-reported ability to concentrate and life satisfaction has significantly deteriorated due to the pandemic; this was also true for MDers' worries about the future, obsessions, compulsive habits, social anxiety, loneliness, depression, boredom, mental exhaustion, anger, emptiness, and lower happiness, self-worth, and ability to maintain household chores.

DISCUSSION

Our data lent support to the first hypothesis of this study and showed that daydreaming addiction indices were higher among participants with suspected MD who adhered to the self-quarantine orders and socially self-isolated. Under lockdown, probable MDers reported a greater urge to daydream, spent more time absorbed in daydreaming, and experienced more intensified and more vivid fantasies. Regardless of their practice of social distancing, those who attempted to control their MD before the outbreak of the pandemic reported that the COVID-19 lockdown impeded their efforts to regulate their habit.

Several factors could account for why MD activity increased during the social distancing enforced at the height of the pandemic. Many people in MD communities described how the restrictive disease-containment measures affected them. Common themes were worry, distress associated with the enforced home confinement and with forced intimacy, disruption to routines, inability to distract from their urges to daydream, and boredom, indicating that their preferred way of coping with the distressing situation was MD. These themes were clearly echoed in the e-mails spontaneously sent by MDers participating in the study to the research team during data collection. It is likely that our respondents behaved along the lines of Khantzian's self-medication hypothesis (36) and resorted to their non-substance addiction to relieve the coronavirus and lockdown distress. While

TABLE 2 | *Post–hoc* ANCOVA results of the relationships between comorbidities and DD indices.

	Yes (n = 200)		No (n = 665)					
	Mean	**SD**	**Mean**	**SD**	$F_{(1,859)*}$	***P***	***95%CI***	***d***
Social anxiety disorder								
Time spent in DD	4.83	4.13	4.49	4.38	0.48	0.49	−0.43−0.91	0.08
Intensity of DD	4.31	4.10	3.50	4.26	4.67	**0.03**	0.07−1.40	**0.19**
Vividness of DD	3.39	4.11	2.83	4.20	2.02	0.15	−0.18−1.14	0.14
Urge to DD	5.19	3.90	4.13	4.31	7.91	**0.005**	0.29−1.63	**0.26**
	Yes (n = 217)		**No (n = 648)**					
	Mean	**SD**	**Mean**	**SD**	$F_{(1,859)*}$	***p***	***95%CI***	***d***
Other anxiety disorders								
Time spent in DD	4.76	4.39	4.50	4.30	0.91	0.34	−0.34−0.97	0.06
Intensity of DD	3.62	4.30	3.71	4.22	0.034	0.86	−0.71−0.59	0.02
Vividness of DD	2.97	4.31	2.95	4.15	0.014	0.91	−0.61−0.68	0.004
Urge to DD	5.06	4.10	4.15	4.27	6.61	**0.01**	0.20−1.50	**0.22**
	Yes (n = 226)		**No (n = 639)**					
	Mean	**SD**	**Mean**	**SD**	$F_{(1,859)*}$	***p***	***95%CI***	***d***
Major depression								
Time spent in DD	4.65	4.51	4.54	4.26	0.53	0.47	−0.41−0.88	0.03
Intensity of DD	4.03	4.12	3.56	4.28	2.88	0.09	−0.09−1.19	0.11
Vividness of DD	3.08	4.28	2.91	4.15	0.47	0.50	−0.42−0.86	0.04
Urge to DD	5.24	3.99	4.07	4.29	12.67	**<0.001**	0.52−1.80	**0.28**
	Yes (n = 189)		**No (n = 676)**					
	Mean	**SD**	**Mean**	**SD**	$F_{(1,859)*}$	***p***	***95%CI***	***d***
Other diagnoses								
Time spent in DD	4.60	4.62	4.56	4.24	0.53	0.47	−0.43−0.94	<0.01
Intensity of DD	4.23	4.13	3.53	4.26	5.70	**0.017**	0.15−1.51	**0.17**
Vividness of DD	3.41	4.36	2.83	4.13	3.79	0.052	−0.01−1.35	0.14
Urge to DD	5.47	4.12	4.07	4.23	17.56	**<0.001**	0.77−2.13	**0.34**

*ANCOVA controlled for age, gender, and education; DD, Daydreaming; p, p-value; CI, Confidence interval of the difference; d, Cohen's d; * there were 7 missing cases for each diagnosis. Bold values refer to statistically significant differences between the groups.*

hypothetically effective in the short run, this form of coping strategy is essentially avoidant. Avoidant coping style is associated with subsequent elevated anxiety and depression in animals (74) and humans alike (75), and can also affect a range of psychological functions among MDers, as we will demonstrate below. The documented increase in MD behavior is in line with recent data presented by Rodriguez et al. (49) who showed that psychological distress associated with the COVID-19 pandemic is consistently related to alcohol use indices. Our findings also correspond with the evidence presented by Elhai et al. (57) who showed that COVID-19 anxiety correlated positively with the severity of another escapist behavior: problematic smartphone use. In a similar vein, the lockdown, following the spread of COVID-19, was also associated with an increase in internet gaming behavior (56).

About one of every four participants in our study who was classified as a probable MD reported a prior diagnosis of major depression or an anxiety disorder. ADHD and OCD were reported by 16.5 and 10.7% respectively, and about one of every five MDers reported a prior diagnosis of another psychiatric disorder. These data support evidence from an earlier study that showed a high likelihood for MD to occur with other psychiatric disorders (68).

In support of our second hypothesis, we also found that probable MDers with reported major depression and those with reported anxiety disorders experienced an increase in MD indices and more difficulties in controlling their behavioral addiction due to the pandemic. From this perspective, MD with co-occurring mental health problems seem to behave like substance use disorders with comorbidities. For example, Najt et al. (76) reviewed the literature and reported poorer outcomes for substance use disorders with co-occurring mood disorders. Compared with the community sample, individuals with dual diagnoses reported more addictive behavior problems, engaged in more substance use to cope, experienced higher relapse rates, experienced more negative life (77), and subsequently incurred higher psychiatric treatment costs (78).

From a biological perspective, the link between MD and psychiatric comorbidities might be associated with an increased default mode network activation. Neuroimaging studies showed

TABLE 3 | *Post-hoc* ANCOVA results of the MDers and non-MDers' differences in worsened psychosocial indicators due to the COVID-19 pandemic.

	MDers (n = 838)		Non-MDers (n = 666)					
	Mean	**SD**	**Mean**	**SD**	$F_{(1,1499)^*}$	p	**95%CI**	d
Ability to concentrate	−3.41	4.35	−1.28	4.42	45.14	<0.001	−2.21– −1.21	0.49
Life satisfaction	−3.28	4.64	−1.28	4.66	22.36	<0.001	−1.80– −0.75	0.43
Future worries	−2.19	5.97	−0.12	5.05	53.08	<0.001	−2.99– −1.72	0.37
Obsessions	−1.64	4.45	0	3.18	54.47	<0.001	−2.15– −1.25	0.42
Compulsive habits	−1.43	4.09	−0.55	3.28	19.95	<0.001	−1.31– −0.45	0.24
Social anxiety	−0.88	5.12	−0.31	4.28	5.23	0.019	−1.20– −0.11	0.12
Loneliness	−1.98	5.60	−1.05	4.74	5.09	0.024	−1.29– −0.09	0.18
Depression	−2.18	4.76	−0.32	3.97	40.07	<0.001	−2.14– −1.13	0.42
Boredom	−1.75	5.66	−0.09	5.03	22.35	<0.001	−2.10– −0.87	0.31
Mental exhaustion	−2.44	5.79	−0.42	4.36	46.92	<0.001	−2.67– −1.48	0.39
Anger	−0.93	4.21	−0.26	3.83	7.99	0.005	−1.13– −0.20	0.17
Emptiness	−2.16	5.24	−0.27	4.27	36.19	<0.001	−2.25– −1.14	0.40
Happiness	−1.79	4.19	−0.40	3.85	24.39	<0.001	−1.63– −0.70	0.35
Self-worth	−2.36	4.69	0.27	4.10	69.13	<0.001	−2.66– −1.64	0.60
Household chores' Maintenance ability	−1.38	4.92	1.82	4.22	110.58	<0.001	−3.35– −2.30	0.70

*ANCOVA controlled for age, gender, and education; MDer, Maladaptive Daydreamer; p, p-value; CI, Confidence interval of the difference; d, Cohen's d; each indicator was measured on a scale ranging from minus 10 to plus 10, with zero indicating the situation before the outbreak of the COVID-19 pandemic; *there were 1,509 valid list wise cases used by MANCOVA and post-hoc ANCOVAs, 34 and 27 list wise missing cases in the MDer and non-MDer groups, respectively; the distribution mode for each of the variables in the non-MDers group is zero.*

that daydreaming is associated with the brain's default mode network [DMN, (79)]. Connectivity and activity alterations in this neural network was also linked to several psychiatric disorders such as depression (80). Future research should investigate if MDers with a comorbidity of depression are more susceptible to engage their DMN during psychological stress.

During the pandemic lockdown and compared to the comparison group, probable MDers reported a significant deterioration in a wide array of psychological indices. Compared to the pre-lockdown period, probable MDers experienced more concentration difficulties, lower life satisfaction, more worries about the future, and more obsessions, compulsive habits, social anxiety, loneliness, depression, boredom, mental exhaustion, anger, emptiness, as well as lowered happiness, decreased self-worth, and impaired ability to maintain household chores. These findings provide further evidence that MD is a mental disorder with typical psychopathological hallmarks of distress and dysfunction. The unfavorable MD outcome resembles that of known escapist behavioral addictions. For example, internet gaming addiction, a fantasy-based escapist habit, was related to lowered academic performance, decreased self-confidence, and lowered self-esteem (81). Pathological internet use, in general, was linked with social withdrawal, self-neglect, and family problems (82), while gambling disorder was linked with stress-related medical conditions, lower work productivity, strained social relationships, guilt, shame, depression, anxiety and, substance use (83).

Some study caveats should be acknowledged. First, while our study recruited a large international sample, generalizability of the findings cannot be ascertained due to sampling limitations. Second, although our questions required respondents to assess psychosocial change in comparison to pre-pandemic times, thereby providing us with information about change, the cross-sectional design of the study limits our ability to infer causal relationships among the measured variables. Third, as measured by Cohen's *d*, the strengths of the relationships between the study variables were moderate to small. Lastly, the timely performance of clinician-administered diagnostic interviews to accurately identify MDers was prohibitive in our very large study sample. Therefore, our study is limited by resorting to an empirically derived benchmark to identify probable MDers.

CONCLUSIONS

This study contributes to the understanding of a newly emerging construct of MD as a behavioral addiction to fantasy and absorption. We showed that MD displays similar characteristics and stress outcomes to those observed in other substance and non-substance addictions. We further demonstrated that although MD may have its origins as a normal, entertaining, and seemingly harmless form of coping, its intensified activation in the face of a major stressor resulted in a marked deterioration in a wide range of psychosocial functions. The ability to test this mental habit under real-time stress provided us with a rare opportunity to employ an objective stressor, rather than relying on the respondents' memory and its inherent biases. The current study also provides further evidence on the adverse mental health effects of the coronavirus pandemic, an unprecedented existential threat to humanity. One immediate implication derived from the current research is that mental health professionals should screen for MD to prevent a possible worsening of this addictive mental behavior and the flareup of resultant psychosocial impairments. Based on the accumulating data, and in line with the recommendation of Sani et al. (84), we advocate the immediate inclusion of mental health experts in policy task forces working on the prevention of a secondary mental health pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors upon request without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Haifa Faculty of Welfare and Health Studies Committee of Ethics in Human Research. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ES: conception and design of the work, data collection, data interpretation, drafting the article, critical revision of the article, and final approval of the version to be published. HA-R: conception of the work, data collection, data analysis and interpretation, drafting the article, critical revision of the article, and final approval of the version to be published. AS: conception of the work, data collection, data interpretation, and critical revision of the article. BM: conception of the work, data collection, data interpretation, and critical revision of the article. RB, EF, BG, and AM: conception of the work, data collection and entry. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

CASE REPORT
published: 19 November 2020
doi: 10.3389/fpsyt.2020.594816

Can Kratom (*Mitragyna speciosa*) Alleviate COVID-19 Pain? A Case Study

Antonio Metastasio[1,2], Elisabeth Prevete[3], Darshan Singh[4], Oliver Grundmann[5], Walter C. Prozialeck[6], Charles Veltri[7], Giuseppe Bersani[3] and Ornella Corazza[1,3]*

[1] School of Life and Medical Sciences, University of Hertfordshire, Hatfield, United Kingdom, [2] NHS Camden and Islington Trust, London, United Kingdom, [3] Department of Medico-Surgical Sciences and Biotechnologies, Sapienza University of Rome, Rome, Italy, [4] Centre for Drug Research, Universiti Sains Malaysia, Minden, Malaysia, [5] Department of Medicinal Chemistry, College of Pharmacy, University of Florida, Gainesville, FL, United States, [6] Department of Pharmacology, Midwestern University, Downers Grove, IL, United States, [7] Department of Pharmaceutical Sciences, Midwestern University, Glendale, AZ, United States

Among the symptoms of COVID-19 fever, general malaise, pain and aches, myalgia, fatigue, and headache can affect the quality of life of patients, even after the end of the acute phase of the infection and can be long lasting. The current treatment of these symptoms, also because COVID-19 patients have been asked not to use non-steroidal anti-inflammatory drugs (NSAIDs), in particular ibuprofen are often unsatisfactory. Among the above mentioned symptoms malaise and fatigue seem the most difficult to treat. In this case report we describe the use of kratom (*Mitragyna speciosa*) by a patient with confirmed COVID-19 infection. What we observed was a fast and sustained relieve of the above mentioned symptoms.

Keywords: COVID-19, kratom, opioid, stimulants, new psychoactive substances, new treatments, long covid

OPEN ACCESS

Edited by:
Carlos Roncero, University of Salamanca, Spain

Reviewed by:
Christian P. Müller, University of Erlangen Nuremberg, Germany
Anahita Bassir Nia, Yale University, United States

****Correspondence:***
Antonio Metastasio
antonio.metastasio@gmail.com

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *14 August 2020*
Accepted: *27 October 2020*
Published: *19 November 2020*

Citation:
Metastasio A, Prevete E, Singh D, Grundmann O, Prozialeck WC, Veltri C, Bersani G and Corazza O (2020) Can Kratom (Mitragyna speciosa) Alleviate COVID-19 Pain? A Case Study. Front. Psychiatry 11:594816. doi: 10.3389/fpsyt.2020.594816

BACKGROUND

Viral infections, including the current COVID-19 pandemic, are often associated with fever, general malaise, pain, and aches (1, 2). Of these, fever (98%), cough (76%), dyspnoea (55%), myalgia or fatigue (44%), headache (8%), and haemoptysis (5%) are commonly noted (2). These infections, therefore, even in the milder and non-life threatening forms, can significantly affect the quality of life. Among the various peculiarities of the COVID-19 infection concerns have been raised about the use of non-steroidal anti-inflammatory drugs (NSAIDs), in particular ibuprofen, which at first seemed to worsen the illness, although further studies have disproved this concern (3). As a consequence, several regulatory agencies, including the European Medicines Agency (EMA), at first expressed concerns about its use, as it may deprive patients of an effective treatment for fever and pain with the exception of paracetamol/acetaminophen (3). The debate about NSAID safety is still open. At the beginning of the pandemic, ibuprofen was hypothesized to increase the risk of severe adverse events in COVID-19 patients and a link between NSAIDs and angiotensin-converting enzyme (ACE) 2 receptors upregulation was suggested to be involved (4). Further, Micallef et al. (5) reported that some preclinical evidences, such as immunomodulatory effects or antibiotics efficacy reduction, would support a possible link between NSAIDs and complications in COVID-19 patients. However, data about NSAIDs use in COVID-19 is still inconsistent. In fact, some authors suggested that NSAIDs should be avoided in COVID-19 (6, 7) and others reported that NSAID use has been associated with worse outcomes (4). At the same time, other authors highlighted that evidence about the worsening of COVID-19 symptoms by ibuprofen is lacking (8, 9) or only suggested to be prudent in the prescription (10).

Up to date it is possible to say that there is not an unique point of view and the controversial NSAIDs use in COVID-19 is still discussed (8), with recently a positive insight on ibuprofen in COVID-19 disease (11). As consequence there has been a drop in ibuprofen sales (as reported by Glaxo Smith Kline–GSK) in the second quarter of 2020 (12). Considering the burden that COVID-19 infection is imposing to the world population (both in the acute phase and in the so called "*long COVID*") we thought important, therefore, to consider also other treatments that could expand our pharmaceutical armamentarium that could alleviate the symptoms of COVID-19 Infection.

In this case report we describe the use of kratom (*Mitragyna speciosa*), a plant used in traditional medicine in South-East Asia for its therapeutic benefits in self-managing opioid dependence and withdrawal, psychological disorders (e.g., anxiety and depression), and chronic pain (13, 14), and to successfully alleviate COVID-19 related symptoms. Kratom contains more than 40 alkaloids (15, 16), though the majority of its pharmacological properties appear to be related to two of the active compounds: mitragynine and its metabolite 7-hydroxymitragynine (17–19). Kratom is reported to have opioid and non-opioid like effects. In traditional settings in Malaysia and Thailand, rural folks traditionally use kratom as a remedy to treat common health maladies, and kratom consumption practice/tradition do not seem to cause any significant health problems (20–22).

The results of several anonymous online surveys have indicated that the use of kratom products may be useful for the self-treatment of acute and chronic pain (23–25), and in fact, its use is only self-reported to be associated with few adverse effects. Findings from a recent clinical trial confirmed the analgesic properties of kratom in healthy volunteers lasting for approximately 2 h with average blood concentrations of mitragynine at 2,000 ng/mL (26). These results suggest that kratom has the potential to be used as a centrally acting herbal analgesic.

Although kratom is reported to be used as a safe substitute to opioids in self-managing pain, dependence and withdrawal (23–25), it is not free from adverse effects and risks. Kratom dependence has been reported if the product is used in larger quantity over a prolonged period, and negative effects such as sleep problems, depressed mood, diarrhea, and flu-like symptoms including muscle and joint pain can develop with sudden withdrawal (27). Fatalities involving kratom are rare and, autopsy findings indicate that in such instances kratom is concurrently used with illicit substances or anti-depressants, and not kratom *per se*, or the user had an underlying health condition (28, 29). So far, there have been no reports specifically on fatal kratom overdose incidences (30).

We are aware, however, that there is a lack of robust data about kratom efficacy in humans, to the best of our knowledge there is only one randomized controlled trial that would give some support to kratom's therapeutic potential in pain. Most of the information available today are the results of surveys and of retrospective studies, in which users claim Kratom's efficacy in treating acute and chronic pain of different etiologies (23, 24). Other conditions that appear to benefit from kratom are headache (24, 25), back, neck and muscle pain (24, 25), fibromyalgia, arthritis (including autoimmune ones like rheumatoid arthritis), autoimmune disorders like multiple sclerosis (13, 25), and other severe conditions like cancer and chronic inflammatory diseases (25). Some autheors have therefore speculated that kratom has a role in the Central Nervous System (CNS) but also as anti-inflammatory (31–33), muscle relaxant (34).

Despite the potential therapeutic benefit, kratom has also severe side effects, that should be always considered when suggesting or only considering a treatment with kratom (35). Among the most severe side effects have been described kratom associated hepatitis (36–39), seizures and coma (40, 41), hypogonadism (42), hypothyroidism (43), posterior reversible leukoencephalopathy (44), fatalities (29, 45) and overdoses (46, 47). It is important to underlie, however that most of these events were described mainly in the US and Europe (where Kratom was recently introduced), with a majority of the reported deaths involving the presence of other substances (29), such as benzodiazepine, opioids, antidepressant or antipsychotic agents, alcohol or other substances, e.g., Datura stramonium, cannabinoids, amphetamines (40, 45, 48–51), and other contaminant such as O-desmethyltramadol (52).

There is growing evidence, however, that kratom is safer if used as pure kratom products or brewed herbal decoction in small doses and for a limited period of time. It should be avoided the consumption of large amounts (more than 15 grams per dose) and high frequencies (more than 3 times/day for extended periods of time) because the risk of developing dependence. Several cases have been reported in both Western (53–55), including cases of neonatal abstinence syndrome (56, 57), and Eastern countries (27, 58, 59), where those who used kratom for a long time experienced both physical (e.g., constipation) and psychological (e.g., anxiety) withdrawal symptoms. More recently an article have been published by Muller et al. (60) in which an individual self-prescribing kratom for pain treatment reported an escalation of the dosage needed and eventually developed a dependence.

Considering the conflicting evidence and the paucity of randomized control studies the balance between kratom benefits and risks is not clear yet, but some data suggested that kratom may cause less issues compared to opioids as well as retrospective data showed that kratom reduced the prevalence opioid adverse effects in users (24) and among illicit opioid users (61).

CASE REPORT

Case Presentation

The subject of this report is a 29 year old male, US citizen of Palestinian descent, who works full-time as a biomedical research technician. His health history is unremarkable, except for the fact that at age 16 he was diagnosed with ulcerative colitis and primary sclerosing cholangitis. Since then, he has been treated successfully with mesalamine (1.2 g, 2 times per day), azathioprine (50 mg, 3 times per day), and ursidiol (300 mg, 2 times per day). The subject has been able to live an active lifestyle and participate in a variety of sports including running, weightlifting, basketball, and baseball. The subject denies any history of smoking or use of alcohol, opioids, or illicit drugs. On April 22, 2020, the subject's father, who lives in the same house as the subject, and works for a major shipping company, was diagnosed with COVID-19. This was about 2 months after the first case of COVID had been confirmed in his state of residence, which was one of the early active zones of COVID-19 transmission in the US. On April 25, the patient began to experience general malaise and fatigue. Over the next 24 h, the symptoms worsened to include severe fatigue and weakness, loss of appetite, tiredness, slight dry cough, body aches, muscle pain, loss of taste and smell, sore throat and fever. The patient was then seen by his general practice physician. Vital signs at the time of examination were BP 110/72, pulse 97 BPM, respiration 14 per minute, oxygen saturation 98%, and body temperature 101.7°F. The patient was given a naso-pharyngeal swab, real-time RT-PCR test [COBAS (R) SARS-COV-@ test, Labcorp Laboratories, South Bend, IN] that confirmed a diagnosis of COVID-19. In compliance with standard medical practice standards, the patient was ordered to self-isolate and to start a 5-day course of azithromycin (250 mg, daily), and to also take 1 g of paracetamol (acetaminophen) every 6 h for treatment of pain and fever. Despite good adherence to the recommended treatment, the symptoms other than fever, did not improve, and he also started to feel depressed, demotivated, and spend long periods in bed. During this period, the patient experienced ongoing generalized myalgia and musculoskeletal pain. He described the pain as persistent and relatively severe (rated 7 on a scale of 1–10). Because of this discomfort, after 4 days the patient decided to consume kratom to relieve his symptoms. According to the patient, he had first used kratom 14 months earlier before his COVID-19 infection. He used kratom sporadically (no more than 4–5 times in total) as a cognitive enhancer and not to self-treat pain.

Treatment

The patient decided to take 2.5 gms (or grams) of green kratom (as ground leaf powder suspended in water). The product was purchased at a local shop in April 2020 sold under the name "Green Bali." After 30 min, he noticed a significant improvement in the intensity of the physical symptoms (mainly pain and fatigue), and within 60 min he felt a sensation of mild euphoria and well-being that lasted for about 5 h. After 6 h following consumption the effects of kratom wore off, and the patient administered another dose. He used kratom three times a day continuously for 3 days (for a total of 9 doses of 2.75 g each) with significant benefit.

Outcome

When asked to score from 0 to 100% the improvement that kratom had on COVID-19 symptoms: fatigue and weakness (80% improvement), tiredness (70% improvement), body aches (80% improvement), muscle pain (90% improvement, "much better than paracetamol/acetaminophen"). The kratom did not seem to have an impact on: fever, cough, or sore throat. The patient also stated: "I didn't have anxiety or any psychological symptoms. For me, kratom mainly gave improvement in physical reaction." "It also elevated my mood and made me feel less miserable, to the point where I was able to get out of bed, shower, look at work emails without feeling completely exhausted and drained"; "Kratom helped me more than antibiotic"; "I slept better, I essentially fell asleep immediately. Without kratom, sleep was not nice, with kratom less wake ups, about 6 h." Over the next 2 weeks the patient's symptoms gradually subsided and on May 13 he had a televisit with his physician and a follow-up swab test that was negative for COVID-19. The subject was able to end his quarantine and return to work in early June. In a follow-up interview with us, the patient reported that he did not experience any side effects from using kratom, except for a very bad taste when swallowing it. The patient was also able to discontinue kratom use immediately without any evidence of physical or psychological withdrawal symptoms. The patient also informed us that he still had some of the kratom product that he had taken and he agreed to provide us with a sample for chemical analysis.

Kratom Sample Analysis

An established quantitative liquid chromatography mass spectrometry method was conducted (62) and found that the sample obtained from the patient is kratom due to the presence of mitragynine (102 mg/g kratom powder) and 7-hydroxymitragynine (0.8 mg/g kratom powder). The extracted kratom sample was analyzed for the presence of 13 opioids and 8 benzodiazepines by comparing the chromatograms to those of the reference mixtures Pain Management Multi-component Opiate Mixture-13 solution and Benzodiazepine Multi-component Mixture-8 solution. These data suggest the sample was not fortified with 7-hydroxymitragynine and there was also no evidence of adulteration with opioids or common benzodiazepines in the sample.

DISCUSSION

To the best of our knowledge, this is the first case report that aims to highlight the use of kratom in alleviating COVID-19 infection related symptoms, and pain. Our findings show that short-term kratom use has the potential to alleviate COVID-19 infection symptoms, primarily pain, and did not seem to cause any physical and psychological withdrawal symptoms when kratom was discontinued after short-term use.

Kratom is an evergreen plant indigenous to Southeast Asia. Historically, kratom is a widely used folk remedy or traditional medicine. Kratom prominence grew a decade ago in Europe and the US, when it was chiefly used for its unique medicinal properties in self-managing pain, infections, opioid dependence and withdrawal (25, 63).

The antinociceptive action depends on mitragynine pharmacology: the compound acts as a partial G-protein biased agonist of mu opioid receptors (64, 65), and also as an agonist at other receptors (serotonin, adenosine-2a, dopamine-2, postsynaptic alpha-2 adrenergic) (17, 66). The antinociceptive effects of mitragynine have been studied in animal models

(18, 67, 68), and human data, derived mainly from surveys or retrospective studies in users, clearly shows that kratom is used for pain relief and to improve mood (23, 24). The exact dose-response relationship is still unknown, but an average daily consumption of 76.3–114.8 mg of mitragynine (equivalent to 3.5 glasses of kratom tea/ juice) seems to be well-tolerated among users in traditional settings (69).

COVID-19 is a global emergency, and most of the clinical trials and research are dedicated to find effective treatments against the virus and the consequences of the infection. However, like many other viral and bacterial infections, COVID-19 infection is also associated with pain, aches and malaise and usually has a negative impact on the quality of life of patients. The current treatment for these symptoms is based mainly on paracetamol and/or NSAIDs. These compounds, however, are not always effective or sometimes should be avoided. It is necessary therefore to consider alternative and more effective treatments that can provide immediate reprieve from COVID-19 infection.

As far as we know, this is the first case report that aims to indicate the potential benefit of using kratom to mitigate COVID-19 related symptoms, as well as pain. Previous case reports mainly reported about the negative effects of kratom consumption that were linked to adverse events such as dependence/withdrawal syndrome, hepatic toxicity, seizures (35, 40), and fatalities (29). A majority of the reported cases involve other substances that cast doubt on the causative contribution of kratom to the adverse outcome. However, the consumption of large amounts (more than 15 g per dose) and high frequencies (more than 3 times/day for extended periods of time) of kratom is ill advised, and can increase the risk of adverse effects. Adverse effects are rarely observed with the consumption of pure kratom products or brewed herbal decoction in different doses and frequencies among users in traditional settings. Though findings from numerous studies continue to support kratom's therapeutic potential chiefly for pain relieve, at this juncture, there is no solid scientific evidences to prove its utility. More controlled clinical studies are needed to identify the pharmacological properties, safety of kratom doses, and its efficacy with the current standard treatment for pain relieve.

We think there is a promising scope for future studies in the field. However, we believe that there is a need for a series of clinical trials to identify the safe dosage and pharmacology of mitragynine, monitor, and identify potential side effects of long-term kratom use, and eventually consider a double blind randomized clinical trial to compare its efficacy with the present standard pain relieve treatment.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR'S NOTE

We confirm that this work is original and has not been published elsewhere, nor it is currently under consideration for publication elsewhere. It is the output of a collaborative effort among the School of Life and Medical Sciences—University of Hertfordshire (United Kingdom), NHS—Camden and Islington Trust (United Kingdom), Sapienza University of Rome (Italy), Center for Drug Research—Universiti Sains Malaysia (Malaysia), Department of Medicinal Chemistry, College of Pharmacy—University of Florida (United States), Department of Pharmacology, Midwestern University (United States), and Department of Pharmaceutical Sciences—Midwestern University (United States). This publication arises from collaborative activities and staff exchanges among collaborating institutions.

AUTHOR CONTRIBUTIONS

AM prepared the original first draft of the manuscript and interviewed the patient with EP and OC. WCP recruited the patient. EP, DS, GB, OG, and WCP contributed to the literature review and the case study analysis. CV carried out the toxicological analysis. OC coordinated all the activities and the preparation of the manuscript. All authors collaborate to the manuscript writing — review and editing.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 25 November 2020
doi: 10.3389/fpsyt.2020.577135

COVID-19 Related Distress Is Associated With Alcohol Problems, Social Media and Food Addiction Symptoms: Insights From the Italian Experience During the Lockdown

*Angelo Panno, Giuseppe Alessio Carbone, Chiara Massullo, Benedetto Farina and Claudio Imperatori**

Cognitive and Clinical Psychology Laboratory, Department of Human Science, European University of Rome, Rome, Italy

OPEN ACCESS

Edited by:
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***Correspondence:**
Claudio Imperatori
claudio.imperatori@unier.it

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 28 June 2020
Accepted: 29 October 2020
Published: 25 November 2020

Citation:
Panno A, Carbone GA, Massullo C, Farina B and Imperatori C (2020) COVID-19 Related Distress Is Associated With Alcohol Problems, Social Media and Food Addiction Symptoms: Insights From the Italian Experience During the Lockdown. Front. Psychiatry 11:577135. doi: 10.3389/fpsyt.2020.577135

Background: Several scholars hypothesize that one of the most negative impacts of the coronavirus disease 2019 (COVID-19) crisis would concern the increase of prevalence and severity of both substances and behavioral addiction. Despite the general concerns about the increase of prevalence and severity of addictions related to the COVID-19 emergency, few data are still available. Thus, the main aim of this study was to investigate the association between COVID-19 related distress and: (i) alcohol problems, (ii) social media addiction (SMA) symptoms, (iii) food addiction (FA) symptoms.

Methods: A national online-survey was carried out during the Italian lockdown (i.e., 9 March 2020–4 May 2020). In the current study, 1,519 participants (365 men and 1,154 women, mean age: 28.49 ± 10.89 years) were included. The survey included socio-demographic related items (e.g., age, sex, residential regions, education level, civil status, tobacco use, etc.), as well as *ad-hoc* developed questions aimed to investigate COVID-19 related variables (e.g., isolation/quarantine, personal diagnosis to COVID-19, friends or relatives with COVID-19 diagnosis, etc.). Participants also completed the following self-report measures in order to investigate: the psychological impact of COVID-19, alcohol problems, SMA symptoms, FA symptoms, and impulsivity.

Results: The psychological impact of COVID-19 was independently associated with alcohol problems ($\beta = 0.058$, $p = 0.043$), SMA symptoms ($\beta = 0.259$, $p < 0.001$), and FA symptoms ($\beta = 0.150$, $p < 0.001$).

Conclusion: Taken together, our results seem to confirm the general concerns about the negative impacts of the COVID-19 emergency on addictive behaviors, suggesting that this issue should be carefully monitored.

Keywords: COVID-19 related distress, problematic alcohol use, social media addiction, food addiction, impulsivity, lockdown

INTRODUCTION

The coronavirus disease 2019 (COVID-19) outbreak is a global health crisis currently (i.e., 05th November 2020) involving 190 nations with more than 48,450,000 confirmed cases and over 1,220,000 deaths around the world (1). This emergency is radically affecting our everyday life with serious consequences from the economic, health and psychosocial perspectives. The sudden development of the epidemic makes it necessary for timely research data to inform clinicians' interventions and policy-makers' decisional processes.

The adverse impacts of the COVID-19 outbreak on mental health concern are not only relevant to frontline staff working in a high-stress environment (2, 3) but also to millions of people forced into isolation (4, 5). A recent meta-analysis on 33,062 healthcare workers reported a prevalence of 22.8% for depression, 23.2% for anxiety symptoms and 38.9% for insomnia during the COVID-19 outbreak (6). Similarly, in response to the problems posed by the pandemic, the lockdown public health strategy, reducing access to family, friends, and other social support systems, produced a general worsening of psychosocial well-being (7–11).

Scholars hypothesize that one of the most negative impacts of the COVID-19 emergency is concerned with the increased of prevalence and severity of both substance and behavioral addictions (11–15). It is well-known that individuals who are isolated and stressed, as well as much of the population during the COVID-19 emergency, frequently turn to substances or rewarded behaviors/actions (e.g., online gaming) to cope with their negative feelings (11, 12). It has been proposed (11, 16) that staying indoors for long periods may increase the risk of compulsive overeating consumption of high calorie food (i.e., foods with high sugar and/or fat), a specific clinical condition known as Food Addiction [FA; (17–20)]. Although not formally recognized in the last edition of the Diagnostic and Statistical Manual of Mental Disorders [DSM-5; (21)], several studies have shown strong biological (i.e., altered dopamine expression) and behavioral overlaps (e.g., compulsive overeating in stressful situations) between drug use and uncontrolled consumption of hyper-palatable foods (17, 18, 22).

Despite the general concerns about the increase of prevalence and severity of addictions related to the COVID-19 emergency, few data are yet available (14). For example, a prospective cohort study of 1,442 health profession students showed that internet addiction severity was associated with outbreak-related psychological distress and symptoms of acute stress reaction (23). Empirical data aimed at providing the greatest amount of information to cope with emergency situations triggered by phenomena, such as the COVID-19 pandemic are needed. A main aim of these kind of studies (e.g., large surveys at national level or longitudinal research designs) consists of shedding light on these phenomena in order to provide useful public health information that might be taken into account by policy-makers and health professionals when such emergency situations occur. On the one hand, clinicians need such information to tailor applied interventions. On the other hand, policy-makers have to take into account such information to support and stimulate clinical interventions, as well as to develop efficient policies aimed at addressing issues of public health.

The main aim of this study was to investigate the association between COVID-19 related stress and the severity of some addictions during the Italian lockdown (9 March 2020–4 May 2020), one of the first countries most affected by the pandemic. We focused on three specific types of addiction that do not entail the intake of substances considered illegal in the nation of interest for the study, because such addictions could be affected by restrictions due to lockdown (e.g., inability to leave the house for no proven reasons). More specifically, we focused on kinds of reinforcing stimuli easily available at home during the lockdown: alcohol, social media and food. In line with some reports (11–15), we hypothesized that COVID-19 related distress would be positively and independently associated with: (i) alcohol problems, (ii) social media addiction (SMA) symptoms, (iii) FA symptoms (when controlling for potential confounding variables that have been traditionally associated with addictions).

MATERIALS AND METHODS

Participants

Data here reported were part of a wider project designed to investigate the psychopathological impacts of the COVID-19. Participants completed an anonymous online survey, after reading and signed a written informed consent. The survey link, preceded by a brief description of the study aim (i.e., understanding the impact of the COVID-19 pandemic on mental health) was shared through social media (e.g., Facebook, WhatsApp, LinkedIn, Instagram), mailing lists, and personal contacts, from 30th March to 4th May 2020 (i.e., "phase one" of the pandemic emergency in Italy where the exponential curve was growing). Participants could complete the survey directly from their smartphone, tablet, or computer.

All Italian regions have been involved in the study. All participants voluntarily took the survey (i.e., they did not receive payment or compensation). This research was approved by the ethics committee of the European University of Rome (Prot. N.004/20) in line with the Helsinki declaration standards. Inclusion criteria were: (i) being resident in Italy during the lockdown, (ii) age $\geq$ 18 years, (iii) correct response to an item of attentional quality check (i.e., responding to this question "completely agree" or skip the question). The exclusion criteria were: (i) the inability to understand written Italian, and (ii) the refusal to provide written consent. The online survey was completed by 1,765 participants: 35 were excluded because they were not Italian resident, and 211 were excluded because they failed to respond to the attentional quality check item. The final sample consisted in 1,519 participants (365 men and 1,154 women, mean age: 28.49 $\pm$ 10.89 years; range 18–74). We performed a *priori* power analysis through G*Power 3.1 software (24). It indicated that, given a probability level of 0.05, a sample size of 1,100 was required to provide a satisfactory statistical power ($1-\beta = 95\%$) to also identify a potential small effect size

($f^2 = 0.02$) in a two-sided test with 7 tested predictors and 17 total number of predictors.

Materials

The survey included socio-demographic items (e.g., age, sex, residential region, education level, etc.), as well as *ad-hoc* developed questions aimed at investigating COVID-19 related variables (e.g., isolation/quarantine, personal diagnosis to COVID-19, friends or relatives with COVID-19 diagnosis, etc.). Participants were also instructed (25) to measure and accurately report their current height and weight to calculate body mass index (BMI). Based on data provided by Italian Ministry of Health (26), we assessed the number of COVID-19 infected people in the region of interest. In particular, we recorded the number of infected referred to the day before the compilation of the survey, in the specific regions where the participant lived during the lockdown. Every day at 06.00 p.m., the newscast informed the population of the number of infected people. We consider these data to estimate the psychological pressure related to the number of infected in the region of interest. There was a wide difference concerning the number of infected across the regions, thus this index provided a measure to estimate people's perceived pressure due to the spread of the COVID-19's infection. Participants also completed the following self-report measures to investigate: COVID-19 related distress, alcohol problems, SMA symptoms, FA symptoms and impulsivity. All variables considered in the study are reported in **Table 1**.

COVID-19 related distress was assessed with the 22-items of the Impact of Event Scale-Revised [IES-R; (27)], a widely-used measure investigating the current subjective distress in response to a specific traumatic event. Items scored on a 5-point Likert scale (from 0 = "not at all" to 4 = "extremely") and assessed the major symptom of post-traumatic stress disorder (PTSD): intrusion, avoidance, and hyper-arousal. The total score ranges from 0 to 88 with higher scores indicating more severe post-traumatic stress symptoms. The instructions of IES-R scale have been specifically tailored for the COVID-19 context (i.e., "phase one" of COVID-19 pandemic, which is considered the traumatic event object of the study). Higher scores indicated more severe stress-related symptoms. We used the Italian adaptation of the IES-R (28), and the Cronbach's α was 0.88. Although there is no specific cut-off score, while scores higher than 23 are considered clinically concerning (29), a total score of 33 represents the best cut-off for a probable diagnosis of PTSD (30).

Alcohol problems were investigated with the CAGE questionnaire, a screening tool composed of 4 dichotomous (1= yes; 0= no) items (31). Total score ranges from 0 to 4 with a higher score reflecting more severe problematic patterns of alcohol use. A cut-off of ≥ 2 is widely used (32) to screen problematic alcohol use (PAU). We used the Italian adaptation of the CAGE (33), and the Cronbach's α was 0.52.

Addiction-like symptoms in relation to excessive and compulsive social media use was assessed through the six-item of the Bergen Social Media Addiction Scale [BSMAS; (34)]. BSMAS items (rated on a 5-point Likert scale, 1 = very rarely to 5= very often) investigate core addiction elements (i.e., salience, mood modification, tolerance, withdrawal, conflict, and relapse) related to social media (Facebook, Instagram, etc.) use in the last 12 months (in this study, items were referred to a time period of the last 2 weeks). Higher BSMAS scores reflect higher SMA symptoms. A cut-off of ≥ 19 is thought to be the ideal threshold identifying individuals at risk of problematic social media use (35). We used the Italian adaptation of the BSMAS (36), and the Cronbach's α was 0.79.

FA was assessed with the modified Yale Food Addiction Scale Version 2.0 [mYFAS 2.0; (37)]. It is composed of 13 items, rated on an 8-point Likert scale (from 0= *never* to 7= *every day*) assessing addictive eating behaviors according to the DSM-5 criteria for substance-related and addictive disorders (37). The mYFAS 2.0. provides two scoring options: a symptom count version (scores ranging from 0 to 11) and a diagnostic version based on the last edition of the DSM criteria (21). We used the Italian adaptation of the mYFAS 2.0 (38), and the Cronbach's α in was 0.89. For

TABLE 1 | Descriptive statistics for the sample (*N* = 1519).

Variables	
Women–*N* (%)	1,154 (76.0)
Age–M ± SD	28.49 ± 10.89
North Italy–*N* (%)	521 (34.3)
Central Italy–*N* (%)	639 (42.1)
South Italy–*N* (%)	359 (23.6)
Self-reported BMI–M ± SD	23.28 ± 4.17
Married or living with partner–*N* (%)	366 (24.1)
School attainment > 13 years–*N* (%)	699 (46.0)
N COVID19-infected people *per* region–M ± SD	10,776.77 ± 15,870.47
Personal status during lockdown†	
Isolation–*N* (%)	1,171 (77.1)
Quarantine–*N* (%)	235 (15.5)
Working during lockdown–*N* (%)	113 (7.4)
Smart-working–*N* (%)	577 (38.0)
N of cohabitants during lockdown phase one–M ± SD	2.43 ± 1.39
Diagnosis of COVID-19–*N* (%)	10 (0.7)
Friends or relatives with COVID-19 diagnosis–*N* (%)	209 (13.8)
Smokers–*N* (%)	438 (28.8)
Illegal drugs use during lockdown phase one–*N* (%)	64 (4.2)
IES-R total score–M ± SD	26.63 ± 13.56
IES-R ≥ 24–*N* (%)	827 (54.4)
IES-R ≥ 33–*N* (%)	461 (30.3)
CAGE total score–M ± SD	0.31 ± 0.67
CAGE ≥ 2–*N* (%)	108 (7.1)
BSMAS total score–M ± SD	14.28 ± 4.94
BSMAS ≥ 19–*N* (%)	311 (20.5)
mYFAS 2.0 total score–M ± SD	1.41 ± 2.17
FA Diagnosis–*N* (%)	713 (46.9)
I_7 impulsiveness total score–M ± SD	6.62 ± 3.86

† "Phase one," the phase during which the exponential curve of the contagions is growing. M, mean; SD, standard deviation; BMI, Body Mass Index; COVID-19, Corona Virus Disease 19; IES-R, Impact of Event Scale-Revised; CAGE, self-report measure of alcohol use problems; BSMAS, Bergen Social Media Addiction Scale; mYFAS 2.0, modified Yale Food Addiction Scale Version 2.0.

this study, items were referred to a time period of the last 2 weeks.

Trait-impulsivity was assessed with the 19 dichotomous (yes/no) items of the impulsiveness subscale of the I_7 impulsiveness-venturesomeness-empathy scale (39). We used the Italian adaptation of the I_7 (40, 41), and the Cronbach's α was 0.79.

Statistical Analyses

All analyses were performed using the SPSS (18.0) statistical package (IBM, Armonk, NY, USA). Hierarchical multiple regression analyses were performed to investigate whether COVID-19 related variables were significant predictors of the different addictive symptoms (i.e., CAGE, BSMAS, and mYFAS total scores), when possible confounding variables were controlled for. The predictors were entered into the regression model according to the following blocks: (1) general data (i.e., gender, age, BMI, educational level, marital status), (2) possible competing predictors (i.e., impulsivity, other addictions), and (3) COVID-19 related variables. We included the following COVID-19 related variables: personal status during lockdown (i.e., isolation, quarantine or neither), diagnosis to COVID-19, friends/relatives with COVID-19 diagnosis, smart working during the lockdown, numbers of infections *per* regions, number of cohabitants during the lockdown, and the IES-R total score. The enter method was used. The associations were reported as standardized beta coefficients (β) and their p-values. We also computed zero-order correlations (see **Supplementary Table 1**) considering $r = \pm 0.1$ as small, ± 0.30 medium, and ± 0.50 large effect sizes (42).

RESULTS

In this sample, during the lockdown, 1,171 (77.1%) of the participants were in isolation and 235 (15.5%) were in quarantine. Moreover, 10 participants (0.7%) received COVID-19 diagnosis and 209 (13.8%) had a relative and/or friend(s) with COVID-19 diagnosis.

According to the IES-R cut-off scores (29, 30), there were 827 (54.4%) participants who met the criteria for clinical-level of stress-related problems and 461 (30.3%) who met the criteria for a probable diagnosis of PTSD. There were 108 participants (7.1%) who met the criteria for PAU, 311 (20.5%) who met the criteria for SMA, and 713 (46.9%) who met the criteria for a diagnosis of FA. Finally, 64 (4.2%) participants reported use of illegal drugs. Clinical and socio-demographic characteristics are reported in **Table 1**.

COVID-19 Outbreak and Alcohol Problems

The models explained between 0.003 and 0.07% of the variance (**Table 2**). In the last block, when controlling for other variables, the IES-R total score remained independently associated with CAGE total score ($\beta = 0.058$; $p = 0.043$). Although the model was significant ($F = 7.850$; $p < 0.001$), it did not increase the variance (R^2 *Change* $= 0.005$; $p = 0.332$). In the last block, male gender ($\beta = 0.090$; $p = 0.001$), being a smoker ($\beta = 0.140$; $p < 0.001$), higher impulsivity ($\beta = 0.133$; $p < 0.001$), and higher FA symptom ($\beta = 0.062$; $p = 0.028$) were independently associated with CAGE total score.

COVID-19 Outbreak and SMA Symptoms

The models explained between 14 and 29% of the variance (**Table 3**).

The last block, which included COVID-19 related variables, increased significantly the variance (R^2 *Change* $= 0.059$; $p < 0.001$), and when controlling for other variables, the IES-R total score ($\beta = 0.259$; $p < 0.001$) was independently associated with BSMAS total score. A more severe self-reported COVID-19 related distress was associated with more SMA symptoms. Personal status during lockdown (i.e., being in quarantine/isolation) was also independently associated with BSMAS total score ($\beta = -0.061$; $p = 0.018$). Female gender ($\beta = 0.055$; $p = 0.019$), age ($\beta = -0.155$; $p < 0.001$), being unmarried ($\beta = 0.076$; $p = 0.003$), and a smoker ($\beta = -0.073$; $p = 0.001$), higher impulsivity ($\beta = 0.133$; $p < 0.001$) and higher FA symptoms ($\beta = 0.173$; $p < 0.001$) were also independently associated with BSMAS total score in the last block.

COVID-19 Outbreak and FA Symptoms

The models explained between 12 and 22% of the variance (**Table 4**).

The last block, which included COVID-19 related variables, increased significantly such a variance (R^2 *Change* $= 0.018$; $p < 0.001$), and when controlling for other variables, the IES-R total score ($\beta = 0.150$; $p < 0.001$) was independently associated with mYFAS 2.0 total score. A more severe self-reported COVID-19 related distress was associated with more FA symptoms. Female gender ($\beta = 0.122$; $p < 0.001$), higher BMI ($\beta = 0.285$; $p < 0.001$), impulsivity ($\beta = 0.109$; $p < 0.001$), SMA symptoms ($\beta = 0.190$; $p < 0.001$), and alcohol problems ($\beta = 0.052$; $p = 0.028$) were also independently associated with mYFAS 2.0 total score in the last block.

DISCUSSION

The main aim of this study was to investigate the association between COVID-19 related distress and addictive symptoms (i.e., alcohol problems, SMA and FA) during "phase one" of the Italian lockdown (9th March 2020–4th May 2020). In line with previous reports on the psychological impact of quarantine (4, 43) during the lockdown, in the current sample, 54.4% of the participants self-reported a significant psychological impact of COVID-19, as assessed by the IES-R (27).

Our results seem to confirm that one of the most negative impacts of the COVID-19 emergency could be related to an increase in the prevalence and severity of both substance and behavioral addictions (11–15, 44, 45). Our data showed that the self-reported psychological impact of the COVID-19 was positively correlated (**Supplementary Table 1**) with alcohol problems (small effect size), SMA symptoms (medium to large effect size) and FA symptoms (medium effect size). At a multivariate level, when controlling for potential confounding variables that have been traditionally related to addictive disorders [e.g., impulsivity (46–48)], the IES-R remained

TABLE 2 | Hierarchical multiple regressions predicting problematic alcohol problems in all the sample (N = 1519).

Dependent variables: CAGE total score	β	p	**[95% CI]**	**Adjusted R^2**	F	**R^2 Change**	**F Change**
Block 1 independent variables				0.003	1.868^{1}	0.006	1.868
Women	−0.048	0.071	[−0.158; 0.007]				
Age	−0.037	0.243	[−0.006; 0.002]				
BMI	0.020	0.735	[−0.005; 0.012]				
School attainment > 13 years	−0.019	0.472	[−0.095; 0.044]				
Married or living with partner	−0.026	0.399	[−0.135; 0.054]				
Block 2 independent variables				0.071	12.535^{2***}	0.071^{***}	23.065^{***}
Women	−0.079	**0.003**	[−0.205; −0.042]				
Age	0.023	0.468	[−0.002; 0.005]				
BMI	−0.004	0.873	[−0.009; 0.008]				
School attainment > 13 years	0.006	0.820	[−0.060; 0.076]				
Married or living with partner	−0.018	0.550	[−0.120;0.064]				
I_7 impulsiveness total score	0.141	**<0.001**	[0.015;0.034]				
Smokers	0.139	**<0.001**	[0.130; 0.281]				
Illegal drugs use during lockdown†	0.037	0.046	[−0.044; 0.292]				
mYFAS 2.0 total score	0.070	**0.012**	[0.005; 0.039]				
BSMAS total score	0.074	**0.010**	[0.002; 0.018]				
Block 3 independent variables				0.071	7.850^{3***}	0.005	1.145
Women	−0.090	**0.001**	[−0.224; −0.058]				
Age	0.035	0.284	[−0.002; 0.006]				
BMI	−0.003	0.916	[−0.009; 0.008]				
School attainment > 13 years	0.017	0.516	[−0.046; 0.092]				
Married or living with partner	−0.018	0.543	[−0.121; 0.064]				
I_7 impulsiveness total score	0.133	**<0.001**	[0.014; 0.032]				
Smokers	0.140	**<0.001**	[0.131; 0.283]				
Illegal drugs use during lockdown†	0.036	0.164	[−0.049; 0.288]				
mYFAS 2.0 total score	0.062	**0.028**	[0.002; 0.036]				
BSMAS total score	0.055	0.063	[0.000; 0.015]				
Personal status during lockdown†	−0.018	0.478	[−0.099; 0.046]				
N of cohabitants during lockdown†	0.033	0.200	[−0.008; 0.040]				
N of COVID19-infected people *per* region	0.021	0.424	[0.000; 0.000]				
Smart-working	−0.029	0.261	[−0.111; 0.030]				
Diagnosis of COVID-19	−0.017	0.506	[−0.549; 0.271]				
Friends/relatives with COVID-19	−0.014	0.588	[−0.124; 0.071]				
IES-R total score	0.058	**0.043**	[0.000; 0.006]				

$^{***}p < 0.001$; Degree of freedom: $^{1}5{:}1509$, $^{2}10;1504$, $^{3}17;1497$; † "Phase one" the phase during which the exponential curve of the contagions is growing, β, standardized beta; CI, confidence interval. Bold values indicate significant variable.

CAGE, self-report measure of alcohol use problems; BMI, Body Mass Index; mYFAS 2.0, modified Yale Food Addiction Scale Version 2.0; BSMAS, Bergen Social Media Addiction Scale; COVID-19, Corona Virus Disease 19; IES-R, Impact of Event Scale-Revised.

independently associated with CAGE, BSMAS, and mYFAS 2.0 total scores. However, neither self-reported COVID-19 related distress, nor the other variables related to this emergency (e.g., isolation/quarantine) were significantly associated with increased CAGE total score variability. This result seems to be in accordance with the scenario supposed by Rehm et al. (13) regarding the consumption of alcohol during the COVID-19 emergency. According to a literature search focused on the impacts of past public health and economic crises on alcohol consumption, the authors hypothesized a decrease in alcohol consumption in the immediate future, followed by an increase in the medium- and longer-term future (13). Although solitary drinking among young adults appears to be associated with drinking problems (49), it is also known that the social context plays a crucial role in PAU (50). It is possible that during lockdown people were more prone to cope with their negative feelings through use of social media and consumption of high calorie food. Accordingly, it should be noted that during the "stay-at home" ordinance, engaging with social networks was the only possible way to communicate with others. Although keeping

TABLE 3 | Hierarchical multiple regressions predicting social media addiction symptoms in all the sample ($N = 1519$).

Dependent variables: BSMAS total score

	β	p	[95% CI]	Adjusted R^2	F	R^2 Change	F Change
Block 1 independent variables				0.138	49.309[1]***	0.140***	49.309***
Women	0.154	**<0.001**	[1.218; 2.341]				
Age	−0.240	**<0.001**	[−0.135; −0.082]				
BMI	0.013	0.593	[−0.042; 0.074]				
School attainment > 13 years	−0.090	**<0.001**	[−1.372; −0.416]				
Married or living with partner	−0.091	**0.002**	[−1.694; −0.396]				
Block 2 independent variables				0.236	47.841[2]***	0.101***	40.001***
Women	0.107	**<0.001**	[0.693; 1.777]				
Age	−0.191	**<0.001**	[−0.112; −0.061]				
BMI	−0.060	**0.015**	[−0.128; −0.014]				
School attainment > 13 years	−0.059	**0.011**	[−1.038; −0.133]				
Married or living with partner	−0.086	**0.002**	[−1.601; −0.378]				
I_7 impulsiveness total score	0.179	**<0.001**	[0.169; 0.290]				
Smokers	−0.078	**0.001**	[−1.359; −0.344]				
Illegal drugs use during lockdown†	−0.018	0.430	[−1.575; 0.671]				
mYFAS 2.0 total score	0.228	**<0.001**	[0.409; 0.629]				
CAGE total score	0.060	**0.010**	[0.108; 0.782]				
Block 3 independent variables				0.292	37.724[3]***	0.059***	17.897***
Women	0.055	**0.019**	[0.104; 1.172]				
Age	−0.155	**<0.001**	[−0.095; −0.046]				
BMI	−0.048	**0.045**	[−0.112; −0.001]				
School attainment > 13 years	−0.039	0.087	[−0.834; 0.057]				
Married or living with partner	−0.076	**0.003**	[−1.473; −0.291]				
I_7 impulsiveness total score	0.133	**<0.001**	[0.111; 0.229]				
Smokers	−0.073	**0.001**	[−1.289; −0.306]				
Illegal drugs use during lockdown†	−0.028	0.221	[−1.759; 0.407]				
mYFAS 2.0 total score	0.173	**<0.001**	[0.285; 0.502]				
CAGE total score	0.042	0.063	[−0.017; 0.635]				
Personal status during lockdown†	−0.068	**0.003**	[−0.178; −0.249]				
N of cohabitants during lockdown†	0.006	0.791	[−0.135; 0.178]				
N of COVID19-infected people *per* regions	0.008	0.714	[0.000; 0.000]				
Smart-working	−0.028	0.212	[−0.740; 0.164]				
Diagnosis of COVID-19	0.002	0.944	[−2.541; 2.731]				
Friends/relatives with COVID-19	−0.005	0.826	[−0.697; 0.557]				
IES-R total score	0.259	**<0.001**	[0.077; 0.111]				

****p < 0.001; Degree of freedom: [1]5:1509, [2]10;1504, [3]17;1497; †"Phase one" the phase during which the exponential curve of the contagions is growing; β, standardized beta; CI, confidence interval. Bold values indicate significant variable.*

BSMAS, Bergen Social Media Addiction Scale; BMI, Body Mass Index; mYFAS 2.0, modified Yale Food Addiction Scale Version 2.0; CAGE, self-report measure of alcohol use problems; COVID-19, Corona Virus Disease 19; IES-R, Impact of Event Scale-Revised.

social contact remotely with people reduces the psychological impacts of isolation, the excessive engagement with technology is associated with several risks, especially when used to reduce stress (15). Indeed, despite any temporary and immediate gratifying effects derived from social networking, long-term effects are potentially addictive (51) and are associated with several negative outcomes including emotional and relational problems (52).

Our results showed that COVID-19 related distress was also associated with higher FA symptoms. Similar to other rewarding stimuli, compulsive and uncontrolled overeating could reflect a dysfunctional coping strategy consisting of "comfort food" used to escape from an unpleasant state and/or to self-regulate emotions (19, 53). From a neurophysiological point of view, it has been suggested that the natural reward of highly palatable food can reduce the activity of the Hypothalamic-Pituitary-Adrenal axis and the production of cortisol (54–56). The constant repetition of this pattern could lead to neurobehavioral adaptations promoting FA (54–56).

The current study extends previous research and could provide useful information to be taken into account when

TABLE 4 | Hierarchical multiple regressions predicting food addiction symptoms in all the sample ($N = 1519$).

Dependent variables: mYFAS 2.0 total score

	β	p	[95% CI]	Adjusted R^2	F	R^2 Change	F Change
Block 1 independent variables				0.118	41.386[1]***	0.221***	41.386***
Women	0.186	**<0.001**	[0.695; 1.194]				
Age	−0.134	**<0.001**	[−0.039; −0.015]				
BMI	0.296	**<0.001**	[0.129; 0.180]				
School attainment > 13 years	−0.062	**0.012**	[−0.484; −0.059]				
Married or living with partner	−0.037	0.204	[−0.475; 0.101]				
Block 2 independent variables				0.208	40.847[2]***	0.093***	35.568***
Women	0.148	**<0.001**	[0.511; 0.993				
Age	−0.052	0.074	[−0.022; 0.001]				
BMI	0.290	**<0.001**	[0.127; 0.176]				
School attainment > 13 years	−0.028	0.235	[−0.326; 0.080]				
Married or living with partner	−0.016	0.550	[−0.358; 0.191]				
I_7 impulsiveness total score	0.129	**<0.001**	[0.045; 0.100]				
Smokers	0.043	0.077	[−0.022; 0.433]				
Illegal drugs use during lockdown†	0.026	0.266	[−0.218; 0.787]				
CAGE total score	0.060	**0.012**	[0.043;0.344]				
BSMAS total score	0.236	**<0.001**	[0.082; 0.126]				
Block 3 independent variables				0.223	26.593[3]***	0.018**	5.114***
Women	0.122	**0.001**	[0.373; 0.862]				
Age	−0.049	0.100	[−0.021; 0.002]				
BMI	0.285	**<0.001**	[0.124; 0.173]				
School attainment > 13 years	−0.024	0.320	[−0.309; 0.101]				
Married or living with partner	−0.014	0.601	[−0.346; 0.200]				
I_7 impulsiveness total score	0.109	**<0.001**	[0.034; 0.088]				
Smokers	0.039	0.106	[−0.004; 0.414]				
Illegal drugs use during lockdown	0.020	0.399	[−0.284; 0.713]				
CAGE total score	0.052	**0.028**	[0.018; 0.317]				
BSMAS total score	0.190	**<0.001**	[0.060; 0.106]				
Personal status during lockdown†	−0.009	0.693	[−0.171; 0.258]				
N of cohabitants during lockdown†	−0.010	0.681	[−0.087; 0.057]				
N of COVID19-infected people *per* regions	0.004	0.881	[0.000;0.000]				
Smart-working	−0.013	0.584	[−0.266; 0.150]				
Diagnosis of COVID-19	0.019	0.406	[−0.699; 1.727]				
Friends/relatives with COVID-19	−0.002	0.918	[−0.304; 0.273]				
IES-R total score	0.150	**<0.001**	[0.016; 0.032]				

***$p < 0.01$; ***$p < 0.001$; Degree of freedom: [1]5:1509, [2]10;1504, [3]17;1497; † "Phase one" the phase during which the exponential curve of the contagions is growing; β, standardized beta; CI, confidence interval. Bold values indicate significant variable.*

mYFAS 2.0, modified Yale Food Addiction Scale Version 2.0; BMI, Body Mass Index; CAGE, self-report measure of alcohol use problems; BSMAS, Bergen Social Media Addiction Scale; COVID-19, Corona Virus Disease 19; IES-R, Impact of Event Scale-Revised.

lockdowns were implemented. To the best of our knowledge, this is the first study shedding light on the relationship between COVID-19 related distress and different types of addictive symptoms. This research focuses on a specific class of symptoms that could give rise to addiction disorders through a "subtle way." Indeed, such disorders do not entail the use of illegal substances and are easily accessible during the lockdown. Research evidence concerning such phenomena would seem to be extendable to situations where traumatic events do not occur on a global scale (57), but at an individual level (58). Furthermore, the survey is based on an adequate sample size, across all regions of a country that has been strongly affected by COVID-19 infection, and the psychological pressure due to the spread of the infection has been considered in the statistical analyses. Moreover, Italy ran into the outbreak before other countries, thus it offers a relevant scenario concerning public health issues that could be very informative for other countries around the globe.

Nonetheless, some limitations of the study need to be acknowledged. For instance, these findings cannot be extended to adolescent populations. Moreover, this is a cross-sectional study and it is difficult to draw causal conclusions. Furthermore, although online surveys have remarkable advantages (e.g., access to unique populations, such as individuals in isolation/quarantine), there are also disadvantages, such as the selection bias, that should be considered (59). For example, notwithstanding increasing Internet use and availability in the society at large, it is known (60) that online questionnaires might be more accessible to some groups of individuals (e.g., students) compared to others (e.g., frail elders, the poorest). Similarly, and accordingly with the present data, it has been reported (61) that online surveys response rate might be biased in favor of female' participants, probably because of gender differences in online behaviors (e.g., women make intense use of social networks, whereas men are more engaged in online games) (62–64). Lastly, it should be noted that, although the CAGE is widely used to screen PAU (32), in the present sample a low Cronbach's α (i.e., 0.52) was detected. A review on 22 studies (65) showed that CAGE reliability coefficients ranged from 0.52 to 0.90, indicating considerable variability of this self-report, which seems to be affected by sample age (i.e., older CAGE respondents generally producing more reliable scores than younger ones). Thus, future reports should investigate the association between COVID-19 related distress and PAU using alternate alcohol screening tool such as the Alcohol Use Disorders Identification Test [AUDIT; (66)].

Future studies might also highlight protective factors that clinicians should take into account during outbreaks to reduce the side-effects of restrictions. Based on the results of this research, policy-makers need to address issues related to the COVID-19 pandemic in two ways: (i) media campaigns for health promotion aimed at increasing people's awareness about the risk of developing "subtle addictions," that do not entail the intake of illegal substances, (ii) tailoring *ad-hoc* on-line interventions during the lockdown and face-to-face clinical interventions after such a phase, to avoid these symptoms giving rise to pathological disorders. An overarching message of this work consists in highlighting the need to take into account addictive symptoms at three levels: (i) when scholars design researches studies investigating outbreak-related phenomena, (ii) when clinicians carry out outbreak-related interventions, and (iii) when policy-makers make public health decisions. For instance, epidemiological studies should monitor the incidence of such addiction symptoms to provide timely information. Monitoring such a phenomenon might implement policies at national level to cope with the incidence of these addictions in society at large, given that subsequent economic and social costs might be higher for the welfare system.

Lastly, our results suggest the need to implement applied psychological strategies aimed at helping people to cope with addictive behaviors during lockdown conditions. These strategies could be included in most of the extant psychological intervention protocols developed to face COVID-19 emergency (67) and/or could be adapted according to current evidence-based programs, such as the Screening, Brief Intervention, and Referral to Treatment [SBIRT; (68)].

To conclude, our results seem to confirm the concerns (11–15) about the negative impact of the COVID-19 emergency on addictive behaviors, suggesting that this issue should be carefully monitored when social distancing occurs. The coronavirus disease 2019 pandemic is a global health crisis requiring, on the one hand, clinicians to be prepared to cope with the increase in the psychopathological symptoms incidence, including those related to addictive behavior. On the other hand, scholars have to design studies and provide guidelines to cope with such crises. Finally, policy-makers should take into account scholars' information to support and stimulate clinical interventions when addressing public health issues related to pandemic emergencies.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This research was approved by the ethics committee of the European University of Rome (Prot. N.004/20) in line with the Helsinki declaration standards. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AP: conceptualization, supervision, methodology, data curation, software and formal analysis, and writing—original draft preparation. GC: conceptualization, methodology, data curation, and writing—review and editing. CM: conceptualization, methodology, data curation, and writing—review and editing. BF: methodology, supervision, and writing—review and editing. CI: conceptualization, supervision, methodology, data curation, software and formal analysis, and writing—original draft preparation. All authors: contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.577135/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 25 November 2020
doi: 10.3389/fpsyt.2020.575755

The Impact of COVID-19 Pandemic on the Castile and Leon Addiction Treatment Network: A Real-Word Experience

Carlos Roncero [1,2,3], Begoña Vicente-Hernández [4], Nerea M. Casado-Espada [1,2,3], Lourdes Aguilar [2,3,4], Sinta Gamonal-Limcaoco [1], María A. Garzón [4], Fernando Martínez-González [5], Carlos Llanes-Álvarez [6], Ruth Martínez [4], Manuel Franco-Martín [2,6,7] and Ana Álvarez-Navares [4]*

[1] Psychiatry Service, University of Salamanca Health Care Complex, Salamanca, Spain, [2] Institute of Biomedicine of Salamanca (IBSAL), University of Salamanca, Salamanca, Spain, [3] Psychiatry Unit, School of Medicine, University of Salamanca, Salamanca, Spain, [4] Addictions and Dual Disorders Unit, Psychiatry Service, Salamanca University Health Care Complex, Salamanca, Spain, [5] Regional Commissioner for Drugs, Social Services Management, Castile and Leon Regional Government, Valladolid, Spain, [6] Psychiatry Service, Zamora Health Care Complex, Zamora, Spain, [7] Psychiatry Service, Rio Hortega University Hospital, Valladolid, Spain

OPEN ACCESS

Edited by:
Giuseppe Bersani,
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Brenda L. Curtis,
National Institute on Drug Abuse
(NIDA), United States

***Correspondence:**
Carlos Roncero
croncero@saludcastillayleon.es

Specialty section:
This article was submitted to
Addictive Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 24 June 2020
Accepted: 29 October 2020
Published: 25 November 2020

Citation:
Roncero C, Vicente-Hernández B, Casado-Espada NM, Aguilar L, Gamonal-Limcaoco S, Garzón MA, Martínez-González F, Llanes-Álvarez C, Martínez R, Franco-Martín M and Álvarez-Navares A (2020) The Impact of COVID-19 Pandemic on the Castile and Leon Addiction Treatment Network: A Real-Word Experience. Front. Psychiatry 11:575755. doi: 10.3389/fpsyt.2020.575755

Background: Patients suffering from addiction are a vulnerable group in the midst of COVID-19, so their healthcare is considered essential. In this paper, the measures and responses of the Drug Addiction Assistance Network of Castile and Leon (DAACYL) in Spain during the first 6 weeks of the COVID-19 pandemic are explained. The aim is that this experience could be useful in places where this problem will continue and could help future interventions.

Methods: A telephone survey was carried out as the main methodology, to collect information for the subsequent organization and repercussion on professionals and patients. This was carried out by the heads of the 18 DAACYL units. Among the interventions applied, the following stand out: implantation of telemedicine techniques, restriction of daily methadone dispensing, suspension of urine controls and initiation of care programs for the homeless.

Results: As a result of these interventions, the professionals observed that patients are less demanding and mostly stable, with a low percentage of relapses. An increase in the consumption of alcohol and benzodiazepines have been reported as more common among people who relapse. Furthermore, the prevalence of COVID-19 infection in the sample is minimal; therefore, different hypotheses should be considered as an explanation (infra-diagnosis, immune system used to aggression, possible anti-inflammatory effect of some psychotropic drugs and a greater perception of danger against infection than the general population).

Conclusions: The rapid adaptation and successful implementation of DAACYL have had satisfactory results. On the other hand, the prevention of the possible increase in the development of behavioral addictions and the use of homemade drugs should be considered.

Keywords: COVID-19, impact, network on drugs and drug addiction, assistance, relapse

INTRODUCTION

Since December 2019, Wuhan, China, reported cases of an acute respiratory disease. The cause was identified as a new coronavirus, previously unknown in humans, named COVID-19, which produces a syndrome called Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2) (1). The characteristics of this disease include, aside from the pulmonary manifestations, the affectation of other organs (2), including the CNS (3). One of the main aspects of this virus is that it is very easily transmitted between people (2). Therefore, from China the infection has spread very quickly to other countries in Asia, Europe, Australia, Africa, and the American continent. During the writing of this article, the disease was declared in 207,634 people in Spain, of whom 23,190 died (4). Therefore, once the pandemic was declared in Spain, the work of reorganization of health and socio-health services, including mental health care was executed, just like China suggested (2, 5).

This infection can produce mental disorders in the general population (6, 7) and in the psychiatric community (6–9), including patients with addictions (10). This last patients, in addition to the risks related to mental health patients who, very frequently, smoke tobacco (9), many of them have respiratory problems due to the consumption of opiates, cannabis or other substances through the intrapulmonary route (10). Also, the presence of previous medical disorders is a risk factor associated with a higher risk of suicide and negative affects (6).

People with mental disorders have a higher risk of getting infected due to the lower ability to protect themselves, considering that in some cases they also show less self-control (5). In addition, specific problems should be considered to patients suffering from addiction must be considered, as they use intravenous drugs, and have partial access, or even barriers, to access treatment resources (11). Moreover, patients with a substance disorders have a greater risk of worsening their previous medical problems, including other infections (12). On the other hand, there is also a risk of overdosing when buying more adulterated or elaborated substances at home. The greater risk of infection rises due to stigmatization and social exclusion, sharing the material or being in risky environments (11, 13, 14).

Finally, it is considered that some consumers are homeless. This population has associated risks such as older age and the presence of medical diseases, as well as more difficulties accessing the health system, or carrying out preventive measures like social isolation, even if they have symptoms (15).

However, the treatment of the population with addiction is important because these patients can present disruptive behaviors, withdrawal syndromes that require healthcare, a risk of overdose, or even the inability to do a confinement due to their homeless situation (10, 16). There could even be a risk of developing behavioral addictions during the confinement, plus the difficulty to access illegal substances, could increase the possibility of creating homemade drugs which could have a greater toxicity (14).

The confinement situation declared by the Spanish government, in the Royal Decree 463/2020 of March 14, socio-sanitary assistance for people who use drugs has been considered a first necessity in Castile and León (Spain). People suffering from addiction have been recognized as a vulnerable group in the pandemic, their assistance being closely linked to COVID-19 (As dictated in the Instructions 1/2020 and 2/2020 of the Directorate of Legal Services of the Ministry of the Presidency of the Castile and Leon Regional Government. on suspension of deadlines of public sector procedures during the state of alarm) (17). This recognition has been corroborated and reinforced by the Resolution in April 8, 2020, of the Presidency of the Board of Directors of the Management of Social Services of Castile y León (18), by which specific procedural rules are determined, as a consequence of the declaration of the alarm status by COVID-19. This resolution establishes that patients are especially vulnerable to the effects of the pandemic and that healthcare services have to provide these people with basic social care (19). This is complemented by a contingency plan of the Regional Commissioner for drugs, released before the declaration of the state of alarm in order to adapt the healthcare response in Castile and Leon to the drug-dependent population to the restrictions and recommendations of the Castile and Leon Health authorities. In the international and national level, adjustments have been proposed for the drug addiction care programs (20–23).

The objective of this work is to describe the real word experience of the Castile and Leon Addiction Treatment Network (DAACYL), to the infection of COVID-19 and the repercussions detected in the first 6 weeks of the state of alarm.

MATERIALS AND METHODS

Castile and Leon is one of the Autonomous Communities of Spain, it has 2,393,285 inhabitants (24). The estimation is that more than 14,000 patients receive drug dependence treatments annually in the public health system, of which 5,300 have an alcohol addiction and more than 3,000 a nicotine addiction (25). The characteristics of this population are described in **Table 1**.

The Drug Addiction Assistance of Castile and Leon (DAACYL) has around 400 professionals, including graduates in psychology, work and social education, medicine and nursing, who are the most numerous (25). This includes 27 first-level specific services (FLSS), of which 13 are exclusively for people with an alcohol use disorder, 11 outpatient drug clinics (ODC). Eight days care centers, one of them is specifically for alcoholics, two outpatient alcohol clinics (OAC), two outpatient dual disorder programs in Salamanca and Zamora integrated into the psychiatric services, 9 Spanish Network against Lung Cancer (AECC) tobacco treatment programs and 5 Tobacco Units/consultations. At the residential level, the specific network has a reference inpatient detoxification and dual disorder unit (ID-DDU) for the whole of Castile and León, located in Salamanca, with 24 professionals: 7 therapeutic communities (TC) and 2 alcoholic rehabilitation centers (ARC).

The centers are distributed throughout the area (**Table 2**), and their function and accessibility is described in the VII Regional Plan on Drugs 2017–2021 (26). In some cases these centers

TABLE 1 | The basic profile of patients with drug addiction treated at DAACYL 2019.

Center or department	*N*	Sex %		Mean age (years)	Main drug %					
		Man	Woman		Heroin	Cocaine	Cannabis	Alcohol	Tobacco	Other
FLSS-alcohol	2.493	78.8	21.2	Not available	0	0	0	100	0	0
FLSS for all drug	2.772	83.7	16.3	Not available	13.5	28.8	28.0	19.9	0	9.8
ODC	3.897	83.5	16.5	38.5	35.3	20.2	12.7	14.5	0	17.3
Day centers	1.026	75.9	24.1	45.0	6.4	19.6	14.2	53.1	0	6.7
OAC	1.246	83.8	16.2	49	0	8	0	92	0	0
OPDD	27	66.6	33.3	35.7	7.4	33.3	44.4	0	0	14.8
Group smoking dishabituation (AECC)	1.018	42.7	57.3	42.1	0	0	0	0	100	0
Smoking treatment units/consultations SACyL	2.332	48.7	51.3	Not available	0	0	0	0	100	0
ID-DDU	183	74.9	25.1	45.3	21.3	19.7	7.6	29.0	0	22.4
Therapeutic communities	565	87.5	12.5	38.9	12.3	46.0	7.8	14.4	0	19.5
ARC	232	86.9	13.1	46.6	0	0	0	100	0	0

Drug Addiction Assistance Network of Castile and Leon (DAACYL). First level-specific services (FLSS). Outpatient treatment for patients with drug addiction (ODC). Outpatient alcohol clinic (OAC). Outpatient Program for Dual Disorder (OPDD). Tobacco treatment program (AECC). Inpatient detoxification and dual disorder unit (ID-DDU). Alcoholic Rehabilitation Centers (ARC).

belong to the Psychiatric Department and are mostly managed by different non-profit entities in the third sector.

A semi-structured telephone survey was carried out on April 13, 14, 15, 21, 22, and 24, by a RADCYL psychiatrist to each of 19 heads of the centers that make up the network, without exclusion criteria: 11 ODC of Castile and León, 2 OAC, 2 TC, the 2 outpatient programs of dual disorder and 2 ARC, following a structured guide of questions in which the following questions about the work system were addressed (**Table 3**): the impact of the pandemic on the organization of these centers and the repercussion on professionals and patients. The information on the other units (day centers, outpatient units, foster homes, etc.) was also collected.

RESULTS

In all ODC/OAC/dual disorder programs and day centers, telework was applied, according to the contingency plan, patients could only be contacted by telephone or telematically. Only in the most urgent clinical cases, the on-site assistance was provided, taking extreme precautions and hygienic and protective measures. Most of the patients agreed on the telephone follow-up. There were no urine controls, with only some specific exceptions. Daily methadone release was discontinued in all centers except one unit, and only for a few not well-controlled patients. The patients only went to these units to collect methadone; they were given doses to cover 1, 2, or 3 weeks (even up to 4 weeks in one of the centers). Furthermore, in a specific area in this community (El Bierzo) a system was organized to bring the methadone dispensing closer to the patients. Seventeen new methadone treatments and 1 buprenorphine/naloxone treatment started in 6 different ODC.

Related to the pharmacological treatments, 3 centers were found administering the monthly injectable treatment to their patients (these patients had already been doing it regularly). The prescriptions for psychopharmacological and buprenorphine/naloxone treatments, were given out thanks to the good coordination of all units with the Primary Care system.

The Detoxification and Dual Disorder Inpatient Unit (DDDIU), located in Salamanca, which is a designated in Castile and Leon, was closed in the beginning of the confinement, in order to give up space to the COVID Rooms for the University Healthcare Complex of Salamanca (7). Likewise, the dispensing of methadone in Zamora's Healthcare Complex was suspended for the same reason. This activity was undertaken by the ODC of this province. Moreover, in Salamanca a program was accomplished to deal with mental health problems, including addictions, for homeless patients confined in a municipal center.

The professionals of 2 Therapeutic Communities (TC) and the 2 Alcoholic Rehabilitation Centers (ARC) of Castile and Leon who were interviewed, continue working with patients who were already admitted.

However, there were no new admissions, except for two patients, one from the ID-DDU in Salamanca and the other from the Psychiatric Service of the Río Hortega Hospital in Valladolid city. The patients who were on therapeutic leave at the time the state of alarm was declared were unable to return to the community. They kept in touch with them and their families over the phone, they will be offered readmission for follow up and treatment when the health authorities and the new contingency plan allows it. There were very few scheduled discharges (7), even some patients preferred to postpone their discharge. No voluntary or forced discharges were performed.

All residential centers had to ease or modify rules to adapt to the circumstances, for example, facilitate the calls to the families, etc. On the other hand family visits and outings were suspended. In all the units, the indications of the contingency plan of the Regional Commissioner for drugs in Castile and Leon have been followed (**Table 4**).

According to the opinion expressed by the professionals surveyed, it was observed that the clinical impact in the first 6 weeks is moderate, which implies that not as many relapses and

TABLE 2 | Resources of the network for addiction treatment in castile and Leon (DDACYL) (Spain).

	Ávila	Burgos	León	Palencia	Salamanca	Segovia	Soria	Valladolid	Zamora	Total
FLSS for all drug patients with addiction	**1** Cáritas	**3** ACLAD Cáritas (A. de Duero) BOREAL (M. de Ebro)	**2** ACLAD Cáritas	**2** ACLAD ASCAT (Guardo)	**3** Cáritas apared nueva gente	**1** Cáritas		**2** ACLAD Cáritas		**14**
FLSS for alcoholics (associations for rehabilitated alcoholics)	**1** Geara	**2** ARBU AREMI (M. de Ebro)	**3** ARLE BEDA (Ponferrada) ARBA (La Bañeza)	**2** ARPA ARGU (Guardo)	**3** ARSA ARBE (Béjar) ARCIU (C. Rodrigo)	**1** ARSEG	**1** ARESO	**3** ARVA AVAR ATRA	**1** ARZA	**17**
ODC	**1** Cáritas	**1** Red cross	**2** Red cross Consejo comarcal de el bierzo (Ponferrada)	**1** S. JUAN DE DIOS	**1** Red cross	**1** Red cross	**1** Red cross	**2** Red cross ACLAD	**1** Cáritas	**11**
Day centers		**2** ARBU (alcohol dependents) PROYECTO HOMBRE	**2** PROYECTO HOMBRE of León y Ponferrada		**2** Cáritas proyecto hombre of Salamanca			**2** ACLAD proyecto hombre		**8**
Outpatient alcohol clinics (OAC)					**1** SACastilla y León				**1** SACastilla y León	**2**
Tobacco treatment programs	**1** AECC	**1** AECC	**1** AECC	**1** AECC	**1** AECC	**1** AECC	**1** AECC	**1** AECC	**1** AECC	**9**
Smoking units and cosultations		**1** SACastilla y León		**1** SACastilla y León	**1** SACASTILLA Y LEÓN			**1** SACastilla y León	**1** SACastilla y León	**5**
Inpatient detoxification and dual disorder units (ID-DDU)					**1** SACastilla y León					**1**
Therapeutic communities		**1** Proyecto hombre	**1** Proyecto hombre	**2** S. Juan de dios spiral	**1** Proyecto hombre (Salamanca)			**1** Proyecto hombre	**1** Cáritas	**7**
Alcoholic rehabilitation center (ARC)				**1** ALDAMA					**1** Cáritas	**2**
Total	4	11	11	10	14	4	3	12	7	76

Roles of the different units.
First level specific services (FLSS): (1) information and guidance on the available resources, (2) recruitment, motivation, referral and psychosocial support for outpatient treatment, (3) coordination, support and development of the individualized social integration program. Specific centers for outpatient drug clinic (ODC): (1) outpatient treatment for drug dependent patients, (2) coordination, support and development of the individualized social integration program. Day centers: (1) treatment for patientsin an intermediate regime, (2) coordination, support and development of the individualized social integration program. Outpatient alcohol clinic (OAC): (1) outpatient treatment of alcoholism and mental disorders associated with alcohol dependence (referral service for Mental Health Teams in the Health Area). AECC tobacco treatment program: individual and group treatment (preferred) to quit smoking. Smoking units/consultations: individual treatment for smoking in a specialized level. Inpatient detoxification and dual disorder unit (ID-DDU): hospital detoxification for patients with addiction and hospital care for patients with dual disorders. Therapeutic communities: treatment of patients in a residential regime. Alcoholic Rehabilitation Centers (ARC): Treatment for alcoholics in a residential regime.

TABLE 3 | Phone interview guide.

- In the Outpatient Centers:
  - Face-to-face assistance/telephone contact.
  - Dispensing methadone and performing urine controls.
  - Initiation of new treatments with opiate agonists (methadone, buprenorphine/naloxone).
  - Coordination with Primary Care units.
  - Implementation of new programs adapted to the circumstances of the alarm state.
  - Information from professionals on the impact on patients of the alarm state: relapses, compliance with the pharmacological treatments, psychopathology's evolution if there is, beginning or increase in the alcohol consumption, benzodiazepines or other substances, changes in the "market" of drugs in their city.
  - Patients and Professionals Affected by Covid-19 Infection.
  - Degree of satisfaction expressed by users with the attention received.
- In the Residential Facilities/Nursing homes:
  - The continuity or not of the center's functioning.
  - Changes in the operating rules.
  - Execution or not of new admissions.
  - Registration of the discharges: scheduled, voluntary, forced.
  - Patients and Professionals Affected by Covid-19 Infection.
  - Degree of satisfaction expressed by users with the attention received.

dropouts were detected as expected compared to the weeks with normal operation without a pandemic. The patients were stable, taking the medication appropriately without presenting clinical complications, even those with dual disorders.

Relapses also seem to be under control. Six centers detected that some patients increased or started consuming alcohol and benzodiazepines (especially alprazolam). In Salamanca's Outpatient Alcohol Clinic (OAC) relapses are detected on the basis of a clinical interview and, if possible, with urine controls in a protocolized manner every week. In this unit, at least 2 relapses and 3 exacerbations in alcohol consumption were detected, one of them required an urgent hospital admission due to acute organic distress; compared to 9 relapses that occurred after attending 144 patients in the week 15–21 April 2019. In the Outpatient Dual Disorder Program of Salamanca, 2 relapses were detected during the confinement period, during the second and fifth weeks.

In general patients describe that the consumption of illegal drugs has decreased, although some of them admit they still continue consuming. Several cases reported the price of cannabis increased these days.

Until May 11, 2020, the date on which the collection of information in the DAACYL centers and services ended, the impact of COVID-19 had been very low. In the case of users, 35 confirmed cases were declared, 72 probable cases pending confirmation and 4 deaths. It is significant that in the residential centers there were only 2 probable cases that were awaiting confirmation at the time of completing the information collection and no deaths. With regard to professionals, the impact was also very low: 6 confirmed cases, 10 probable cases and no deaths. The data referring to the volume of patients treated up to that moment in the centers and services were not collected, so it is not strictly possible to calculate the prevalence in patients. Regarding the professionals who provide service in the DAACYL, the prevalence of probable and confirmed cases was 4.78%.

DISCUSSION

The readjustment of the network has been very fast and consistent with the preliminary descriptions of the literature, such as reducing the face-to-face and hospital activity (5), deploying resources with telephone and online supports. The adaptation and use of telemedicine that has been implemented so suddenly in patients with addiction, seems to be working well. This adjustment has already been suggested by authors who have studied the pandemic in China (6, 8). There are previous international experiences, especially in the United States, on the use of telemedicine in patients with addictions (27, 28).

Possibly the distance and the type of health resources have facilitated its development. In Europe the experience is preliminary (29) and in Spain this experience is not developed in a massive scale. It has only been used in experimental programs and mostly with tobacco addiction (30).

The access to treatments with opiate agonists was simplified and was made more flexible, increasing the "take-home" system, doubling or quadrupling the number of days allowed, following the Castile and León contingency plan, with Spanish (20) and international recommendations, in America (21, 23), and Asia (22). Other suggested options, such as door-to-door delivery (21) were not implemented, although in large and uninhabited areas such as El Bierzo area, methadone dispensing was brought closer to further areas. Very few treatments with opioid agonists were introduced, due to difficulties in starting it, since the appointments could not be done regularly. In the future, the pharmacological approach and the interactions between psychotropic drugs and the drugs used in the treatment of COVID-19 patients should be considered (31). The interactions of antivirals and psychotropic drugs is known (12), but the complex combinations used for the treatment of COVID-19 is not known. The side effects during and after the treatment of COVID-19 is unknown, so they must be especially considered (8).

The DDDIU, located in Salamanca, which is the designated unit in Castile and Leon, was closed. There are no descriptions of this type of units in the literature. In the Chinese psychiatric units, the hospitalizations reported are shorter, with a stricter criteria for admission, the outpatient follow-up was the basis, they implanted isolation and visits were avoided (6).

Some of the measures, such as having minimum contact with the family on detoxification admissions, are already common in this units. However, the other measures are not very applicable. It should be noted that there are differences due that many of these units seem to be based in psychiatric hospitals (6). Some of the measures cited, such as the isolation of patients from the outside and the increase of telephone contacts, have been applied in residential centers.

The telephone interviews did not find the reported consequences of COVID-19 such as anxiety, depression, insomnia, suicide risk, poor adherence to treatment (6). Not even the specific risks in patients with addiction, including relapses, emergency department problems, and COVID-19 infections (10). Although these findings must be verified when the situation returns to normal. In the area where the homeless

TABLE 4 | Action proposals in DAACYL.

Situation/measures	General measures		Locale cases		Cases among DAACYL professionals and/or users	
	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient
Social distancing and/or mask	✓	✓	✓	✓	✓	✓
Information line	✓	✓	✓	✓	✓	✓
Hand washing Coughing into the elbow Ventilation and cleaning	✓	✓	✓	✓	✓	✓
Do not attend to the center and contact the healthcare system if symptoms develop	✓	✓	✓	✓	✓	✓
Distance the time of collection of methadone	✓	✗	✓	✗	✓	✗
Replace face-to-face attention with telephone follow-up	✓	✗	✓	✗	✓	✗
Discontinuation of family visits	✓	✓	✓	✓	✓	✓
Temporary suspension of hospital admissions (minimum 14 days)	✗	✓	✗	✓	✗	✓

DAACYL: Drug Addiction Assistance Network of Castile and Leon. Outpatient: centers for outpatient drug clinic; Outpatient alcohol clinic, Day centers. Inpatient: Therapeutic communities, alcoholic Rehabilitation Centers. Based on the contingency plan of the Regional Commissioner for drugs (March 2020).

program was implemented, no emergency department visits and clinical decompensation was detected, but these programs have not been generalized around the territory.

Against the expected the frequent relapses and clinical decompensation that drug dependent people and dual patients present in normal conditions (32), are minimal nowadays, although drug consumption is still ongoing; since it is easier to acquire, the consumption of alcohol and anxiolytic drugs is possibly increasing.

The limited number of COVID-19 cases detected is surprising. These patients seem to be more vulnerable due to the organic and mental disorders associated, together with their lifestyle with low hygiene and self-control, the social exclusion they suffer, and their smoking addiction. It is possible that the infection is being underestimated, and that some patients have had the infection asymptomatically or with mild symptoms, since this population is accustomed to have withdrawal (33) or intoxication symptoms (34). Therefore, it is possible that the symptoms of COVID-19 have gone unnoticed. We contemplate that these patients have an immune system accustomed to different pathogens. We also discuss that some of the psychotropic drugs that these patients frequently take, such as methadone (35), other opiates (36), antipsychotics (37) or mood stabilizers (lamotrigine) (38) may have an anti-inflammatory effect. This could modulate the inflammatory effects produced by COVID-19, being one of the research lines in the treatment of this infection (39, 40).

The hypothesis that patients with addiction, who have experienced serious infections such as HIV, tuberculosis and viral hepatitis (41–43), have considered the severity and risks of this infection before the general population, adopting protective measures.

COVID-19 infection among DAACYL professionals is not very high, even being a population at risk. The high risk of acquiring the infection has been described in mental health professionals (2, 5, 7). The practice of telemedicine and not resorting to the units can explain this situation.

The response described is the initial one and it will change, however, it is relevant to plan long-term care incorporating the needs of everyone, professionals and different types of patients (11). Decisions must also be made to allow the continued attention and access to treatment, despite the current pandemic of COVID-19, or possible future ones. On the other hand, specific programs should be developed to prevent transmission among drug users, especially, through intravenous dissemination. Also avoiding the share of equipment for smoking, inhaling, vaping or injected drugs (13).

In the limitations of this study, the successful use of telemedicine in this situation could not possibly be the same as the normal attention, so the results should be viewed with caution. Probably, the presence of the COVID-19 infection in patients is being underestimated, this work is only a 6-week report. It was not possible to contact the smoking cessation programs, currently paused, since it is closely related to the Pneumology Service. However, this work is a real-world experience and can be useful to explain the complete response of a drug-addiction healthcare network. It would be important to consider it in the places where the infection is developing or for future measures, if the pandemic were to happen again.

We conclude that the response was assembled in a short time and the execution has been successful. At the moment the clinical response and the care system for people with substance use disorder have managed to control the situation in the drug units of Castile and León.

The use of telemedicine techniques in a pandemic situation for patients with addiction is encouraging. Its implementation *in situations* outside the crisis in Spain should be studied. However, these findings must be re-evaluated, since in the medium term the system cannot be paralyzed.

Further research should be carried out to study the reaction of the health system and the impact of COVID-19 on the course, treatment, prevalence and new approaches for patients with addictions. It is meaningful to prevent the development of behavioral addictions, the increase in the consumption of alcohol and benzodiazepines and the use of homemade preparations in confined patients suffering from addiction (14).

It is essential to move toward a progressive normalization in socio-sanitary assistance to drug dependent people. Always taking into account the recommendations of the health authorities to prevent the spread of the infection, while the impact on the health system begins to subside.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

CR has been the main author of the article, designing, and elaborating the complete investigation process. AÁ-N, MG, LA, and BV-H have collected the clinical data necessary for its construction and have written fragments of it. MF-M and FM-G have revised the article bringing new perspectives. NC-E, SG-L, CL-Á, and RM have revised and improved the translation, design, and elaboration of the tables. All authors have contributed ideas and clinical experience for the discussion of the main topic.

ACKNOWLEDGMENTS

The authors of this work want to thank the professionals from the ODCs of Cáritas de Ávila, the Spanish Red Cross of Burgos, León, Salamanca, Segovia, Soria, and Valladolid, Bierzo de Ponferrada County Council, San Juan de Dios de Palencia, ACLAD of Valladolid and Cáritas de Zamora, Day Center and ambulatory program of Cáritas de Salamanca, the Unit of addictive behaviors and treatment of alcoholism of SACYL de Zamora, the Therapeutic Communities from San Juan de Dios in Palencia and Proyecto Hombre in Salamanca and from the Residential Centers for the Rehabilitation of Alcoholics of Cáritas de Zamora and ALDAMA from Palencia, for their collaboration in reporting their situation and the execution of their actions through the phone. This research project was supported by Castile and Leon's (Spain) Regional Management of Health (GRS COVID 59/A/20) Scholarship for the project Impacto y abordaje de la salud mental de los pacientes afectados por COVID, sus familiares y del personal sanitario que los atiende. (Impact and approach on the mental health of patients affected by COVID, their families and the health professionals who care for them). This scholarship was awarded to CR (main researcher) and his research team.

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Conflict of Interest: CR declares that in the last years he has received remuneration for participating as a speaker in activities of Janssen-Cilag, Indivior, Lundbeck, Otsuka, Servier, GSK, Astra, Gilead, MSD, Sanofi, Exceltis, Abbvie, Takeda Rubio and Casein. He has received remuneration for participating as a consultant in meetings of Gilead, MSD, Mundipharm, INDIVIOR, Exceltis, Martindale, Camurus, Gebro and Abbive. It received funding for the Proteus project and the COSTEDOPIA project by Indivior. He has received Gilead medical education scholarships. BV-H declares that in the last years she has received remuneration as a speaker for Janssen-Cilag and Lundbeck. NC-E declares that in the last years she has received an economic prize from the Janssen-Cilag oral communications competition and received remuneration as a speaker for Sanofi. MF-M declares that in the last years she has received remuneration as a speaker for Sanofi. MF declares that he has carried out applied research studies (clinical trials mainly) and speaker at activities carried out by the following companies in recent years: Janssen-Cilag, MSD, Lundbeck, Otsuka, Servier, Acadia, Pfizer, Roche.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

PERSPECTIVE
published: 26 November 2020
doi: 10.3389/fpsyt.2020.574483

Current and Future Potential Impact of COVID-19 on Kratom (*Mitragyna speciosa* Korth.) Supply and Use

Darshan Singh[1], *Paula N. Brown*[2], *Eduardo Cinosi*[3,4], *Ornella Corazza*[3], *Jack E. Henningfield*[5,6], *Albert Garcia-Romeu*[7], *Christopher R. McCurdy*[8], *Lance R. McMahon*[9], *Walter C. Prozialeck*[10], *Kirsten E. Smith*[11], *Marc T. Swogger*[12], *Charles Veltri*[13], *Zach Walsh*[14] and *Oliver Grundmann*[8]*

[1] Centre for Drug Research, University Sains Malaysia, George Town, Malaysia, [2] Centre for Applied Research and Innovation, British Columbia Institute of Technology, Burnaby, BC, Canada, [3] Department of Clinical and Pharmaceutical Sciences, School of Life and Medical Sciences, University of Hertfordshire, Hatfield, United Kingdom, [4] Hertfordshire Partnership National Health Service University Foundation Trust, St Albans, United Kingdom, [5] Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [6] Pinney Associates, Bethesda, MD, United States, [7] Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [8] Department of Medicinal Chemistry, College of Pharmacy, University of Florida, Florida, FL, United States, [9] Department of Pharmacodynamics, College of Pharmacy, University of Florida, Florida, FL, United States, [10] Department of Pharmacology, College of Graduate Studies, Midwestern University, Downers Grove, IL, United States, [11] National Institute on Drug Abuse Intramural Research Program, Baltimore, MD, United States, [12] Department of Psychiatry, University of Rochester Medical Center, Rochester, NY, United States, [13] Department of Pharmaceutical Sciences, College of Pharmacy, Midwestern University, Glendale, AZ, United States, [14] Department of Psychology, University of British Columbia, Kelowna, BC, Canada

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Edited by:
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United Kingdom
Georgios Demetrios Kotzalidis,
Sapienza University of Rome, Italy

***Correspondence:**
Oliver Grundmann
grundman@ufl.edu
orcid.org/0000-0003-2302-8949

Specialty section:
This article was submitted to
Addictive Disorders,
a section of the journal
Frontiers in Psychiatry

Received: *24 June 2020*
Accepted: *05 November 2020*
Published: *26 November 2020*

Citation:
Singh D, Brown PN, Cinosi E, Corazza O, Henningfield JE, Garcia-Romeu A, McCurdy CR, McMahon LR, Prozialeck WC, Smith KE, Swogger MT, Veltri C, Walsh Z and Grundmann O (2020) Current and Future Potential Impact of COVID-19 on Kratom (Mitragyna speciosa Korth.) Supply and Use. Front. Psychiatry 11:574483. doi: 10.3389/fpsyt.2020.574483

Kratom (*Mitragyna speciosa* Korth., Rubiaceae) is native to and has traditional use in Southeast Asia. The number of kratom users outside of Southeast Asia has increased significantly in recent decades with use spreading to the Unites States (US) and Europe. Because of its reputed opioid-like psychoactive effects at higher doses, kratom has been regulated in several countries and is subject to an import ban by the US Food and Drug Administration. Nonetheless, in the US it is estimated that 10–15 million people consume kratom primarily for the self-treatment of pain, psychiatric disorders, to mitigate withdrawal from or dependence on opioids, and to self-treat opioid use disorder or other substance use disorders (SUDs). Due to the global COVID-19 pandemic, a shortage in the supply of kratom products may place unexpected burdens on kratom users, potentially influencing some who use kratom for SUD self-treatment to regress to harmful drug use, hence increasing the likelihood of adverse outcomes, including overdose. Inadequate treatment, treatment barriers, and increases in the sales of adulterated kratom products on the internet or in convenience stores could exacerbate circumstances further. Although there are currently no verified indications of kratom scarcity, researchers and clinicians should be aware of and remain vigilant to this unanticipated possibility.

Keywords: COVID-19, kratom, SUD, OUD, withdrawal

INTRODUCTION

Kratom (*Mitragyna speciosa* Korth., Rubiaceae) is a tree native to Southeast Asia with psychoactive properties due to the presence of indole alkaloids (1, 2). The primary alkaloid, mitragynine, has been shown to interact with μ-opioid receptors as a biased partial agonist leading to analgesia (3). In addition, kratom products may also produce dose- and strain-dependent stimulant and sedative effects (4). Chronic consumption at high doses has a potential to cause dependence and withdrawal symptoms (5) consistent with a Substance Use Disorder (SUD) (6, 7). A majority of user surveys and numerous observational studies suggest that kratom is widely used in Western nations for a range of conditions, including self-treatment of acute and chronic pain, psychiatric conditions, such as depressive and anxiety disorders, and mitigation of withdrawal symptoms from addictive drugs, both illicit and prescribed, particularly opioid-based medications (8). Among polydrug users and those with a history of SUD, kratom has also been consumed as a means of reducing use of or abstaining from dangerous prescription opioids and heroin (9, 10). Adverse effects of kratom use have been reported in several cases of polydrug use with opioids, benzodiazepines, and acetaminophen primarily resulting in seizures, hepatotoxicity, and gastrointestinal symptoms (11). Polydrug exposure involving kratom increases the odds ratio of more serious adverse events occurring, including admittance to a healthcare facility and occurrence of more serious medical outcomes such as hepatic damage and death (12, 13). Kratom withdrawal symptoms are similar to those of opioids but with lower severity, presenting with transient gastrointestinal upset, muscle and nerve pain, insomnia, sweating, tremor, fatigue, and psychological distress including restlessness, irritability, increased cravings, depressed mood, and anxiety. Buprenorphine in combination with clonidine may prove to be a clinically effective treatment for most of these symptoms as indicated by case reports, although these drugs are associated with their own adverse effects (5). However, in traditional settings, kratom users have their own methods for mitigating kratom withdrawal symptoms.

The widespread use of kratom and consistent reports of its benefits or therapeutic value that are important to users raises the question: would sudden decreases in the availability of the plant have negative impacts on kratom users? Various internet studies found that some kratom users are concerned about the possibility of relapsing to opioids and/or seeking alternative, possibly questionable, sources of kratom if products become less readily available. This is a serious concern as kratom, not currently regulated as a dietary supplement, may be adulterated by unscrupulous traders and cause users to relapse to opioid use and inevitably experience a significant increase in overdose risk (7, 9, 14–17). Indeed, there is evidence to suggest that the COVID-19 pandemic has been associated with increased drug overdose deaths and that the reduced access to conventional treatment, as well as mutual-aid groups, is a plausible contributing factor (18), though it is unknown whether diminished access to kratom has explicitly contributed to any overdose deaths.

Possible Kratom Scarcity and Misuse in the Context of COVID-19

Because of the potential public health impact of kratom scarcity and the international implications of COVID-19, the probable impact of the global pandemic on kratom availability is of significant interest in regard to consumption patterns. Specifically, COVID-19-related disruptions in kratom access/supply and use could increase the likelihood that users turn to more readily available, but more dangerous, products to self-treat symptoms they had primarily used kratom for. Even prior to the pandemic, the kratom supply chain experienced significant, repeated disruptions and episodes of consumer uncertainty. This was at least partially due to the import alert issued by FDA in February 2014 which resulted in companies restricting inventory to avoid FDA seizure (19). Another concern that COVID-19 raises in addition to potential supply chain disruptions is the possibility that people may use or misuse kratom in an attempt to inoculate themselves from COVID-19 infection or to self-treat the various symptoms associated with COVID-19, despite no scientific support for kratom use in such a manner (20, 21).

Origin of Anecdotal Accounts

Although the obtained information is anecdotal, we were able to solicit informal accounts from kratom growers in Malaysia and vendors in the United States (Arizona, Florida, and Illinois) and Europe. Kratom users also provided us with information on the state of kratom supply and personal consumption. Due to the fast-moving nature of COVID-19, we relied on informal, personal networks and publicly advertised vendors to compile a sense of the situation over a period of 3 months between March and May 2020, rather than undertake a systematic study of a continually evolving situation. We believe that these anecdotal accounts will help researchers identify key areas of focus in the coming year.

DISCUSSION

Kratom Growers and Vendors

Using community and personal contacts, we were alerted to several important factors that warrant investigation. First, due to shelter-in-place orders and social distancing restrictions, kratom growers in Malaysia experienced problems selling their harvest. Further, the initial rigid phase of the movement control order disrupted distribution of kratom supply from kratom plantations to consumers, chiefly among those who have been using kratom to self-treat SUDs. Disrupted trade routes via sea or air have been reported for some kratom products, although it is unknown to what degree this has impacted global kratom supply to date. Kratom vendors in the US and Europe, despite the imposed import bans, primarily obtain their kratom supplies from Indonesia which is the main global exporter for kratom (22). The majority of vendors have not seen changes in supplies of kratom products since December 2019 although they expressed uncertainty as to whether that may change in the future if COVID-19 leads to the imposition of additional commercial restrictions. In response to the uncertainty of the kratom market, many vendors have increased their stock supply in recent months in preparation for potential pandemic-related disruptions. Distributors who obtain a majority of their kratom product from Thailand were able to continue typical purchasing levels until February 2020, which resulted in a stockpile due to shop closures related to mandated lock-downs and social distancing. Vendors are expecting a resumption in purchasing now that some shops are reopening, and anticipate a return to typical sales volume. Though kratom vendors noticed an increased demand for kratom products among users in recent months, they did not perceive that the increase was associated with a novel indication or different uses of kratom. At least one vendor associated the increased demand with the Netflix production "A Leaf of Faith" (released 2018 but still available on Netflix), having several new customers mention their decision to try kratom as a result of having watched the documentary, rather than COVID-19 related issues.

Kratom Users

Given disruptions described above, kratom users in Malaysia encountered problems obtaining their regular kratom supply. The problem worsened when enforcement agencies raided illegal kratom ports in the community—making it more difficult for opioid users and people with SUDs who were self-treating their dependence with kratom to obtain their regular supply. Similarly, due to COVID-19, manual laborers who were daily wage earners lost their income and could not afford kratom products to self-treat medical conditions. Most US kratom users did not discuss difficulties with obtaining kratom products from their usual sources since the outbreak of COVID-19 in their respective locality. Still, users were cognizant of the possibility of kratom shortages if the pandemic continues. Many users feared that they may not have access to their usual products for the rest of the year. To date, this fear has not resulted in users stockpiling kratom, likely due to limited affordability (e.g., most people could not afford to hoard kratom like other, less expensive commodities). Few users mentioned increasing their kratom consumption during COVID-19. Reasons for use primarily centered on alleviating stress or psychiatric disorder symptoms (e.g., anxiety and depression), or continuation of kratom as a means of addressing SUD symptoms. Given the limited number of kratom users informally consulted ($n = 42$), these anecdotes cannot be generalized. Of concern, some sources have noted increases in unscientific claims made by irresponsible vendors regarding kratom's supposed "anti-coronavirus" properties (23). The FDA is issuing warnings to such disreputable vendors and kratom advocacy organizations are condemning misinformation through consumer advisory postings, though the degree to which this misinformation is spreading to users remains unclear and if it differs by nation (21, 23).

Potential Implications of COVID-19 on Kratom Availability and Use

Our on-the-ground conversations provided an outlook of how kratom growers, vendors, and users perceive COVID-19 and its impact, providing a starting point for systematic investigation. According to published user surveys, common reasons for kratom use include the self-treatment of acute and chronic pain, psychological distress, mitigation of dependence and/or withdrawal symptoms from an illicit or prescription drug use (7, 9, 15). While the ongoing pandemic has created uncertainty among vendors and users about kratom availability, it has not, to date, impacted the actual availability of the product in the US. Considering the potential importance of kratom as a self-treatment strategy or harm-reduction component for SUDs, an unanticipated supply disruption may lead to a rise in opioid and other drug use with subsequently increased risk for overdose and fatality. Reduced kratom access may also negatively impact the well-being of individuals who use kratom for the acute relief of psychological distress at a time of increasing socioeconomic uncertainty and stress. COVID-19-related disruptions in kratom availability may also influence or coerce regular users to try more harmful herbal, synthetic, or plant-based New Psychoactive Substances or even illicit drugs in self-managing their aggravating health conditions (24). In an unexpected situation, if there is an imminent increase in kratom fatalities/toxicities arising from the COVID-19 pandemic, enforcement agencies may use the scenario as a precedent to legally or effectively ban kratom use.

Based on import and sales of kratom, there are an estimated 10–15 million kratom users in the US, meaning that disruptions for even a small proportion of regular users could result in an outsized effect (25). In the coming months, it will be important to monitor kratom supplies and purchasing avenues (e.g., Internet and local shops). The Internet will likely be an increasing method for monitoring sales, user reaction to COVID-19, issues related to supply, and motivations for use during the pandemic. It will also be important to raise awareness among healthcare professionals if current kratom users circumstantially experience shortages. In such cases, regular kratom users may come to the clinical attention of healthcare professionals, possibly requiring prescribed treatment options in the absence of kratom (e.g., anxiolytics, antidepressants, analgesics, and opioid agonist therapies). Further information is also needed to improve our understanding on how the impact of COVID-19 is affecting kratom users in terms of obtaining unadulterated kratom products, as well as other important occurrences that could affect kratom supply, patterns of use and its therapeutic popularity among users.

DATA AVAILABILITY STATEMENT

The data generated in this study is subject to the following licenses/restrictions: Datasets are on a secured cloud drive as part of larger datasets. Requests to access these datasets should be directed to Oliver Grundmann, grundman@ufl.edu.

AUTHOR CONTRIBUTIONS

DS and OG conceptualized the paper. All authors revised and finalized the paper.

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Conflict of Interest: JH is an employee of Pinney Associates which provides consulting services on the development and regulation of pharmaceuticals, cannabinoids, and dietary supplements including kratom and advises the American Kratom Association on Kratom science. PB provides scientific guidance on dietary supplement manufacture and regulatory compliance to companies, associations, and government and in her capacity as Director of Applied Research at BCIT engages in contract research on medicinal plants, including Kratom. AG-R serves as a scientific advisor for ETHA Natural Botanicals, a distributor of kratom supplements.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The handling editor and two of the reviewers, JC and SC, declared a shared affiliation, though no collaboration, with two of the authors, EC and OC, at the time of review.

frontiers in Psychiatry

PERSPECTIVE
published: 27 November 2020
doi: 10.3389/fpsyt.2020.602033

Developments in Drug Addiction During COVID-19—An Austrian Perspective Based on a Clinical Sample

Isabella Fuchs-Leitner[1,2], Kurosch Yazdi[1,2], Nikolas W. Gerstgrasser[1,2] and Jan Rosenleitner[1,2]*

[1] Department of Psychiatry - Specialization Addiction Medicine, Kepler University Hospital, Linz, Austria, [2] Faculty of Medicine, Johannes Kepler University Linz, Linz, Austria

Concerns about the negative consequences of the COVID-19 pandemic on people with substance use disorder (SUD) were raised by experts in the field around the world. Here we provide an Austrian perspective, discussing the impact of the pandemic on help-seeking patient with drug use disorder during the initial stage of the pandemic. Our perspectives are based on the situation as perceived at our clinical facility, and supported by original data collected from a small clinical sample of patients with drug use disorder ($N = 32$). The viewpoints and related descriptive data include the perceived individual impact of COVID-19, as well as various aspects of drug use behavior and the Austrian drug market before and after the onset of the pandemic. The consequences for a subgroup of patients in opioid substitution treatment ($N = 24$) are discussed. Surprisingly and in contrast to anticipated developments, we had the impression of a rather stable situation in Austria, at least at this early stage of the pandemic. The immediate impact of COVID-19 on these help-seeking patients with high levels of drug dependency seemed less severe than anticipated so far. Importantly, this observation might be a short-term effect for this already fragile group and careful monitoring of further developments as well as preparation of long-term strategies are advised. In general, problematic drug use is associated with many health risk factors and finding appropriate long-term health care strategies has to remain a top priority facing the pandemic. Our perspectives are restricted to observations from help-seeking patients at our clinic, and no conclusions for the general population can be directly drawn.

Keywords: COVID-19, drug addiction, consumption pattern, illicit drug market, opioid substitution therapy (OST)

OPEN ACCESS

Edited by:
Giuseppe Bersani,
Sapienza University of Rome, Italy

Reviewed by:
Dan P. Covey,
University of Maryland, Baltimore, United States
Diana Martinez,
Columbia University, United States

***Correspondence:**
Kurosch Yazdi
kurosch.yazdi@kepleruniklinikum.at

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *02 September 2020*
Accepted: *05 November 2020*
Published: *27 November 2020*

Citation:
Fuchs-Leitner I, Yazdi K, Gerstgrasser NW and Rosenleitner J (2020) Developments in Drug Addiction During COVID-19—An Austrian Perspective Based on a Clinical Sample. Front. Psychiatry 11:602033. doi: 10.3389/fpsyt.2020.602033

INTRODUCTION

Experts around the world have clearly articulated their concerns about the impact and consequences of the COVID-19 pandemic on the mental health. The impact of COVID-19 might be particularly challenging for vulnerable populations (1) including people suffering from substance use disorder (SUD) (2). The reciprocal impact between Covid-19 and SUD have been described, categorized in spread of disease, risk of infection, increased severity of COVID-19 symptoms, psychological stress, and reduced access to addiction treatment services (3). Reports from different countries suggest reduced availability of illicit and prescribed drugs, altered consumption patterns, higher probability of relapse, and even elevated risk of deadly overdose without opportunity for rescue due to social distancing and isolation (4–8). All this is seen as a result of government control strategies and border closures, leading to interruptions in illegal drug supply, self-manufacturing of substances, changes in quality and strength of those substances, poor access to health services, psychological stress due to isolation, worries about employment, and personal financial situation and even suicide (9–13).

As a direct consequence, people who use drugs (PWUD) are at higher risk of COVID-19 from a physiological perspective (4). Preexisting conditions regarding the respiratory system from inhalation drugs, damaging effects of drugs on the cardiovascular system and an overall worse health condition further increase the risk of mortality associated with COVID-19 (10). In fact, mortality in the population with OUD appears to be higher than in the general population (6). From a psychological perspective, recent literature indicate a serious impact of COVID-19 on the feelings, thoughts and behavior of patients with substance addiction (14, 15). The current pandemic can lead to indirect consequences on PWUD, as additional stressors on mental health conditions could trigger relapses (5). Direct and indirect consequences can even grow more acute for PWUD given the poor access to health services (9). For patients in opioid substitution treatment (OST), misuse and diversion of OST medicine can result in many negative effects on health, including risks from injecting behavior and overdose, and these problems have been discussed long before the COVID-19 crisis (16). Furthermore, progress in recovery might be at risk and the indirect impact on the whole society ranges from economic costs of untreated opioid dependence to drug-related criminal behavior (17). In the context of COVID-19, experts warn about fatal opioid poisoning due to increased medication diversion (10). People in OST already experience vulnerabilities in their medical, mental, and social health (13), making the COVID-19 pandemic as potential source of additional distress especially challenging. Providing stable OST services for this clinical population is therefore advised to remain a priority (13).

Regarding the initial stage of the pandemic in Austria, cases of confirmed COVID-19 (total population of 8.859 Million) are displayed in **Figure 1** between March and June 2020. Government measures for health care systems included reduction of face-to-face contacts, postponement of non-urgent procedures and major restrictions for outpatient clinics. For most patients in OST, less strict regulations were applied for medication prescription (extension from 1–2 months) and dispensation (from daily to weekly). In sum, Austria adopted early and aggressive control strategies (18). Development of COVID-19 incidents and mortality was comparable to other European countries like Germany or Switzerland at this stage of the pandemic.

Closely looking at the situation reported by health care systems of other countries, we feared a major impact on our drug addicted patients, whether in OST or not. As the largest addiction care facility in our province (Upper Austria) we prepared for different scenarios including an onrush of patients suffering from withdrawal due to reduced availability of illicit drugs or relapse of former patients, loss of contact in ongoing OST due to restricted access to our outpatient clinic, severe intoxications due to altered consumption patterns, etc. As an attempt to quantify the impact of COVID-19 pandemic on our patients, we added specific questions to our routine anamneses for later analysis.

Data is presented in a descriptive manner additionally to our perspectives in the following sections (for more details see tables in the **Supplementary Material**). Our sample consisted of 32 patients (27 male, 5 female; mean age = 28.8 years), who sought treatment for drug addiction at our clinical facility. Data collection was conducted in accordance to the Declaration of Helsinki and approved by the local ethics committee. Current drug consumption was evaluated by the first four items of the "Drug Used Identification Test" (19) [DUDIT-C (20) with a total score ranging between 0 and 16], whereas subjective craving was indicated by the patients on a 5-point Likert-scale ranging from 0 (no craving) to 4 (strong craving). Additionally, various aspects of drug consumption patterns and drug supply (e.g., availability and prices) were evaluated, and perceived changed due to COVID-19 were documented. For patients in substitution treatment (N = 24) misuse and concomitant use of other drugs were assessed. Data collection started 1 month after the onset of the COVID-19 crisis in Austria, determined by the first official Austrian government measures mid of March 2020. Data was collected for 2 months (mid of April until mid of June 2020). Please note that this original data supports our personal perspectives, but that our views are based on our general perception of the situation in a clinical setting at the beginning of the pandemic.

PERSPECTIVES

Individual Impact of COVID-19 on Drug Use Behavior

Our overall impression at our clinical facility was that patients were less affected by the pandemic than anticipated. In this clinical setting often mostly highly addicted patient are treated, which is also reflected by high levels of drug dependency in our sample (mean DUDIT-C score = 9.9; mean craving = 2.3, correlation coefficient Spearman's $rho = 0.43$, $p = 0.015$). The impact of COVID-19 on personal life was categorized into physiological, psychological, economic, social, and other aspects, and indicated by the patients as either absent or present (see **Table 1**).

At the beginning of the pandemic, especially psychological and social aspects seemed to affect the personal life. Among our sample, struggling with anxiety, fear, and isolation was reported, but no direct association with factors due to COVID-19 could be observed for levels of craving or drug dependency.

From our point of view, drug consumption patterns seemed hardly affected by the COVID-19 pandemic among the patients in Austria at the initial stage. Preferred drugs and consumption forms appeared to be unaltered by COVID-19, which was also reflected in our sample. (All consumed drugs and substances, as well as those indicated as "preferred drug" are displayed in **Supplementary Table 1**). None of our patients indicated a

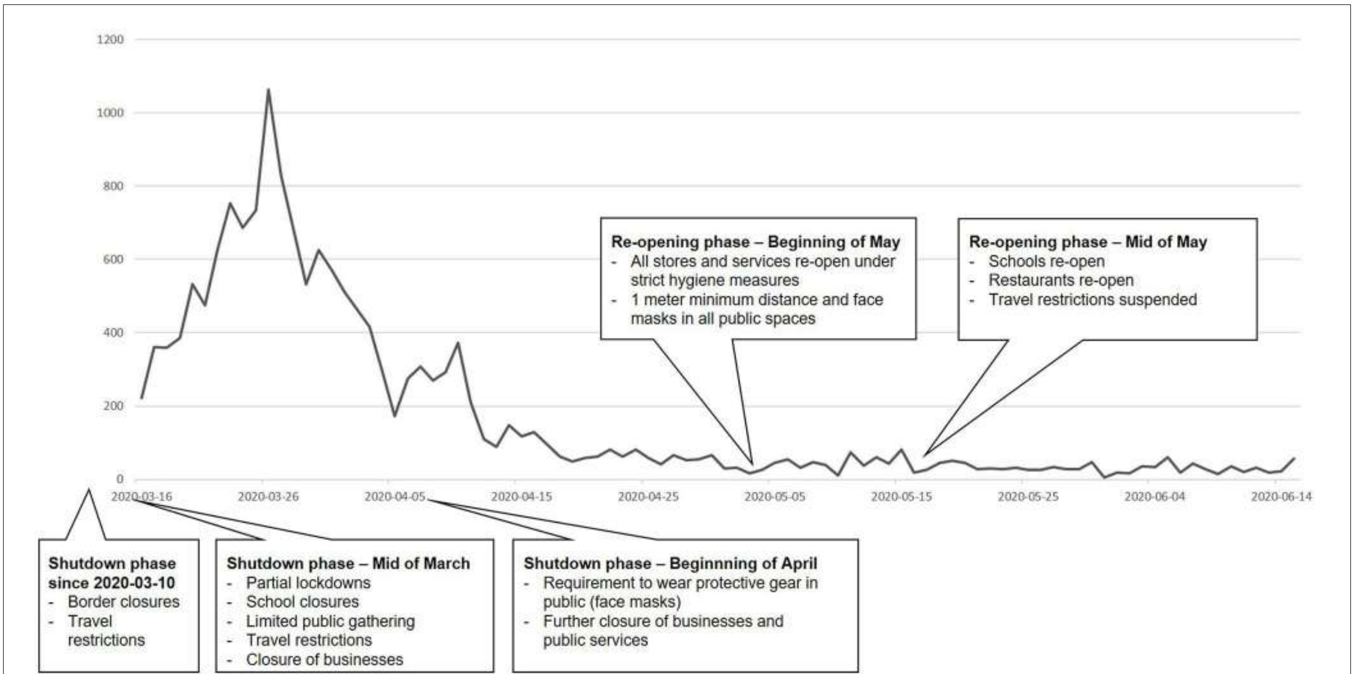

FIGURE 1 | COVID-19 in Austria between mid of March and mid of June 2020: confirmed cases per day and related government measures during the shutdown and re-opening phases.[1]

TABLE 1 | Individual impact of COVID-19 on different areas of life: Physiological, psychological, economic, social, and other factors are displayed with respective examples, total numbers and percentages ($N = 32$; multiple references were possible).

COVID-19 factors	Examples	Total number	Percent
Physiological	Health problems; access to health care	10	31.3
Psychological	Anxiety; depression; anger	20	62.5
Economic	Financial troubles; job loss	9	28.1
Social	Isolation; visitor restrictions	16	50.0
Others	Drug acquisition	10	31.3

change in their preferred drug, nor how they consumed it (i.e., inhalative, intravenous, oral etc.) before and after the onset of COVID-19. Related government measures like physical distancing resulted in reduced contact only for the minority of our participants, in terms of consuming alone instead of in groups or only in private spaces. Furthermore, we found a wide range of consumed illicit drugs in our sample, with many reporting regular consumption of more than one substance or drug. The unaltered pattern of consumption is also tightly connected to a stable drug availability at the illicit drug market.

Our impression is that this group of patients was struggling with many aspects brought along by the pandemic. These aspects include high levels of unemployment, financial instability, health problems, social isolation, and psychological stress. This might be a reason why the observed direct impact of COVID-19 on drug use behavior seems less severe at this initial stage, but can result in fatal long-term effects, if no specific treatment for this group is provided. Therefore, a special emphasis on this already deprived population is of utmost importance to avoid a further downward spiral, and enabling access to psychological support and therapy is essential during the next phases of the pandemic.

Developments at the Illegal Drug Market in Austria

Developments of the illegal drug market were deflected by participants' information regarding source, pricing and quality of illicit drugs, as well as other aspects of drug supply and potential changes due to COVID-19 (see **Supplementary Table 2**). The way of receiving drugs (active: having to leave the house; passive: getting drugs delivered) did not change for any of our participants, even though government measures included movement restrictions.

Only 16% of our sample reported changes in their usual source of drugs due to COVID-19. In terms of availability and pricing, only a small proportion reported increased difficulties (from 9% before to 22% after COVID-19) in obtaining certain substances. An increase in pricing was indicated by 20% of our patients and reported for heroin, cannabis, and methamphetamine. The majority of our patients (81%) judged the quality of the

[1] Sources: www.data.gv.at/covid-19; www.acaps.org

consumed substances unaffected by the pandemic. Stockpiling of drugs due to concerns about future availability was not observed in our study, and expected disruption in drug availability (21) could rarely be observed.

Overall, the situation at the Austrian drug market seemed stable at the initial stage of COVID-19. This might be related to the fact that in Austria COVID-19 incidence (i.e., confirmed cases relative to the size of the population) was lower compared to many other European countries and also worldwide so far (18). This overall impression of stability is in line with expert opinions on drug retail prices and availability at the consumer level reported for Austria (EMCDDA: European Monitoring Center for Drugs and Drug Addiction) (22). According to this report, this stability on the drug market could also be observed for Czechia, Hungary, Netherlands, and Sweden, whereas changes were perceived for countries heavily impacted by COVID-19 like France or Spain (22). In contrast, the EMCDDA expected a decline in drug use during the first 3 months of the pandemic (as summarized in their related trendspotter briefing) (23). While this might be true for other countries or in other populations with lower levels of drug dependency like recreational drug users or social substance use, our results did not confirm this anticipation. This observation is restricted to the initial stage of the pandemic, but we do not expect a long-term diminution for this specific population due to lack of drug availability or increase in pricing. In other words, drug addiction will not disappear due to outer circumstances, and again, stability in treatment and therapy is strongly advised.

Patients in Opioid Substitution Treatment: Misuse and Concomitant Use

Misuse and concomitant use among patients in OST appeared to be a prevalent problem, even before the pandemic. We anticipated that the less restricted access to substitution medicine might lead more patients to use OST medication divergent from its purpose. From our point of view, it would also have been possible that disruption in illicit drug supply might lead patients to less concomitant use of other drugs. Another expectation was that new patients were prone to start OST due to a potential lack of availability in opioids at the illicit drug markets. All of these anticipations were not confirmed by our observations.

Among our sample of patients in OST misuse and diversion were found to be very common. Patients in OST ($N = 24$) were evaluated as a subsample regarding misuse and diversion of OST medication, as well as concomitant use of other illicit drugs (see **Supplementary Table 3**). In Austria pharmacological treatment in OST includes buprenorphine, buprenorphine/naloxone, methadone, levomethadone, and retarded morphine. In our sample 79% reported concomitant use of other illicit substances. Misuse (e.g., injecting or snorting) of the prescribed oral OST medication was indicated by 50%, with estimates on how often they used their OST medication divergent from the prescription ranging from 20 to 100% (mean 92.5%). In respect to diversion, 16.7% reported additional consumption of unprescribed OST medication. We further asked all participants ($N = 32$) for their judgment on the frequency of misuse and diversion of OST medication in their social environment. Fifty-six percentage indicated misuse of OST medication by others, with estimated misuse frequencies ranging between 20 and 100% (mean = 79.4%). Again, no changes between before and after the onset of COVID-19 were observed. The remaining 44% of participants did not provide an answer.

Importantly, no changes in consumption patterns related to OST due to COVID-19 were indicated at all. In Austria, access to health care providers (1) was less affected than the situation required in heavily impacted countries like Italy, Spain, or France. Essentially, regulations regarding prescriptions for OST medication were temporarily eased to ensure maintenance of therapy despite the lock down. It is widely acknowledged that misuse and regular concomitant use of illicit drugs in addition to prescribed OST medication is highly prevalent among these patients (17). In our opinion, the impression that the less rigid OST supply policies had no direct impact on these problematic topics, could only be a short-term effect and the situation can get out of hand rapidly. From our perspective, during lock-down only the main pharmacological supply of these patients was enabled, while long-term treatment including psychological and psychiatric support was nearly impossible due to restricted access to all outpatient clinics. For the future, it is important to provide patients suffering from addictive disorders with all possible resources in order to maintain a high standard in addiction care practice, including use of telehealth and adopting proactive policies (3). In this context, we strongly recommend the EMCDDA's conclusion that developments in the area of PWUD due to COVID-19 should be closely monitored in respect to potential risky and hazardous patterns of use (23).

Risk of Overdose Due to COVID-19

Many factors that are brought along by the predominant COVID-19 crisis lead to an anticipated increase in overdoses and fatal outcomes, including disruption in drug supply and social distancing (13). In Austria these risk factors seem to play a minor role so far, which can only be indirectly deduced from our study. At least for now, drug availability is not a major concern as indicated by our participants. Fear of overdose was prevalent in only 13% of patients in our sample and even dropped to 6% since the onset of COVID-19. This lack of awareness of possible overdoses in our sample is also a cause for concern, as the majority of our participants usually consumed alone, even before the onset of the pandemic. This bears the danger that no help can be administered in case of an overdose as discussed earlier (7). Crucially, our observations are restricted to patients in treatment. We can therefore not assure that drug users, who are not seeking help, might be at greater risk of overdose during the pandemic. Therefore, emphasizing the increase of potential overdoses for persons who use drugs due to many factors brought along by COVID-19 should be implemented in current health care strategies.

DISCUSSION

At the initial stage of the pandemic, the impact of the COVID-19 pandemic in terms of incidents and mortality has been less severe in Austria compared to other countries in Europe and worldwide. From our point of view as a clinical facility treating patients with drug use disorder, drug use behavior, and the drug market seemed also less directly affected by COVID-19 than anticipated in Austria, at least at the initial stage of the pandemic. This is also reflected in our data collected from a small clinical population of patients with a high level of drug dependency. Although this group clearly indicated an impact of the pandemic on many aspects of their personal life, individual drug use patterns seemed less affected at this initial stage. Furthermore, the Austrian drug market in terms of pricing and availability appeared also rather stable, which is in line with other expert opinions and our overall observations at our clinical facility. The overall maintenance of the Austrian health system due to the less severe impact of COVID-19 so far could be hypothesized as possible reasons for the stable drug situation.

We urge to not misinterpret this surprising lack of direct massive impact of COVID-19 on this clinical group as an all-clear. In fact, close monitoring of the development of this clinical population is of great importance, since long-term effects have yet to be investigated. For instance, the already difficult job situation for patients struggling with addiction might result in long-term negative consequences given the general increase in unemployment due to COVID-19 in the general population. Furthermore, existing psychological problems might deteriorate resulting in higher numbers of comorbidities and co-addictions. Finally, pushing this clinical group further to the edge of society can have severe consequences for their well-being. In this still ongoing pandemic it cannot be foreseen, when the impact on this already deprived population struggling with many problems reaches its peak and the situation starts getting out of control. Therefore, stability in access to addiction treatment should be emphasized with regard to the COVID-19 pandemic and resulting government measures.

Prevalent misuse and concomitant use in OST are particularly alarming and need to be addressed rapidly, while maintaining a high standard in care. This is especially challenging during the COVID-19 pandemic, with many resources of the health care system fully occupied with controlling the disease and its impact on other mental health issues. With COVID-19 on the rise again and the multiple known risk factors for people with drug addiction, development of long-term strategies to improve the outlook for this vulnerable group cannot be neglected.

In conclusion, the immediate impact of COVID-19 on highly addicted patients with drug use disorder in treatment, was less severe than expected. We emphasize, that our perspectives are based on observations at a clinical facility and restricted to the described clinical sample. As a major health care provider in our region (Upper Austria), a wide range of consequences on our patients can directly be observed and developments on the Austrian drug market can be deflected from our patients' reports. However, we emphasize that no direct conclusions for the general population can be drawn from our impressions and our small sample.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Commission of the Medical Faculty of the Johannes Kepler University Linz. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

IF-L: conceptualization, formal analysis, methodology, and writing—original draft preparation. KY: supervision, data curation, resources, and writing—review. NG: conceptualization, data curation, and writing—review. JR: conceptualization, data curation, data preparation, and writing—review & editing. All authors: contributed to and have approved the final manuscript.

ACKNOWLEDGMENTS

We are very grateful to the medical staff at the Department of Psychiatry - Specialization Addiction Medicine of the Kepler University Hospital for their valuable help with data collection.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.602033/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 16 December 2020
doi: 10.3389/fpsyt.2020.620612

Impact of the COVID-19 Pandemic on Patients With Alcohol Use Disorder and Associated Risk Factors for Relapse

Kurosch Yazdi[1,2], *Isabella Fuchs-Leitner*[1,2]*, *Jan Rosenleitner*[1,2] and *Nikolas W. Gerstgrasser*[1,2]

[1] *Department of Psychiatry - Specialization Addiction Medicine, Kepler University Hospital, Linz, Austria,* [2] *Faculty of Medicine, Johannes Kepler University Linz, Linz, Austria*

Background: The impact of the ongoing COVID-19 pandemic on vulnerable groups like patients suffering from substance use disorders is expected to be tremendous, and corresponding concerns were raised early on by many experts around the world. Psychosocial distress, financial insecurities and physiological problems associated with the COVID-19 crisis could be especially challenging for this group of patients.

Methods: In the current study data was collected from a clinical sample of patients with alcohol use disorder (AUD; $N = 127$) during the initial stage of the pandemic. The impact of various COVID-19 related factors (physiological, psychosocial, economic and others) on patients' personal life was evaluated. Alcohol consumption, craving, and potential posttraumatic stress disorder (PTSD) symptoms were assessed using different scales and their associations were analyzed. Furthermore, differences regarding these variables between comparably sized groups of patients who remained abstinent ($N = 37$), relapsed ($N = 41$), or reported unaltered drinking behavior (consuming subgroup, $N = 49$) were investigated. The impact of sociodemographic and COVID-19 factors on relapse (in comparison to abstinence) was evaluated using binary logistic regression analysis.

Results: Our results confirmed the expected positive associations between alcohol consumption, craving, and PTSD symptoms, respectively, among patients with AUD. Furthermore, group differences indicate significantly lower levels on all three scales for abstinent patients. Although generally low PTSD scores were observed, 8% of our participants were found to be at risk of PTSD. Results of a binary logistic regression analysis indicated the presence of psychosocial COVID-19 factors (e.g., isolation, anxiety, and depression) as well as living alone as two major risk factors for relapse.

Discussion: Our findings based on actual patient data support the anticipated negative consequences of the pandemic on persons with AUD. Crucially, our results regarding relapse emphasized psychosocial COVID-19 factors and isolation as especially challenging circumstances for persons with AUD, whereas economic and physiological health aspects seemed of minor impact on relapse. Our results reflect the initial stage of the pandemic, whereas long-term developments should be closely monitored.

Keywords: COVID-19, alcohol use disorder (AUD), relapse, psychosocial impact, PTSD symptom, isolation

OPEN ACCESS

Edited by:
Fernando Barbosa,
University of Porto, Portugal

Reviewed by:
Antoni Gual,
Hospital Clínic de Barcelona, Spain
Giuseppe Carrà,
University of Milano-Bicocca, Italy

***Correspondence:**
Isabella Fuchs-Leitner
isabella.fuchs-leitner@kepleruniklinikum.at

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *23 October 2020*
Accepted: *24 November 2020*
Published: *16 December 2020*

Citation:
Yazdi K, Fuchs-Leitner I, Rosenleitner J and Gerstgrasser NW (2020) Impact of the COVID-19 Pandemic on Patients With Alcohol Use Disorder and Associated Risk Factors for Relapse. Front. Psychiatry 11:620612. doi: 10.3389/fpsyt.2020.620612

INTRODUCTION

The current pandemic with a novel corona virus, SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), and its worldwide spreading is extensively impacting on the global physical and mental health. At the end of 2019, a cluster of atypical cases of pneumonia was observed in Wuhan, Hubei Province, China (1), which shall be designated as *Coronavirus disease 2019* (COVID-19) by the World Health Organization (WHO) on February 11, 2020 (2). Rapidly evolving, on March 11, 2020, the WHO made the assessment that the outbreak could be characterized as a global pandemic (2). The reported symptoms of COVID-19 are primarily respiratory with acute respiratory distress syndrome ultimately leading to death in the most severe cases (3). Effects on other organs, including the brain, and neurological symptoms due to COVID-19 infection have been recently reported [for a recent review see Vindegaard et al. (4)].

Alongside the obvious physiological impact of COVID-19, economic, psychosocial and other COVID-19 related factors immensely affect further areas of life during this ongoing pandemic. From an economic perspective, social distancing, self-isolation and travel restrictions have led to a reduced workforce across all economic sectors (5). Hence, insolvent businesses, job losses and financial insecurities are unavoidable consequences. Taking that into account, the economic impact of the COVID-19 pandemic seems to be a substantial source of distress.

Psychosocial impact of the pandemic is far-ranging, and increases in stress, anxiety, depressive symptoms, sleep disorders, denial, anger, and fear, have been clearly articulated (6, 7). Short-term and long lasting mental health impacts of COVID-19 on the general population are not yet quantifiable, but are expected to be tremendous (8). COVID-19 associated government measures like physical distancing and the uncertainty about future development additionally worsen the prospects of mental health issues (9). The psychological impact of quarantine was reviewed in detail by Brooks et al. (10).

In particular, the current pandemic and its related psychological stressors are expected to promote PTSD due to COVID-19 as a common psychiatric response (11). A high prevalence of posttraumatic stress was evident in China's hardest-hit areas 1 month after the COVID-19 outbreak (12). The COVID-19 pandemic is associated with significant levels of psychological distress in the general population (13, 14). Similar findings were reported in Italy (15).

Although the COVID-19 crisis is unique in many aspects, studies on former pandemics (e.g., SARS outbreak in China in 2003) implicate higher levels of stress and psychological distress among SARS survivors during and even 1 year after the outbreak (16). In this context, distress was a frequently observed symptom in the general Chinese population with up to 35% during the initial phase of the COVID-19 pandemic (17). Data from an anonymous online questionnaire survey showed a prevalence of PTSS of 4.6% in mainland China 1 month after the outbreak of the virus (18). 14.6% of participants of an Italian survey (15) were in the high range and 12.6% in the extremely high range according to the stress subscale of the *Depression, Anxiety and Stress Scale—21 items* (DASS-21) (19). In a recent study, Di Crosta et al. found that 35.6% ($N = 446$) scored above the cutoff score on the *Impact of Event-Scale – Revised* (IES-R) (20) and thus belonged to the high-PTSD group (21). This high number of participants at risk of PTSD in the general population is alarming. Limited access to mental health services during the pandemic may even deteriorate the situation, and global strategies are indispensable facing the related mental health issues.

Impact of COVID-19 on Addictive Behaviors and Disorders

Unsurprisingly, the COVID-19 pandemic can alter pre-existing or trigger new addictive behaviors. In this context, an increased prevalence (4.3%) of severe Internet use disorder, as well as rising numbers of relapse in alcohol (19%) and smoking abuse (25%) were reported (22). These three behaviors were interpreted as coping strategies during this crisis. As anticipated, distress (especially during long periods of isolation) resulting from this pandemic may result in negative emotions and related maladaptive coping styles (23). However, results from various European studies on the general population indicated both, increases and decreases in alcohol consumption. According to an UK-survey 21% of the participants reported to drink alcohol more frequently and 15% to drink more alcohol per session during the lockdown than before. In the subgroup of daily drinkers 18% increased their amount of alcohol (24). The same study reported that a third stopped drinking or reduced their frequency since the lockdown in March, whereas 6% ceased drinking alcohol entirely (24). A study from Poland even found that alcohol was the most commonly used psychoactive substance in this country (almost 73%), followed by tobacco smoking (25%) during the initial stage of the pandemic (25). According to this survey, 14% of the participants reported to drink more alcohol, whereas 16% consumed less alcohol than pre-epidemic. An Austrian study reported an increase in alcohol consumption in 14% of participants and 2% even just starting to drink alcohol due to the COVID-19 crisis (26).

The COVID-19 crisis might affect vulnerable persons particularly hard (27). Physiological aspects in this context might be even more distressing among this group, since marginalized communities—especially those with substance use disorder (SUD) (28)—are at greater risk of worse COVID-19 outcome (29). Pre-existing cardio-pulmonary morbidities, compromised immunity, mucociliary dysfunction and altered health-seeking behavior might additionally increase the risk of infection for patients with SUDs [for an overview see Dubey et al. (29)]. An overall worse health condition and damaging effects of drugs on the cardiovascular system might further increase the risk of mortality associated with COVID-19 (28, 30). Anticipated psychological consequences of the pandemic, including depression, anxiety, irritability and anger among persons suffering from SUD, are expected to heighten the risk for relapse into a new episode of drug use (28).

In respect to alcohol use disorder (AUD), alcohol consumption leads to a significantly higher risk for contracting bacterial and viral lung infections (including COVID-19) (31).

Psychosocial distress might be particularly challenging for patients with SUDs, since social distancing and quarantine might intensify isolation and loneliness (32). In this context, living alone is associated with a greater risk of suffering from SUDs in older adults (33). Furthermore, family support was emphasized to play a crucial role in preventing relapse of persons with addiction problems (23), challenging especially for those patients who were living alone during lockdown phases. Economic aspects including job loss might worsen potential preexisting financial troubles and poverty (30). In fact, studies on economic crises found associations between an increase in unemployment with a substantial increase (28%) in mortality due to SUDs and higher numbers of suicide (4.5%) (34). Additionally, the pandemic disproportionately affects people with SUDs by diminishing resources that people with SUD need for their recovery and wellbeing (32).

Combining these aspects, deterioration of preexisting conditions such as AUD and associated relapse were anticipated (30). In general, pre-existing mental disorders (including SUDs) increase the risk of relapse during the pandemic (27). A recent study from China reported almost a fifth (18.7%) of abstinent persons suffering from AUD who relapsed during the first phase of the pandemic, and about a third of regular drinkers increased the amount of consumed alcohol (22). In line with these findings, a study from the UK observed that 17% of former abstinent patients relapsed during lockdown (35). Naturally, addiction psychiatry is facing major challenges during this pandemic to maintain high standards in care (36).

A recent study on the impact of the COVID-19 pandemic on various addictive disorders in Italy found relatively high rates of depression, anxiety, irritability, and posttraumatic stress symptoms among a clinical sample of patients suffering from different SUDs (including alcohol, cocaine and THC). Furthermore, the authors evaluated quality of life and craving in this context (37). Craving is one of the key symptoms and predictor for relapse in patients with addictive disorders (38). They found positive associations between craving with symptoms of depression, anxiety, and traumatic stress (37). Associations between stress and anxiety levels with increased alcohol use during the initial stage of the pandemic have already been demonstrated (39). Furthermore, addictive disorders and PTSD seem to be interconnected (40), and AUD and PTSD are both known outcomes of former crises (41).

COVID-19 Situation in Austria

Incidents of confirmed COVID-19 cases in Austria (total population of 8.859 Million) between March and June 2020 are displayed in **Figure 1**. The first case of COVID-19 was confirmed on February 25, 2020. The government responded to the quick increase of cases in mid-March with massive restrictions and a shutdown phase including partial lockdowns. After a drop in COVID-19 cases , the first reopening phase began at the beginning of May with the reopening of stores and services under strict hygiene measures. The next reopening phase mid-May included the reopening of schools and restaurants, as well as the suspension of travel restrictions and border openings. The development of COVID-19 cases and mortality during this initial phase was comparable to other European countries like Germany or Switzerland.

Aims and Research Questions

Concerns about the multifaceted consequences of the pandemic on patients with SUDs were raised early in this pandemic (29, 32). However, studies including clinical populations are rare so far. The current study therefore aimed to investigate addictive behavior, craving, and PTSD symptoms, as well as various COVID-19 factors directly in a clinical sample of patients with AUD during the initial stage of the pandemic.

First, associations between current alcohol consumption (i.e., frequency, quantity and heavy drinking days), subjective craving and PTSD-symptoms were assessed. Second, differences regarding these aspects between groups of patients who remained abstinent, relapsed, or showed unaltered alcohol consumption behavior (i.e., were still consuming) after the onset of COVID-19 in Austria were evaluated. Third, the impact of different sociodemographic and COVID-19 related factors on relapse (vs. abstinence) during the beginning of the pandemic were investigated.

MATERIALS AND METHODS

Participants

Data was collected from patients diagnosed with AUD (N = 127) at our inpatient and outpatient facilities as part of routine anamneses. This study includes a retrospective data analysis and was conducted in accordance to the Declaration of Helsinki and approved by the local ethics committee. Data was processed and analyzed anonymously. All patients seeking help at our facilities between the beginning of April and mid-June 2020, who were diagnosed with AUD and consented to provide their responses were included in this study. From our total sample 41.7% were treated at our inpatient facilities. Outpatients were assessed either in face-to-face consultations (24.4%) or via telephone (33.9%).

According to their current state of alcohol consumption with respect to the beginning of the COVID-19 pandemic in Austria, participants were classified into three subgroups: persons remaining abstinent (N = 37), patients suffering relapse since mid-March (N = 41) and those still consuming (unaltered since COVID-19; N = 49). Descriptive summary statistics of sociodemographic variables of the total sample and the three subgroups are shown in **Table 1**.

Procedure

Data was collected shortly after the onset of the COVID-19 crisis in Austria for 10 weeks (between the beginning of April until mid-June 2020, see also **Figure 1**). Relevant sociodemographic information (e.g., age, gender, living alone, access to outdoor spaces during the lockdown) was collected as part of routine anamneses.

Current alcohol consumption was assessed by the German version of the *Alcohol Use Disorder Identification Test* (consumption part: AUDIT-C) (42). The AUDIT (43) is a widely used screening tool developed by the World Health Organization (WHO). The short version AUDIT-C consists of the first three questions of the AUDIT and relates to alcohol consumption (frequency, quantity, and heavy drinking days) with a total range from 0 to 12. To identify alcohol misuse, screening thresholds of 4 (in men) and 3 (in women) are recommended. Subjective craving was indicated by the patients on a 5-point Likert scale (ranging from 0 = no craving at all to 4 = intense craving).

To evaluate the presence of PTSD and indicated stress symptoms triggered by COVID-19 the German version of the *Primary Care PTSD screen for DSM5* (PC-PTSD5, range 0–5) (44) was used. The screening tool consists of five questions about how a traumatic event has affected the patient over the past month. These questions correspond to DSM-5 criteria for PTSD and include typical symptoms like re-experiencing, numbing, avoidance, hyperarousal, and guilt. Patients were asked to respond exclusively with respect to the COVID-19 pandemic and related government measures as a potential traumatic event.

The impact and burden of COVID-19 related factors on patients' personal life was evaluated. To that end, patients were asked to determine the presence or absence of different aspects in regard to the COVID-19 pandemic that resulted in personal worries or problems. The corresponding answers were categorized into four different COVID-19 factors. Physiological aspects included all health problems, as well as access to health care in relationship to the COVID-19 pandemic. Economic factors ranged from financial problems, economic uncertainty to job loss due to the pandemic. Psychosocial aspects included negative emotions such as depression, fear, anxiety, and worries about others, as well as a reported psychological burden as a result of isolation during this initial stage and lockdown. A reported lack of access to alcohol, as well as closing of bars were summarized as other factors. Each of these four COVID-19 factors was registered as either absent or present for each participant.

Statistical Analysis

Data was analyzed using IBM SPSS Statistics for Windows (Version 25.0) (45). Descriptive statistics such as (relative) frequencies for nominal variables are presented. Ordinal and metric variables are described using the median and the interquartile range or the mean and the standard deviation, respectively. To assess potential associations between the scale scores (i.e., alcohol consumption, craving, and PTSD), spearman rank correlations were calculated for the total sample. Group differences in the scale scores across abstinent, relapsed, and consuming patients were investigated using Kruskal-Wallis tests. Sociodemographic variables as well as COVID-19 factors were analyzed as possible risk factors for relapse, using a binary logistic regression model for the outcome variable relapse (comparison of relapsed and abstinent patients). The significance level is defined as 0.05. Hence, small p-values indicate possible associations between the variables. Detailed information on the applied analyses can be found in the Results section below.

RESULTS

Descriptive Statistics

Descriptive statistics for COVID-19 factors, as well as alcohol consumption (AUDIT-C), craving, and PTSD symptoms

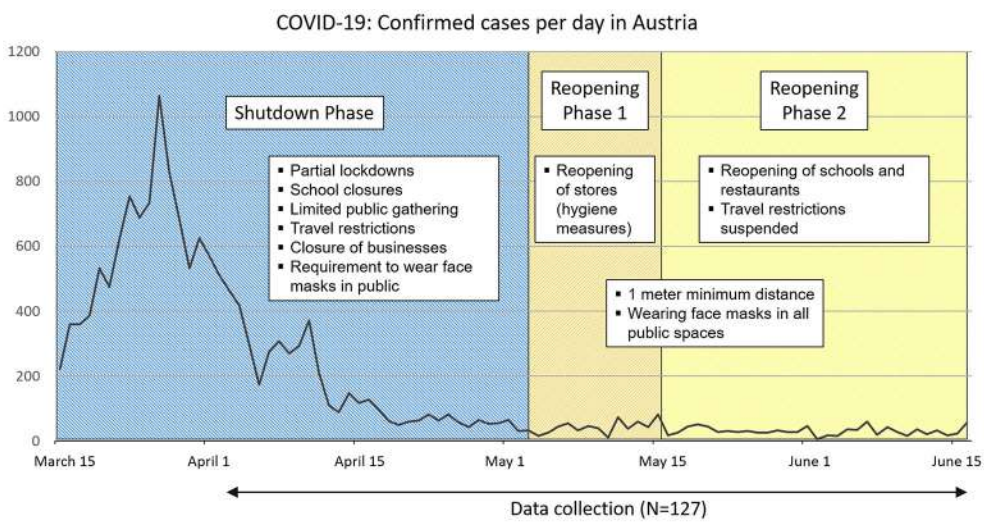

FIGURE 1 | Incidence of COVID-19 cases in Austria and data collection of the study. The confirmed cases of COVID-19 in Austria[1] (total population of 8.859 Million) between mid-March and mid-June 2020 are displayed. Examples of related government measures during the shutdown and reopening phases and the period of the data collection are provided.

[1]Sources: Open Data Austria. Retrieved on July 15, 2020 from: www.data.gv.at/covid-19; Assessment Capacities Project (ACAPS). Retrieved on July 15, 2020, from www.acaps.org

TABLE 1 | Sociodemographic factors of the total sample and the three subgroups respectively.

	Total (N = 127)	Abstinent (N = 37)	Consuming (N = 49)	Relapsed (N = 41)
	Percent/Mean (SD)	**Percent/Mean (SD)**	**Percent/Mean (SD)**	**Percent/Mean (SD)**
Sociodemographic factors				
Age (in years)	49.3 (12.3)	51.0 (13.0)	48.5 (13.4)	48.9 (10.5)
Gender: Male	66.9%	64.9%	63.3%	73.2%
Living alone	42.5%	29.7%	40.8%	56.1%
Outdoor space available	83.5%	86.5%	85.7%	78.0%

SD, standard deviation.
For interval data mean and standard deviation are presented; for dichotomous variables the percentage of the given subset indicating "yes" is displayed.

TABLE 2 | Descriptive statistics for COVID-19 factors and scales in the total sample and the three subgroups respectively.

	Total (N = 127)	Abstinent (N = 37)	Consuming (N = 49)	Relapsed (N = 41)
	Percent	**Percent**	**Percent**	**Percent**
COVID-19 factors				
Physiological factors	24.4%	27.0%	22.5%	24.4%
Economic factors	21.3%	21.6%	16.3%	26.8%
Psychosocial factors	53.5%	32.4%	59.2%	65.9%
Other factors	21.3%	18.9%	24.5%	19.5%
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**
Scales				
AUDIT-C (0–12)	7 (12)	0 (0)	10 (6)	11 (6)
Craving (0–4)	2 (2)	1 (2)	2 (2)	3 (3)
PC-PTSD5 (0–5)	0 (1)	0 (0)	0 (1)	0 (2)

IQR, interquartile range; For dichotomous variables the percentage of the given subset indicating "yes" is displayed; for ordinal data median and interquartile range are given.

(PC-PTSD5) are displayed for the total sample and the three subgroups (abstinent, relapsed and consuming patients) in **Table 2**.

In the total sample (mean age = 49.3 years, 66.9% male), psychosocial COVID-19 factors were reported by the majority of patients (53.5%), whereas burden by physiological, economic and other factors were indicated less frequently (between 21.3 and 24.4%).

Alcohol consumption measured by AUDIT-C scores (range 0–12) were high in the relapsed (median = 11) and consuming (median = 10) subgroups of patients. Craving scores (range 0–4) were also highest among those who relapsed (median = 3) at the initial stage of the pandemic. Regarding PTSD symptoms due to COVID-19, only a third of our patients (31.7%) reported one or more symptoms, resulting in medians of zero for the total sample and the three subgroups. Importantly, 7.9% (N = 10) of the sample were indicated at risk of PTSD due to the pandemic (with a recommended PC-PTSD5 cut-off score of 3 or more) (44). Half of these patients were in the relapsed group, four were in the consuming group and only one patient was in the abstinent group.

Association Between Alcohol Consumption (AUDIT-C), Craving, and PTSD Symptoms (PC-PTSD5)

Spearman rank correlations between alcohol consumption (AUDIT-C) and craving and PTSD symptoms (PC-PTSD5) were calculated for the total sample. (Please note that all abstinent patients scored zero on the AUDIT-C.) Significant positive correlations between all three factors were found, with moderate correlations for AUDIT-C and craving (Spearman's rho = 0.44, $p < 0.001$) and AUDIT-C and PC-PTSD5 scores (Spearman's rho = 0.41, $p < 0.001$), respectively. Craving and PC-PTSD5 scores showed a weak to moderate positive correlation (Spearman's rho = 0.29, $p = 0.001$). These results suggest a positive association between all three variables, indicating higher levels of alcohol consumption (AUDIT-C score) with higher levels of stress (PC-PTSD scores) and craving. Bubble plots of the different combinations of scales, and for the three subgroups are depicted in **Figure 2**.

Groupwise Comparisons for Alcohol Consumption, Craving and Stress

AUDIT-C, craving, and PTSD scores were compared between the three groups of abstinent, relapsed, and consuming patients, respectively, using Kruskal-Wallis tests. Boxplots for the scales per subgroup are shown in **Figure 3**.

A significant difference between the three groups was found for AUDIT-C scores, $H\ (2) = 82.1$, $p < 0.001$, $d_{COHEN} = 2.7$. *Post-hoc* Dunn-Bonferroni groupwise tests showed significant differences between the abstinent group and both relapsed ($p < 0.001$) as well as consuming patients ($p < 0.001$), respectively. Note that all patients in the abstinent group scored zero on the AUDIT-C. This finding therefore indicates the obviously higher alcohol consumption scores for the two other subgroups. Relapsed and consuming patients did not differ with respect to AUDIT-C scores.

For craving, a significant difference between the groups was found, $H(2) = 19.4$, $p < 0.001$, $d_{COHEN} = 0.81$. *Post-hoc* Dunn-Bonferroni groupwise comparisons revealed significant differences for the abstinent group compared to both relapsed ($p < 0.001$) and consuming patients ($p = 0.001$; consuming vs. relapsed: $p = 1.0$), respectively. These findings indicate lower subjective craving for the abstinent compared to the other patients (see also descriptive statistics in **Table 2**).

A significant difference between the three groups was also found for the PTSD scores, $H(2) = 8.6$, $p = 0.013$, $d_{COHEN} = 0.47$.

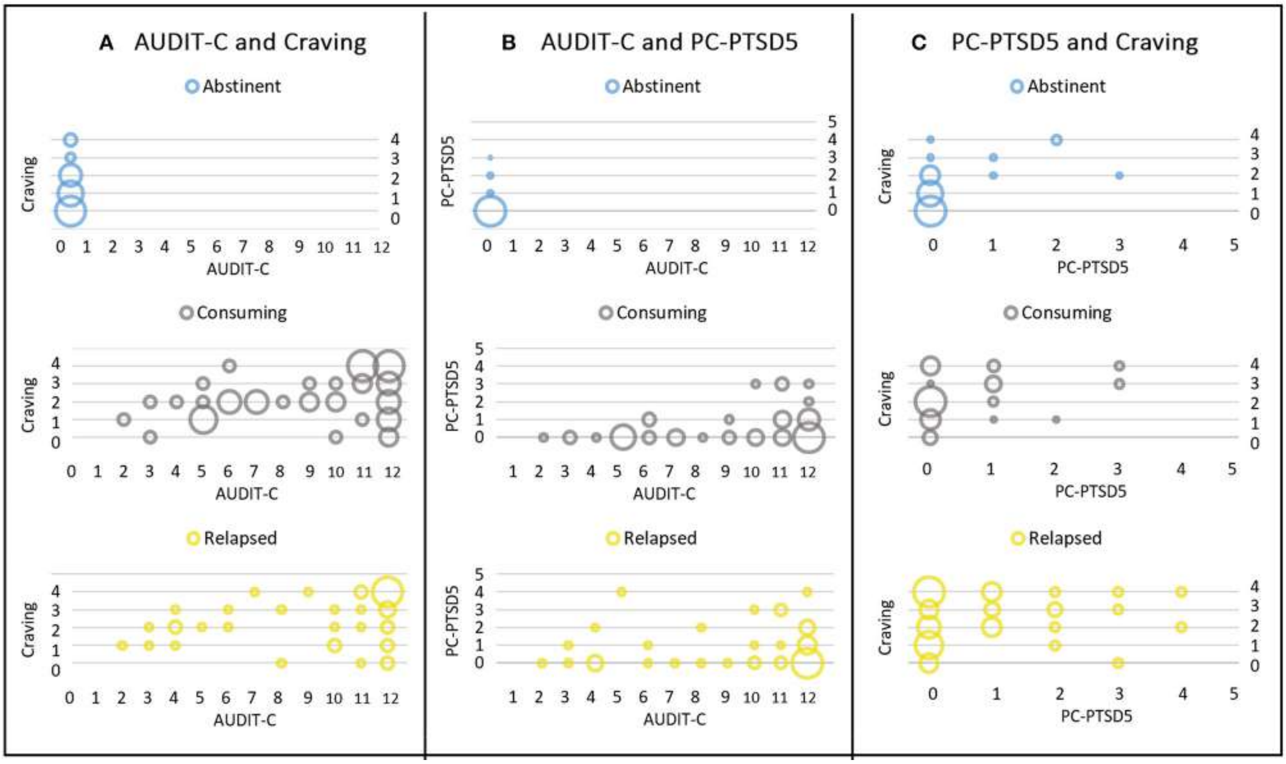

FIGURE 2 | Bubble plots of different combinations of the three scales. Results are presented for the three subgroups of abstinent (first row), consuming (second row), and relapsed patients (third row). **(A)** Depicts AUDIT-C (x-axis) and craving scores (y-axis), **(B)** AUDIT-C (x-axis) and PC-PTSD5 scores (y-axis), and **(C)** shows PC-PTSD5 (x-axis) and craving scores (y-axis). Scores of different subgroups are depicted in blue (abstinent), gray (consuming), and yellow (relapsed group). The size of the bubble represents the number of cases, i.e., bigger bubbles indicate higher numbers of participants with the respective combination of scores.

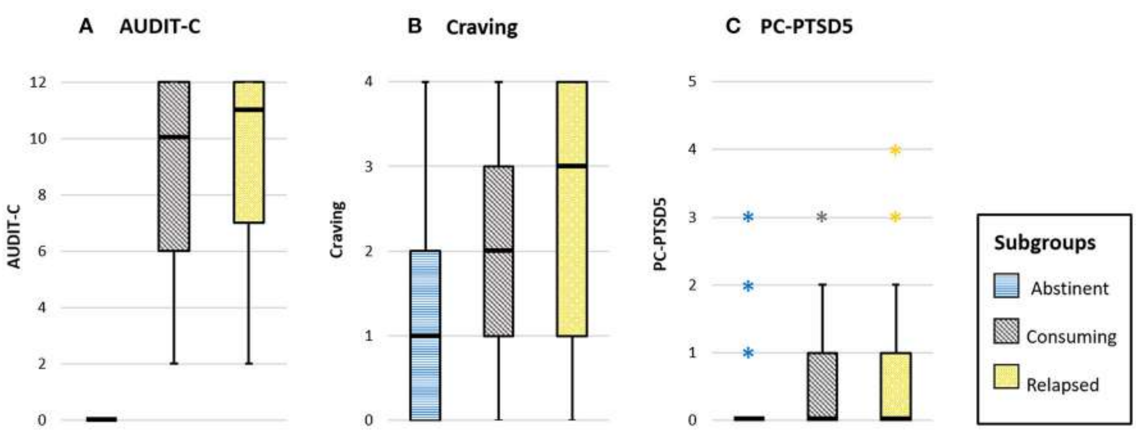

FIGURE 3 | Boxplots for the scales **(A)** AUDIT-C (range 0–12), **(B)** craving (range 0–4), and **(C)** PC-PTSD5 (range 0–5) are provided for the three subgroups. The different subgroups are depicted in blue (abstinent), gray (consuming), and yellow (relapsed group). Outliers are presented as asterisks.

Post-hoc performed Dunn-Bonferroni tests revealed a significant difference only between abstinent and relapsed patients ($p = 0.01$), but not between the other groups (abstinent vs. consuming: $p = 0.26$; relapsed vs. consuming: $p = 0.50$). These results suggest higher subjective stress (corresponding to higher PTSD scores) for relapsed patients compared to the abstinent group (see also descriptive statistics in **Table 2**).

Modeling and Predicting Relapse With Logistic Regression Analysis

Binary logistic regression analysis was performed for the subsample ($N = 78$) of patients being abstinent before the beginning of the pandemic, and either remained abstinent ($N = 37$) or relapsed ($N = 41$) throughout the initial stage of COVID-19. The model allows to evaluate the effects of sociodemographic factors (age, gender, living alone, access to outdoor spaces) and COVID-19 impact (physiological, economic, psychosocial and other factors) on the probability of relapse. A backward variable selection procedure (Wald) was performed using a cutoff value of 0.53 (i.e., the proportion of relapsed patients in this subsample). Results of this regression analysis are presented in **Table 3** in form of the full model and the final model after variable selection.

The model with the highest correct classification rate (step 6 of 7: 70.5%) was selected as the final logistic regression model. [2] This final model included psychosocial COVID-19 factors, age, and living alone as predictors, and was statistically significant, $\chi^2(3) = 14.3$, $p = 0.003$. Nagelkerke R^2 of 22.4% shows a moderate goodness of fit of the model, which has high levels of sensitivity (0.78) and specificity (0.62). Patients with psychosocial COVID-19 factors have an increased risk (odds ratio=3.65, $p = 0.010$) of relapsing compared to patients not reporting psychosocial impact of COVID-19. Living alone also leads to a higher risk of relapsing (odds ratio of 3.00, $p = 0.037$) compared to those living with others, and age showed a small negative non-significant effect (odds ratio = 0.97, $p = 0.171$).

DISCUSSION

The current study investigated different aspects of COVID-19 in a clinical sample of persons with AUD, who sought help at our inpatient and outpatient facilities during the initial stage of the pandemic. Furthermore, although the impact of the COVID-19 crisis might differ between individuals, we aimed to identify general risk factors regarding relapse of persons with AUD. Current alcohol consumption, subjectively perceived craving, and PTSD symptoms were assessed as relevant factors for AUD with respect to COVID-19. A general increase regarding addictive behavior due to COVID-19 was anticipated and already confirmed for a Chinese population (18). Specifically, increased alcohol consumption was reported during the initial stage of the pandemic in different European countries (24, 25), including Austria (26). However, corresponding data from persons with AUD is still lacking. In our clinical sample, alcohol consumption was reported to be rather high among consuming and relapsed patients (with median scores of 10 and 11 compared to a maximum of 12 on the AUDIT-C, respectively). Regarding craving, a moderate level was found in the total sample. PTSD scores were generally low, with two thirds of our patients not reporting any PTSD symptoms due to COVID-19 at all.

In line with our first aim, anticipated associations between the three variables alcohol consumption, craving and posttraumatic stress symptoms were confirmed. It is not surprising that increased craving—irrespective of its cause—leads to increased alcohol consumption (46). On the other hand, alcohol consumption can lead to increased craving via feedback loops of the reward system as described by the term addiction cycle (47). The association between alcohol consumption and PTSD symptoms is in line with prior findings reporting the interconnection between PTSD and SUDs (40). Furthermore, the positive correlation between craving and PTSD symptoms was also reported in a recent study on persons with SUDs (37). The authors also stress the importance to consider associations between craving and psychopathological conditions to gain useful information for successful treatment and prevention strategies.

Our clinical sample consisted of three subgroups of patients who remained abstinent, relapsed, or were consuming before and after the onset of the pandemic. The second aim of this study was to further investigate group differences regarding the various scores. Naturally, lower alcohol consumption (i.e., a score of zero) was reported among abstinent persons compared to the other subgroups. Craving was also significantly lower for abstinent compared to both, relapsed and consuming patients. One can only speculate about the causal relationships. However, an increase in craving scores has already been described by other authors to be associated with an elevated risk for relapse (38). We found significant differences between abstinent and relapsed patients for PTSD scores. Though PTSD did not affect most patients in our sample, we also found 8% of the sample at risk of PTSD due to the pandemic, whereof the majority was part of the relapsed subgroup. This finding indicates that those at risk of PTSD seemed to be at risk of drinking, too. Screening via PC-PTSD-5 at any contact with AUD would thus be helpful during the ongoing crisis, since this questionnaire is short and can easily be implemented into any routine anamnesis. The COVID-19 pandemic does cause traumatic stress for a substantial portion of people suffering from SUD and these persons need special attention by providers of addiction treatment. Otherwise, they are at high risk of relapse or to continue drinking with standard SUD care without focus on PTSD falling short.

Our final aim was to investigate different sociodemographic and COVID-19 factors as potential risk factors for relapse among persons with AUD. Recent literature discussed the potential harming effects of various relevant aspects of life due to COVID-19. Physiological factors involve the elevated risk of a severe outcome of COVID-19 among persons with AUD (31). Most prominently, psychosocial factors like depression, anxiety and isolation are discussed to impact not only the mental health of the general population (6, 7), but are expected to be especially severe for persons with SUDs (32). Economic aspects during the COVID-19 pandemic are anticipated to be particularly challenging for persons with addictive disorders (30). A binary logistic regression model revealed significant impacts of psychosocial COVID-19 factors and living alone, and a small non-significant negative effect of age as increasing the probability for relapse in AUD. Distressing psychosocial factors even manifested as psychiatric comorbidities (e.g., depression) are generally common in SUDs, but the COVID-19 situation has intensified these burdening factors. As they seem to be of predictive value, they need to be considered especially for abstinent patients to make relapses less likely during the ongoing pandemic. Our finding that living alone increased the

[2] Since the second-order Akaike's Information Criterion (AIC_C) was slightly lower for variable selection step 7 ($AIC_C = 101.86$) compared to step 6 ($AIC_C = 102.15$), the factor age was removed by the automated backward variable selection procedure in SPSS in the final step (data available upon request). However, the correct classification rate in step 7 was 66.7%, which is lower than in step 6 (70.5%). Given the negligible difference in AIC_c scores, the model with the highest classification rate was favored in this analysis.

TABLE 3 | Results of the binary logistic regression model for relapsed (vs. abstinent) patients.

	B	SE	Wald χ^2	OR	95% CI	*p*
Initial Model (Step 1)						
Age	–0.03	0.02	1.56	0.97	0.93–1.02	0.212
Gender	–0.28	0.57	0.24	0.76	0.25–2.32	0.627
Living alone	1.05	0.58	3.30	2.86	0.92–8.89	0.069
Outdoor space	0.04	0.74	0.00	1.04	0.25–4.43	0.953
Physiological Factors	–0.30	0.60	0.26	0.74	0.23–2.37	0.609
Economic Factors	0.06	0.62	0.01	1.07	0.32–3.59	0.918
Psychosocial Factors	1.42	0.53	7.20	4.13	1.47–11.61	**0.007**
Other Factors	–0.37	0.69	0.28	0.70	0.18–2.68	0.595
Constant	0.62	1.42	0.19	1.86		0.663
	B	**SE**	**Wald χ^2**	**OR**	**95% CI**	***p***
Final Model (Step 6)						
Age	–0.03	0.02	1.87	0.97	0.93–1.01	0.171
Gender	*	*	*	*	*	*
Living alone	1.10	0.53	4.36	3.00	1.07–8.39	**0.037**
Outdoor space	*	*	*	*	*	*
Physiological Factors	*	*	*	*	*	*
Economic Factors	*	*	*	*	*	*
Psychosocial Factors	1.30	0.50	6.63	3.65	1.36–9.79	**0.010**
Other Factors	*	*	*	*	*	*
Constant	0.53	1.11	0.23	1.69		0.634

Results and test statistics for the initial and final logistic regression model (step 6) are displayed. Significant results with $p < 0.05$ are presented in bold letters.
SE, standard error; OR, odds ratio; CI, confidence interval.
**Variables dropped in backward selection procedure.*

probability for relapse is also in line with literature emphasizing the importance of family support in preventing relapse (23). Furthermore, living alone was found to be associated with a generally higher risk for SUDs in a sample of persons aged 50 years and older (33).

Based on our current findings, abstinent persons suffering from AUD, who are living alone and report the presence of psychosocial distress due to COVID-19 should be in special focus of health care providers with respect to potential relapse. Complementary measures to support this group through the pandemic could be telemedicine services for diagnostic purposes as well as counseling (48). Our results further indicate that physiological and economic aspects of COVID-19 do not seem to play a crucial role as risk factors for relapse in AUD, at least during the study period. This is surprising, given the fact that many persons in our sample have considerable somatic comorbidities and are heavy users of different health services under usual circumstances, where parts of those services were not easily accessible during the experienced lock down. Furthermore, our data does not support anticipated concerns of other authors regarding particular distress stemming from economic and financial problems (30). One reason for this discrepancy could be due to the early stage of the COVID-19 crisis at the time of our data collection between April and June 2020. Back then, most Austrians expected the pandemic to be over soon, and the government provided substantial financial support for companies to prevent massive job losses. Thus, people might have been optimistic about the outcome of the crisis and their personal situation at that time. With the progression of the pandemic the worries about the individual economic and health situation could have changed though. On the long term, this might be a cause of considerable distress and might even promote relapses in AUD.

Our findings involve some limitations, and have to be interpreted with caution. First, the current study investigated individual-level characteristics, whereas area-level correlates (e.g., levels of education, unemployment, or overcrowding in a specific geographical area) (49) were not evaluated. Since our findings are deflected from patients living in the same region (i.e., Upper Austria) and more detailed information (e.g., district of residence) was not assessed, potential impact of unexplored area-level factors cannot be excluded. Established associations between area-level deprivation and adverse consequences of SUDs (49) might also play a crucial role for relapse in AUD. Hence, these variables should be taken into account in future studies. Second, as the data in the current study was collected at a specific point in time (i.e., during the first stage of the COVID-19 pandemic) it has to be considered a cross-sectional study. Naturally, limitations of this type of study also apply for the current findings. Since exposure and outcome are assessed at the same time, interpretations of the temporal relationships between cause and effect without longitudinal data are restricted. Consequently, the direct impact of the identified risk factors for relapse in AUD have to be evaluated. Further investigations are therefore inevitable to fully understand the long-term consequences of the pandemic. Third, the clinical sample investigated in this study qualifies as "convenience sampling," and leads to another limitation. Since our findings are solely based on patients with AUD, conclusions about the general population cannot directly be drawn.

In conclusion, our data suggests that the current situation and specially periods of COVID-19 caused lockdowns overstrain the capacity of stress management and relapse prevention as a substantial part of this vulnerable group suffering from AUD. Without quick and specific help by health care services many of them would use alcohol as means of short-termed stress management. Conceiving psychosocial stressors and PTSD symptoms should be part of every inpatient or outpatient contact and depending on their incidence the medical care should be intensified. But also the health care system as a whole should lay particular attention on SUD, since this group needs extra support due to the crisis on hand. In case of further lockdowns people suffering from SUD need unhindered and low-threshold access to treatment. However, our data only depicts the first phase of the COVID-19 pandemic including the first lockdown stage. More research is needed to capture long-term effects and to develop long-acting strategies for the support of persons with SUDs during this ongoing and future pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Commission of the Medical Faculty of the Johannes Kepler University Linz. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

KY: supervision and resources. IF-L: formal analysis and methodology. JR and NG: data curation. All authors contributed to the conceptualization of the study and writing of the original draft, and have approved the final manuscript.

ACKNOWLEDGMENTS

We are very grateful to the medical staff and the psychologists at the Department of Psychiatry - Specialization Addiction Medicine of the Kepler University Hospital for their valuable help with data collection. Special thanks for the very helpful and competent statistical support provided by Assoc. Prof. Helga Wagner and Dr. Philipp Hermann at the Center for Clinical Studies (CCS Linz, Johannes Kepler University Linz, Huemerstr. 3–5, 4020 Linz and Altenberger Strasse 69, 4040 Linz, Austria).

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Public Health

BRIEF RESEARCH REPORT
published: 17 December 2020
doi: 10.3389/fpubh.2020.609347

Excessive and Problematic Internet Use During the Coronavirus Disease 2019 School Closure: Comparison Between Japanese Youth With and Without Autism Spectrum Disorder

Kentaro Kawabe [1,2], Rie Hosokawa [1,2], Kiwamu Nakachi [1,2], Ayumi Yoshino [1,2], Fumie Horiuchi [1,2] and Shu-ichi Ueno [1]*

[1] Department of Neuropsychiatry, Ehime University Graduate School of Medicine, Toon, Japan, [2] Center for Child Health, Behavior and Development, Ehime University Hospital, Toon, Japan

OPEN ACCESS

Edited by:
Hironobu Fujiwara,
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****Correspondence:***
Fumie Horiuchi
matsufu@m.ehime-u.ac.jp

Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: *23 September 2020*
Accepted: *30 November 2020*
Published: *17 December 2020*

Citation:
Kawabe K, Hosokawa R, Nakachi K, Yoshino A, Horiuchi F and Ueno S-i (2020) Excessive and Problematic Internet Use During the Coronavirus Disease 2019 School Closure: Comparison Between Japanese Youth With and Without Autism Spectrum Disorder. Front. Public Health 8:609347. doi: 10.3389/fpubh.2020.609347

Internet use in the youth has increased manifold during the coronavirus disease 2019 (COVID-19) pandemic. Individuals with autism spectrum disorder (ASD) generally have a higher risk of problematic internet use. The aim of this study is to investigate the differences in internet and related digital media use between children with ASD and their typically developing counterparts during the COVID-19 pandemic. In this online survey in Japan conducted from April 30 to May 8, 2020, we analyzed digital media time of 84 children with ASD and 361 age- and gender-matched controls before and after school closure. Digital media use duration was significantly longer in the ASD group than in the control group before the pandemic. The increase of media use time was more prominent in the control group than in the ASD group. We observed excessive Internet use among children with ASD and without ASD, especially during the COVID-19 pandemic. It is necessary to establish strategies to prevent excessive internet use in not only children and adolescents with ASD but also without ASD in the post-pandemic world.

Keywords: COVID-19, internet addiction, autism spectrum disorder, children, problematic internet use

INTRODUCTION

Coronavirus disease 2019 (COVID-19) infection is evolving rapidly, with an increase in the number of reported cases and affected countries worldwide (1). The World Health Organization declared the COVID-19 outbreak a public health emergency of international concern on January 30, 2020 and a pandemic on March 11 (2). In view of the rapid increase in COVID-19 cases from the end of February, the Japanese government declared the closure of elementary and junior high schools from the 1st through 12th grades on March 2 and a public health emergency of international concern on April 7.

The closure of schools and other educational facilities poses a significant disruption to daily life and is a source of stress for children and their families. In response to the crisis, governments in Japan have introduced a series of steps aimed at curbing the effects of the pandemic, such as maintaining social distance (a minimum of 2 m) and the temporary closure of cultural and entertainment facilities. As a result, children's interactions, both physical and intellectual, with their peers have reduced, which may further induce social isolation and loneliness. With regard to managing this situation, information and communications technology (ICT) holds promise, as through its use, children can continue to engage in educational and entertainment activities, stay in touch with friends using social networking services, and access entertainment or educational content, all while maintaining social distancing. ICT can alleviate social isolation through the development of a sense of connection, maintenance of existing relationships, facilitation of social support, engagement in activities of interest, and enhancement of self-confidence (3).

Although ICT is proving to be an important tool during the COVID-19 pandemic, there are concerns about the rise in problematic internet use and internet addiction among the youth. In a Japanese survey of 8,464 junior high school to university students conducted between March 27 and April 6, during the pandemic, over 80% of the participants were spending more time on YouTube than before, while 40–50% were also spending more time on gaming apps (4). Autism spectrum disorder (ASD) is characterized by difficulties in reciprocal social interaction skills; deficits in communication skills; stereotypic, obsessive, or repetitive behaviors; and restricted patterns of interests and activities (5). In general, adolescents with ASD tend to devote themselves to video games or internet use. Adolescents with ASD who also have attention deficit hyperactivity disorder symptoms have a higher risk of internet addiction (6). Owing to the characteristics of ASD, it can be difficult for children with this condition to understand the context of school closure and manage their internet use time at home during the COVID-19 pandemic (7). Adolescents with ASD have been identified as a high-risk group for complications in mental health from COVID-19 (8). To our knowledge, there are no studies about internet and digital media use in adolescents with ASD during the COVID-19 pandemic. Thus, we hypothesized that internet use in children and adolescents with ASD differs from that in their typically developing counterparts during the COVID-19 pandemic. The objective of this study was to explore the difference in internet and digital media use between children and adolescents with and without ASD and compare the change in use time in these groups before and during the COVID-19 pandemic.

METHODS

Participants

This cross-sectional and matched case-control study was conducted online from April 30 to May 8, 2020, during the period of school closure in Japan. Members of the ASD group were outpatients at Ehime University Hospital, Matsuyama Kinen Hospital, and Horie Hospital in Ehime prefecture. Matsuyama Kinen hospital and Horie hospital were psychiatric hospitals. These hospitals have specialized psychiatry outpatient clinic for children and adolescents. The inclusion criteria for children and adolescents were: [1] aged 6–18 years; [2] diagnosis of ASD based on the Autism Diagnostic Observation Schedule-2, Autism Diagnostic Interview-Revised, or Diagnostic and Statistical Manual of Mental Disorders-5 criteria; [3] attending elementary, junior high, or high school; [4] residing in Ehime prefecture; and [5] provision of written informed consent by their mothers. The control participants were invited to this survey through social media. The inclusion criteria for children and adolescents were: [1] aged 6–18 years; [2] no history of visiting hospitals regarding a child's development; [3] attending elementary, junior high, or high school; [4] residing in Ehime prefecture; and [5] provision of written informed consent by their mothers. The participants were recruited through snowball sampling.

Procedure

Mothers whose children met the inclusion criteria were invited to participate in the online survey using the Google Forms software in Japanese. The link to the questionnaire was sent via a letter in the ASD group and social media in the control group. The social media was used LINE, which was first released in 2011 and then became very popular messaging and social media system in Japan. Upon receiving and clicking the link, participants were automatically transferred to the page providing information about the study.

Instruments

The online survey included three categories: (a) demographic data including age, gender, and school level (elementary school: ages 6–12, junior high school: ages 12–15, and high school: ages 15–18; (b) three yes-no questions: "Is your child stressed by the COVID-19 pandemic?" "Is your child making fewer visits to the after school activities, e.g., lessons, culture schools, education centers, and rehabilitation centers?" After school activities are provided by private agency or establishment. It was not part of school life and Japanese government did not declare the closure of after school activities, therefore if participants want to utilize after school activities, they can access during the school closure period. Another yes-no questions: "Are you spending more time playing games with your child since school closure?"; and (c) multiple choice questions related to digital media use time, "How long did your child spend using the internet or digital media use on weekends before school closure?" and "How many hours a day is your child spending on the internet or digital media use on weekends during the COVID-19 pandemic?" The response options were from 0 min to 15 h, and every 30 min.

Data Analysis

In this study, we planned to recruit about 125 ASD participants and about 500 participants as the control group. The sample size was calculated on the basis of two-sample t-tests using G*Power 3.1.9.2 software (9). An effect size of 0.5, a significance level of $\alpha = 0.05$, a statistical power of $1\text{-}\beta = 0.95$, and a 1:4 allocation ratio between the ASD and control groups were

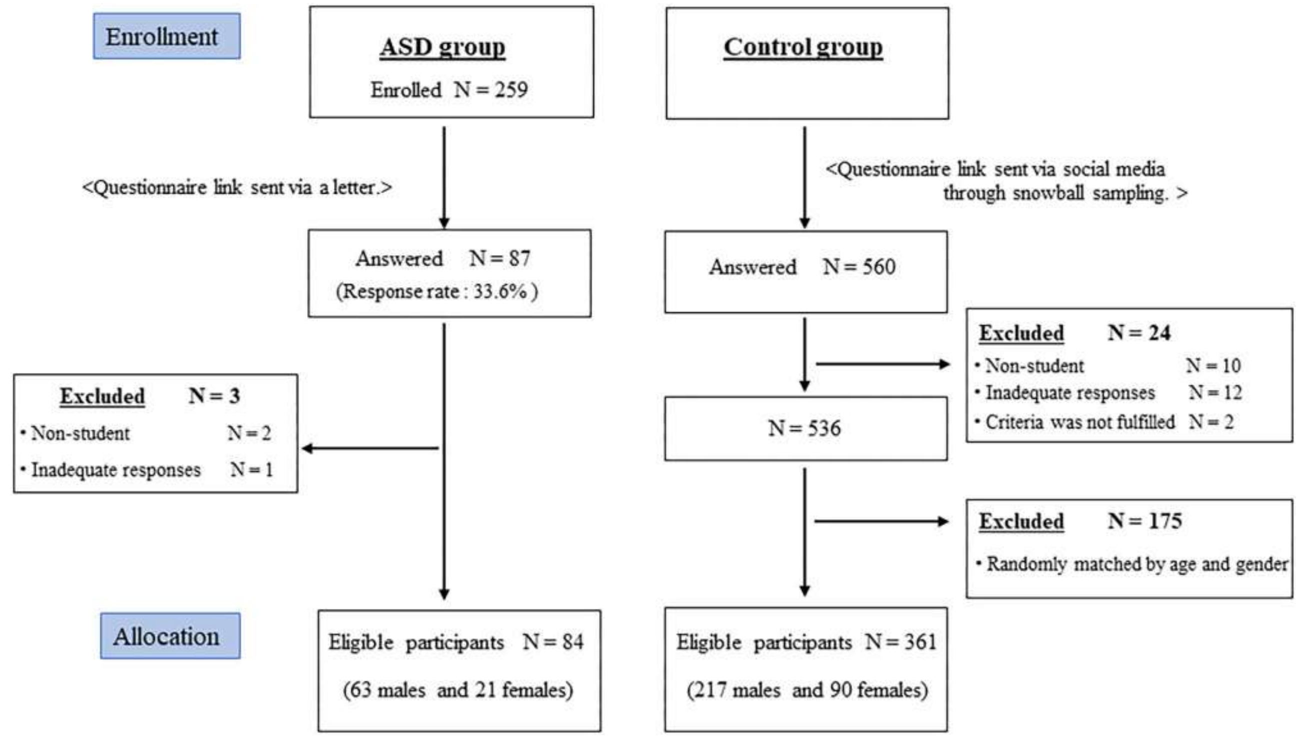

FIGURE 1 | Flow diagram of the process of sampling the autism spectrum disorder group and a matched control group. ASD, autism spectrum disorder.

also considered. Sample size calculation was performed before initiating recruitment. Descriptive statistics were used to describe the distributions of the participants' characteristics. The results were expressed as median (25 and 75% quartile) for continuous variables and percentages for categorical variables. The Mann-Whitney *U*-test was used for the comparison of numerical variables. The chi-square test was used for the comparison of categorical variables, and to compare responses between the two groups. The Wilcoxon signed-rank test was used to compare the change in internet or digital media use time before and during the pandemic. All tests were two sided, and the significance level was set at 5%. All data were analyzed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA) for Windows and R version 3.6.3.

Ethics

Data were protected according to the General Data Protection Regulation. The text message bearing the link to the Google Form that was shared with the participants contained the title of the study, its aim, eligibility for participation, potential advantages and disadvantages of participation, and the average time required to answer all questions, which was 5 min. The questionnaire was anonymized. In addition, the first page of the Google Form mentioned the informed consent requirement.

RESULTS

Characteristics of the Study Population

A flowchart of the recruitment process is depicted in **Figure 1**. We received responses from 87 participants (response rate: 33.6%). Of these, two were excluded because they did not meet the study criteria and one because of inadequate answers. Thus, there were 84 eligible participants with ASD (63 males and 21 females) who completed this study (**Table 1**). The mean age in the ASD group was 11.6 ± 3.1 years. Of the ASD group, 42 were in elementary school, 24 in junior high school, and 18 in high school. For the control group, we used data from 560 individuals to whom the same questionnaire was sent. We applied random age and gender matching for the control group. A total of 361 participants (271 males and 90 females) were selected as controls. The mean age in control group was 11.2 ± 3.4 years.

Between-Group Differences in Changes in Children's and Parents' Daily Lives Because of COVID-19

Table 2 depicts the percentage of each response and internet or digital media use time in both groups. Most children −76.2% [64/84, 95% confidence interval (CI): 65.7–84.8%] in the ASD group and 77.8% (281/361, 95% CI: 73.2–82.0%) in the control group— were reported to experience stress due to the pandemic. There were no significant differences in the rate of children who were reported to experience stress due to COVID-19 and parents

TABLE 1 | Characteristics of the participants.

	ASD	Control
N	84	361
Gender		
Male, n (%)	63 (75.0)	271 (75.1)
Female, n (%)	21 (25.0)	90 (24.9)
Age	11.6 ± 3.1	11.2 ± 3.4
School level		
Elementary school	42	182
Special class	14	0
Special school	6	0
Junior high school	24	107
Special class	10	0
Special school	3	0
High school	18	72
Special school	5	0

ASD, autism spectrum disorder.

who spent more time playing games with their children between the two groups. Regarding the number of visits to the private agency, there was a significant decrease in the control group (77.6%, 280/361, 95% CI: 72.9–81.8%) as compared to the ASD group (31.0%, 26/84, 95% CI: 21.3–42.0%). The pre-pandemic internet or digital media use time in the ASD group was reported that significantly longer (median [quartile]: 3 h [2–5]) than in the control group (2 h, [1.5–3]) ($p < 0.001$). Internet use time significantly increased after school closure in both the ASD group ($p < 0.001$) and the control group ($p < 0.001$). The digital media use time significantly increased in the control group than in the ASD group. (ASD: one point two 5 h, [0–2], control; 2 h, [1–3]) ($p = 0.002$).

DISCUSSION

Our results based on parental report indicated that internet or digital media use time was longer in the ASD group than the control group on weekends before the pandemic and increased in both groups during the pandemic. However, the digital media use time was significantly increased in the control group. To the best of our knowledge, this is the first study clarifying the difference of internet and digital media use time between children and adolescents with ASD and without ASD before and during the COVID-19 pandemic.

Although children have been less severe clinical manifestations and infected rate of COVID−19 than those of adults (10), the psychological effect and the change in their lifestyles is a serious problem. The COVID-19 pandemic has been the cause of mental health problems, public health crises, social isolation, and economic downturns; the cumulative effect may worsen mental health among children and adolescents (11). A study in mainland China during the initial phase of the COVID-19 pandemic reported that more than half of the general public rated the psychological impact as moderate to severe, and about one-third reported moderate to severe anxiety during that phase (12). In particular, students have been reported to be experiencing the psychological impact of the COVID-19 pandemic and higher levels of stress, anxiety, and depression (12). Especially for students, school closure has reduced opportunities for communicating with friends as well as access to school mental health services (13). While online education is a practical and recommended measure during the pandemic (14), at least in our area, it was not adequately serving educational purposes or facilitating communication with friends or teachers. To date, although there have been no consistent results regarding gender differences in children's pathological internet use, many studies show male dominance; moreover, the prevalence of problematic internet use increased with school grade (15). According to our findings, children in control group increase time of internet or digital media use than in the ASD group. This is a surprising finding because adolescents with ASD are considered to be at a higher risk for problematic media use and internet addiction (16). So et al. showed the higher rate of problematic media user in ASD and/or ADHD than in general population evaluated by the rating scale of internet addiction (17). Chen et al. reported that there was an inverse relationship between autism tendency and internet addiction in their school-based and a longitudinal investigation (18). According to meta-analysis, there were no consistent evidence between Internet use and ASD because autistic traits were so widely among individual, though there were moderate association between Internet use and ADHD (19). We evaluated only the digital media use time, in future study it is necessary to examine not only the media use time, but also the association between characteristics of ASD and tendency of internet addiction. Consensus guidance indicated that psychological stress related to the COVID-19 pandemic may contribute to developing a mindset that rationalizes new unhealthy habits, such as engaging in poorly controlled use of the internet or excessive screen time (20). Children might rationalize problematic media use on the grounds of school closure. In any case, psychological stress in children due to school closure affected not only participants with ASD but also those without, and our results indicate that internet use time increased in the control group more than it did in the ASD group. Several researchers have reported that problematic internet use leads to deterioration in mental health, such as the development of depression and anxiety (21, 22). COVID-19-related anxiety was also associated with the severity of problematic internet use (23). Excessive smartphone uses such as seeking information on COVID-19 might have adverse consequences. Protracted periods of isolation, technology-based activity, and limited face-to-face interaction have the danger of solidifying unhealthy lifestyle patterns, intensifying technology-related disorders, and leading to difficulties in re-adaptation when the COVID-19 crisis has passed (24). Children have experienced at least 2 months of school closure, and in this period, school authorities have been rethinking or considering terminating events such as physical education, club activities, and school trips in accordance with infection control measures. From the above, it can be inferred the school during pandemic is so boring for children.

TABLE 2 | Comparison of responses between the autism spectrum disorder and control groups.

	ASD	Control	*P*
N	84	361	
Age	11.6 ± 3.1	11.2 ± 3.4	0.419
School type			
Elementary school, n (%)	42 (50.0)	182 (50.4)	0.95
Junior high school, n (%)	24 (28.6)	107 (29.6)	
High school, n (%)	18 (21.4)	72 (20.0)	
Is your child stressed by the COVID-19 pandemic?			
Yes, n (%)	64 (76.2)	281 (77.8)	0.744
No, n (%)	20 (23.8)	80 (22.2)	
Parents who spent more time playing games with their children?			
Yes, n (%)	40 (47.6)	177 (49.0)	0.816
No, n (%)	44 (52.4)	184 (51.0)	
Is your child making fewer visits to the private agency, for example education centers, and rehabilitation centers?			
Yes, n (%)	26 (31.0)	280 (77.6)	< 0.001**
No, n (%)	58 (69.0)	81 (22.4)	
Is your child making fewer visits to the after school activities, e.g., lessons, and culture schools?			
Yes, n (%)	44 (52.4)	184 (51.0)	0.816
No, n (%)	40 (47.6)	177 (49.0)	
Internet or digital media use time, median hour (quartile)			
Before pandemic	3 (2–5)	2 (1.5–3)	< 0.001**
During pandemic	5 (3–7)	4 (3–6)	0.12
Change time	1.25 (0–2)	2 (1–3)	0.002**

ASD, autism spectrum disorder. The chi-square test was used for categorical variables and the Mann-Whitney U-test for numerical variables.
$^{**}p < 0.01$.

The current study has several limitations. First, the recruitment methods for the ASD and control groups differed; the ASD group was invited to participate by mail and the control group through snowball sampling. The ASD group were intended all patients who met the criteria, however a selection bias was unknown due to the sampling methods. As snowball sampling was not based on a random selection, the study population might not be representative of the general population. Second, our study relied on parent reports, and did not collect personal information, such as the domestic environment, including economic status, level of intelligence in children, and level of education in mothers, because of ethical requirements concerning anonymity and confidentiality. Therefore, the possibility of information bias cannot be disregarded. Third, this study did not indicate the way mothers grasp their children's media time. Depending on the background and characteristics of the children, it may be difficult for parents to grasp their children's media use time exactly. Forth, our assessment did not include detailed characteristics of the ASD group. There are individual differences in the characteristics of ASD, which might affect internet use. Fifth, as the participants belonged to a single prefecture, attempts to generalize our results to other prefectures must be undertaken with caution. Sixth, the present study employed a cross-sectional design. Further prospective studies should be performed on the same group of participants over a longer period.

CONCLUSION

Our study makes a valuable comparison of internet use time between children and adolescents with and without ASD before and after school closure related to the COVID-19 pandemic. Following school closure, increased internet and digital media use time was observed in most children. It is necessary to formulate strategies to prevent excessive internet use in the post-pandemic world, wherein children's school and daily lives will no longer be the same.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This study was approved by the concerned institutional review board (IRB No. 2006014). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

KK conceived, designed, managed the study, and wrote the manuscript. RH, KN, and AY collected the data. RH and KN performed the data analysis FH and SU supervised to study design, and revision of the manuscript. All authors provided critical feedback, contributed to the final manuscript, and agreed to the publication of the article.

FUNDING

This study was supported by a grant from KAKENHI, the Japan Society for the Promotion of Science (JSPS), as a Grant-in-Aid for Scientific Research (JSPS KAKENHI Grant No. 20K18935).

ACKNOWLEDGMENTS

The authors thank all the participants.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

BRIEF RESEARCH REPORT
published: 21 December 2020
doi: 10.3389/fpsyt.2020.601653

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Cannabis and COVID-19: Reasons for Concern

Margriet W. van Laar[1], Pieter E. Oomen[1], Charlotte J. A. van Miltenburg[1], Eefje Vercoulen[1], Tom P. Freeman[2] and Wayne D. Hall[3]*

[1] *Trimbos Institute, The Netherlands Institute of Mental Health and Addiction, Utrecht, Netherlands,* [2] *Addiction and Mental Health Group (AIM), Department of Psychology, University of Bath, Bath, United Kingdom,* [3] *National Centre for Youth Substance Use Research, The University of Queensland, St Lucia, QLD, Australia*

The lockdown measures implemented to curb the spread of SARS-CoV-2 may affect (illicit) drug consumption patterns. This rapid response study investigated changes in cannabis use in a non-probability sample of cannabis users in the Netherlands during the early lockdown period. We fielded an online cross-sectional survey 4–6 weeks after implementation of lockdown measures in the Netherlands on March 15, 2020. We measured self-reported \motives for changes in use, and assessed cannabis use frequency (use days), number of joints per typical use day, and route of administration in the periods before and after lockdown implementation. 1,563 cannabis users were recruited. Mean age was 32.7 ± 12.0 years; 66.3% were male and 67.9% used cannabis (almost) daily. In total, 41.3% of all respondents indicated that they had increased their cannabis use since the lockdown measures, 49.4% used as often as before, 6.6% used less often, and 2.8% stopped (temporarily). One-third of those who were not daily users before the lockdown became (almost) daily users. Before the lockdown, most respondents (91.4%) used cannabis in a joint mixed with tobacco and 87.6% still did so. Among users of joints, 39.4% reported an increase in the average number consumed per use day; 54.2% stayed the same and 6.4% used fewer joints. This rapid response study found evidence that during the lockdown more users increased rather than decreased cannabis consumption according to both frequency and quantity. These data highlight the need to invest more resources in supporting cessation, harm reduction, and monitoring longer term trends in cannabis use.

Keywords: cannabis, corona, COVID-19, route of administration, risks

OPEN ACCESS

Edited by:
Giuseppe Bersani, Sapienza University of Rome, Italy

Reviewed by:
Anahita Bassir Nia, Yale University, United States
Hollis C. Karoly, Colorado State University, United States

****Correspondence:***
Margriet W. van Laar
mlaar@trimbos.nl

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *01 September 2020*
Accepted: *16 November 2020*
Published: *21 December 2020*

Citation:
van Laar MW, Oomen PE, van Miltenburg CJA, Vercoulen E, Freeman TP and Hall WD (2020) Cannabis and COVID-19: Reasons for Concern. Front. Psychiatry 11:601653. doi: 10.3389/fpsyt.2020.601653

INTRODUCTION

Worldwide some 192 million people have used cannabis in the last year (1). Globally, the most prevalent route of cannabis administration remains smoking (with and without tobacco) (2). In North America, the use of alternative cannabis products, including concentrates, edibles and vaped oils, has increased in states with legal cannabis markets (3). Smoking tobacco results in worse COVID-19 outcomes, and smokers show an upregulation of the angiotensin converting enzyme II-receptor, which is the main entry point for the SARS-CoV-2 virus (4, 5). This is relevant, as a 2016 study reported that 77.2–90.9% of European cannabis users preferred tobacco-based routes of administration (2). The respiratory risks of cannabis vaping are unclear, but vaping may also increase risk of infection with SARS-CoV-2 and/or worsening of COVID-19 outcomes (6).

In the USA, cannabis use increased among seniors between 2015 and 2018 (7). This is of concern because the most serious complications and highest mortality rates from COVID-19 infection occur in older people (8, 9). Weakly or unsupported claims on the internet that cannabis use can prevent COVID-19 (10, 11) may encourage its use.

Cannabis use is very often a social activity that involves sharing joints, pipes, bongs, or vaporizers; practices that may facilitate SARS-CoV-2 infection. This risk is enhanced if cannabis is smoked in badly ventilated and crowded spaces without respecting social distance guidelines. Chronic cannabis smoking is also associated with increased coughing, which may conceal COVID-19 and spread the virus.

We do not know how the pandemic has affected cannabis availability. In Canada and several states in the US where cannabis is legal, cannabis sales showed a spike in March and April, when recreational users appeared to stockpile in preparation for lockdown (12, 13). Various states allowed sales to continue by classifying cannabis as an "essential product."

So far there are no indications of major disruptions to cannabis markets in the EU, although the European Monitoring Center for Drugs and Drug Addiction (EMCDDA) notes a shortage of cannabis (resin) at retail level in some countries (14). In several EU countries (e.g., Ireland, Italy, Poland, and Portugal), there are reports of difficulties in accessing cannabis during the lockdown. A Google trend analysis suggested an increase in home cultivation of cannabis. An analysis of three major marketplaces pointed to a strong increase in cannabis trafficking between January and March 2020; however, only 2% of the respondents in the COVID edition of the European Drug Survey used the darknet to obtain drugs (15).

There are signals that restrictions introduced in many countries to prevent COVID-19 may have affected illicit drug use (14, 16). In this paper we report data on changes in cannabis use from a rapid response survey of an online convenience sample of cannabis users in the Netherlands, which was conducted soon after the implementation of social distancing and lockdown measures. These surveys do not provide representative prevalence estimates (17) but they can provide rapid evidence on how cannabis use patterns among more regular users may have changed during the COVID-19 pandemic.

METHODS

Study Design and Participants

We conducted an online survey of 1,563 Dutch cannabis users from 14 to 28 April 2020. During the time of recruitment, "intelligent" lockdown measures (from March 15th) were in place, which included closing of cafés, restaurants, sports and sex clubs, working from home if possible, keeping physical distance (1.5 m), no gatherings of >100 people and banning groups of >3 people in public. Initially, coffeeshops were closed, but after a few days, they were allowed to reopen for takeaway purchases, in order to avoid promotion of an illegal market.

Participants were recruited through social media and by recontacting cannabis users from a former study. The Central Committee on Research Involving Human Subjects in the Netherlands does not require approval from an ethical review committee for non-medical survey research (18). Respondents were informed about the purpose of the study and storage of the data and their anonymity was guaranteed. There was no (financial) incentive provided for completing the survey.

Measures

The survey included questions on age and gender (male, female, other), an "overall" self-reported change in use (more often, same, less often) and motives for increasing or decreasing use (boredom, stress, loneliness, mental health, physical health, less parties/nightlife, see friends less, less use of other drugs, and other). The respondents were allowed to choose one or more motives. Use patterns were further specified by assessing frequency of use before and after implementation of the lockdown as: [(almost) daily; a few times a week; once a week; a few times a month; once a month; a few times a year but less than once a month; (temporarily) stopped], number of joints per typical use day and mode of use.

Analysis

Sample characteristics were obtained with descriptive statistics. For the purpose of this study, age was divided into two groups, "young adults" (16–34) and "adults" ($\geq$35). Participants ($n = 10$) reporting a gender other than male or female were excluded from analyses when differences between gender were examined. To assess whether the quantity of use (measured by number of joints) decreased or increased as a consequence of the pandemic, the change in number of joints (Δ) was calculated and subsequently one-sample T-tests (test value 0) and independent sample t-tests were performed. Differences between categorical variables were analyzed using χ2-tests. All analyses were performed in SPSS v25.

RESULTS

Sample Characteristics

In total, 2,412 respondents reached the landing page of the questionnaire; 836 respondents were excluded because they closed the survey before answering the last mandatory question and 13 respondents were excluded for different reasons (e.g., inconsistent answers, stopped using cannabis long before the pandemic). The final sample consisted of 1,563 cannabis users (**Table 1**). The mean age was 32.7 years (SD = 12.0); young adults made up 63.7% of the sample. Participants were predominantly male (66.3%). No other demographic information was collected. Seven out of 10 participants (67.9%) indicated that they used cannabis (almost) daily.

Self-Reported Changes in Use

In total, 41.3% of all respondents reported using cannabis more often since the lockdown measures, 49.4% used cannabis as often as before and 6.6% used less often. A smaller number of participants (temporarily) stopped using cannabis during the lockdown (2.8%). Chi-square test showed a relation between self-reported change and gender ($\chi^2 = 34.3$, $p < 0.001$) and age ($\chi^2 = 157.9$, $p<0.001$). The proportion of women

(50.4%) who used cannabis more often since the lockdown was higher than the proportion of men (36.5%). In addition, the proportion of young adults (51.6%) who used cannabis more often since the lockdown was higher than the proportion of older adults (23.1%).

TABLE 1 | Sample characteristics before lockdown measures.

	$N = 1{,}563$
DEMOGRAPHICS	
Age (mean yrs (SD))	32.7 (12.0)
Male (%)	66.3
Female (%)	33.0
Other (%)	0.6
TYPE OF CANNABIS (%)	
Mainly herbal	71.9
Mainly hashish	14.9
Both herbal/hashish (equally)	13.2
FREQUENCY OF USE (%)	
(Almost) daily	67.9
A few times a week	15.9
Once a week	6.1
A few times a month	4.7
Once a month	2.4
A few times a year, less than monthly	3.0
Average number of joints per use day (mean (SD))	3.0 (2.6)
(Almost) daily user	3.7 (2.6)
Less than daily user	1.6 (1.5)
MODE OF USE[a] (%)	
Joint mixed with tobacco	91.4
Pure joint/cigarette	7.8
Edibles	6.5
Water pipe or bong	5.8
Vaporiser	5.6
Pipe or chillum	4.6
Other	0.3

[a]*As multiple answers were possible, percentages do not add up to 100%.*

Changes in Frequency of Use

Table 2 shows that the majority of those who were (almost) daily users before the lockdown continued this pattern of use. Among those who did not use cannabis (almost) daily before the lockdown measures, 53.6% ($n = 269$) increased their overall frequency of use and 35.7% ($n = 174$) started using (almost) daily during the lockdown. This proportion was highest among those already consuming a few times a week (52.0%). Moreover, over half (56.9%) of those who consumed cannabis once a week before the lockdown measures, increased their frequency of use.

Of the (almost) daily consumers, 4.4% reduced their use or (temporarily) stopped altogether. This was more common among occasional users (e.g., 17.6% among those using a few times per month), although the number of users in this category was small.

Changes in Number of Joints per Use Day

In the total sample, among those who smoked joints before and after the measures ($n = 1{,}414$), 39.4% reported an increase in the average number of joints used per use day; 54.2% used the same number and 6.4% used fewer joints per day.

In the total sample, the average number of joints increased from 3.0 (SD = 2.6) to 3.7 (3.0) [$t_{(1413)} = 15.6, p < 0.001$]. Among the users who smoked more joints ($n = 557$), the average number increased from 2.8 joints (SD = 2.3) before to 4.6 (SD = 3.2) joints after implementation of the lockdown. In this group, no statistically significant differences were found for the change in number of joints per day by gender [$t_{(549)} = -1.10; p = 0.268$] or age [$t_{(555)} = -0.54; p = 0.586$].

Table 3 illustrates the changes in number of joints for the high-risk group of users who smoked cannabis (almost) daily after implementation of the lockdown measures. Among the one-third of these users who maintained this daily use pattern and smoked more joints, the average number of joints per day

TABLE 2 | Frequency of cannabis use before and after the introduction of the lockdown measures.

		After introduction of the measures						
		(Almost) daily	**A few times a week**	**Once a week**	**A few times a month**	**Once a month/few times a year**	**Stopped (temporarily) during lockdown**	**Number of respondents before measures (n)**
Before introduction of the measures	**(Almost) daily**	95.7	2.1	0.3	0.2	0.0	1.8	1,059
	A few times a week	52.0	40.3	2.4	2.0	0.0	3.2	248
	Once a week	23.2	33.7	28.4	7.4	3.2	4.2	95
	A few times a month	18.9	16.2	17.6	29.7	13.5	4.1	74
	Once a month/few times a year	16.5	15.3	10.6	7.1	40.0	10.6	85

Numbers are shown as percentages. Data for respondents who indicated to use once a month (n = 38) and a few times a year but less than monthly (n = 47) were pooled because of the low numbers. This table shows how the frequency in cannabis use has shifted before and after the introduction of the coronavirus measures per user group. The gray diagonal indicates the percentage of users reporting no change in frequency of use. Boxes to the right of the diagonal indicate a decrease in frequency of use after measures were introduced. Boxes to the left of the diagonal indicate an increase in frequency of use after measures were introduced. The answer category "(temporarily) stopped" was later added to the questionnaire. For the first 171 respondents this answer option was not available. It was checked whether these respondents indicated in the open fields to have (temporarily) stopped using.

increased from 3.4 to 5.5. Among those who did not use (almost) daily and who became an (almost) daily user after the lockdown measures, three-quarters also used more joints per use day, increasing from 1.6 to 3.3 joints on average.

Reasons for Changes to Use

Table 4 shows that boredom was by far the most commonly stated reason for using cannabis more often (78.4%). (Mental) health problems and stress were more important for women than men, while social motives were more important for men. Those who reported stopping or decreasing their cannabis use attributed this to seeing friends less (often) (32.2%) and mental health concerns (29.5%). One fifth (19.9%) of this small group of users decreased their use because of physical health concerns.

TABLE 3 | Change in average number of joints per use day among respondents who used (almost) daily after implementation of the lockdown measures.

		Before	After	
	% of total group	Mean number of joints (SD)	Mean number of joints (SD)	*p*-value $t_{(df)}$
BEFORE LOCKDOWN: (ALMOST) DAILY; AFTER IMPLEMENTATION: (ALMOST) DAILY				
Total group ($N = 959$)		3.7 (2.6)	4.4 (3.0)	**0.001** $t_{(958)} = 14.7$
Less joints	4.2	–	–	
Same number	57.4	3.8 (2.7)	–	
More joints	38.5	3.4 (2.4)	5.5 (3.2)	
BEFORE LOCKDOWN: LESS THAN (ALMOST) DAILY[a]; AFTER IMPLEMENTATION: (ALMOST) DAILY				
Total group ($N = 174$)		1.8 (1.7)	2.9 (2.3)	**0.001** $t_{(173)} = 7.7$
Less joints	2.9	–	–	
Same number	23.6	1.8 (1.2)	–	
More joints	73.6	1.6 (1.4)	3.3 (2.5)	

Respondents were asked to report the average amount of joints they used on a typical use day before and after lockdown measures were introduced. This table reports if respondents increased, decreased or used the same amount of joints on an average day of use. Only respondents who reported to have used joints before and after the introduction of the lockdown measures were included (n = 1,414). [a]This category included respondents who reported to use: a few times a week (71.8%, n = 125), once a week (12.1%, n = 12), a few times a month (8.0%, n = 14), once a month and a few times a year (8.0%, n = 14). – number of respondents too low to report average. Bold values indicates P < 0.05, a significant difference between number of joints before and after lockdown.

Route of Administration

Before the lockdown, most respondents (91.4%) smoked joints in which cannabis was mixed with tobacco. Other modes of use were each reported by less than 8% of the respondents (**Table 1**). 87.6% of respondents who usually smoked cannabis in a joint with tobacco before the lockdown and did not stop their use, still did so. Among those who smoked cannabis in a joint before the lockdown measures, the most common adjustment was "using less tobacco in a joint" (7.3%). A small proportion indicated that they used edibles (more often) (2.0%) or vaped (more often) (1.1%). Less than one percent (0.6%) stopped mixing their cannabis with tobacco.

DISCUSSION

Our findings suggest that regular cannabis users in the Netherlands have increased rather than decreased their use in response to COVID-19 lockdown measures. This is generally in line with recent results from online surveys in convenience samples of cannabis users in other countries (14, 16), in (general) population samples in France (19) and Belgium (20), and a sample of medicinal cannabis users in the United States (21). However, a survey among young (16–18 years) Canadian high school students revealed mixed results (22). While our survey largely sampled (almost) daily users, of whom over one-third increased the amount of cannabis consumed per day, the findings also suggest that a substantial proportion of those who were not using daily also increased their consumption, both in terms of frequency and number of joints per day.

How these findings translate to the population level is not known. Research shows that intensive or daily users form the smallest group of last-year cannabis users, yet account for the largest part of the cannabis consumed (23, 24). An increase in the proportion of (almost) daily users in particular may be associated

TABLE 4 | Reasons to increase or decrease/stop cannabis use.

	Increased use ($N = 645$)					Decreased/stopped ($N = 146$)				
	Total	Women	Men	X^2	*P*-value	Total	Women	Men	X^2	*P*-value
Boredom (%)	78.4	74.7	81.0	3.62	0.057	8.2	5.1	9.3	–	–
Stress (%)	36.3	45.2	29.6	16.46	**0.000**	7.5	5.1	8.4	–	–
Loneliness (%)	29.6	31.4	28.2	0.75	0.385	6.8	2.6	8.4	–	–
Mental health (%)	30.1	37.9	24.5	13.20	**0.000**	29.5	20.5	32.7	2.05	0.153
Physical health (%)	7.9	10.7	5.8	5.20	**0.023**	19.9	17.9	20.6	0.12	0.726
Less parties/nightlife (%)	26.5	21.1	30.1	6.45	**0.011**	19.9	2.6	26.2	10.00	**0.002**
See friends less (%)	22.5	18.0	25.1	4.46	**0.035**	32.2	17.9	37.4	4.95	**0.026**
Use less other drugs (%)	4.8	4.2	5.3	0.38	0.538	4.8	0.0	6.5	–	–

Bold values indiactes P < 0.05, a significant difference between men and women. As multiple answers were possible, the percentages do not add up to 100%. – numbers per cell too low for the analysis.

with adverse (health) consequences, as they largely continued to smoke cannabis (with tobacco) and used the highest average number of joints per day.

The COVID-19 crisis has boosted activities promoting cessation of tobacco smoking in some countries (25, 26). More efforts should be made to encourage cannabis users to take a break or cease their use, since our data show only a minority of users appeared to have done so. As access to drug treatment services may be limited due to social distancing measures, implementing support at distance via the web may be beneficial, even if intervention effects are generally small (27, 28). Because simultaneous cannabis and tobacco users are five times more likely to experience cannabis dependence (2), specific attention should be paid to this "dual use." Preferably, both tobacco control and drug policies should embrace this challenge.

As smoking is still the most preferred route of cannabis use, specific advice should be given on reducing the risks of spread and severity of COVID-19 via this mode of use. This would include avoiding use of any inhaled cannabis product, including joints, pipes, bongs or vaporisers, and avoiding deep inhalation that may provoke coughing, not sharing cannabis products (e.g., joints) and maintaining physical distancing and thorough handwashing (29, 30). Although vaping (non-combusted) cannabis is likely less harmful than smoking and is perceived by users as the most important way to reduce harm (2), there is limited evidence on the precise health effects of the use of various vaping products. Cannabinoid-containing e-cigarettes have been associated with serious illnesses in the USA that share symptoms with COVID-19 (31, 32). Health education should also address misinformation about the alleged protective effects of cannabis or CBD against COVID-19 that may encourage users to maintain or increase their consumption or promote initiation for perceived medicinal benefits.

It is important to prevent cannabis users from adopting an unhealthier use pattern that may persist after relaxation of restrictive measures. The smaller group of users who reported increased use of cannabis to cope with mental health problems and stress may be most vulnerable, since prior research identified these factors, as well as negative life events (e.g., financial problems), as predictors of problematic cannabis use (33, 34). Moreover, women and young adults seem to be at higher risk from increased consumption.

This study has some limitations. First, being a rapid response survey, it was intended to keep the questionnaire as brief as possible. Besides age and gender, no other personal data were collected, which could contribute to a further characterization of the study population and allow a generalization of the results to the wider population of cannabis users. Second, no detailed information was collected on changes in the use of other substances, which could have had an effect on changes in the use of cannabis. The low (5%) proportion of respondents reporting a change in their cannabis use, because they "used less other drugs," nonetheless suggests that there might not have been a major (substitution) effect, at least with regard to drugs. Third, this study did not distinguish between recreational users or medicinal users of cannabis, although the number of respondents who obtained their cannabis (on prescription) from pharmacies was very low ($n = 2$). Future studies might explicitly address the impact of the COVID-19 crisis on cannabis use in people who self-medicate mental or somatic health symptoms (or disorders) or use cannabis on prescription.

Finally, it is of paramount importance to continue monitoring cannabis use over the course of the pandemic and the period beyond. This is a challenge, because population surveys typically pick up only (major) trends in prevalence of use. Daily users comprise a minority in their samples and they do not routinely collect detailed information on the extent of cannabis (and THC/CBD) exposure (35). The differential dynamics of both increases and decreases in use may flatten trends and mask the existence of a high risk group of users.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The Central Committee on Research Involving Human Subjects in the Netherlands does not require approval from an ethical review committee for non-medical survey research. Respondents were informed about the purpose of the study and storage of the data and their anonymity was guaranteed.

AUTHOR CONTRIBUTIONS

ML and PO: conceptualization and writing—original draft. EV: investigation. CM: data curation. CM and EV: formal analysis. TF, WH, and CM: writing—review and editing. ML: supervision. All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by the Dutch Ministry of Public Health, Welfare, and Sport. The sponsor had no role in the study design, data collection, interpretation of the data, writing of the article or the decision to submit it for publication.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

PERSPECTIVE
published: 13 January 2021
doi: 10.3389/fpsyt.2020.623032

Isolation, Solitude and Social Distancing for People Who Use Drugs: An Ethnographic Perspective

Laura Roe [1], Jesse Proudfoot [2], Joseph Tay Wee Teck [3], Richard D. G. Irvine [1], Stan Frankland [1] and Alexander Mario Baldacchino [3]*

[1] Department of Social Anthropology, University of St Andrews, St Andrews, United Kingdom, [2] Department of Sociology, Durham University, Durham, United Kingdom, [3] School of Medicine, University of St Andrews, St Andrews, United Kingdom

COVID-19 has resulted in deepened states of crisis and vulnerability for people who use drugs throughout Europe and across the world, with social distancing measures having far-reaching implications for everyday life. Prolonged periods of isolation and solitude are acknowledged within much addiction literature as negatively impacting the experiences of those in recovery, while also causing harm to active users – many of whom depend on social contact for the purchasing and taking of substances, as well as myriad forms of support. Solitude, however, is proposed by the authors as inherent within some aspects of substance use, far from particular to the current pandemic. Certain forms of substance use engender solitary experience, even where use is predicated upon the presence of others. Adopting a cross-disciplinary perspective, this paper takes as its focus the urgent changes wrought by the pandemic upon everyday life for people who use drugs, drawing on recent ethnographic fieldwork with substance users in Scotland. Beyond the current crises, the paper proposes solitude, and by extension isolation, as an analytical framework for better apprehending lived experiences of substance use.

Keywords: substance use, COVID-19, isolation, solitude, social distancing, substance use disorder, harm reduction

OPEN ACCESS

Edited by:
Ornella Corazza, University of Hertfordshire, United Kingdom

Reviewed by:
Chloe Jordan, McLean Hospital, United States
Amira Guirguis, Swansea University, United Kingdom

****Correspondence:***
Laura Roe
lr383@st-andrews.ac.uk

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *29 October 2020*
Accepted: *16 December 2020*
Published: *13 January 2021*

Citation:
Roe L, Proudfoot J, Tay Wee Teck J, Irvine RDG, Frankland S and Baldacchino AM (2021) Isolation, Solitude and Social Distancing for People Who Use Drugs: An Ethnographic Perspective. Front. Psychiatry 11:623032. doi: 10.3389/fpsyt.2020.623032

INTRODUCTION

Considerations of isolation and solitude in relation to Substance Use Disorders (SUD) are often accompanied by portrayals of life as lacking in social connection, where the possibilities for meaningful relationships are subsumed by the compulsive drive toward substances. In popular depictions, bonds of family and friendship are turned away from and the person gradually finds themselves alone, together only with the substance. Characterisations such as these have extensive roots in historical understandings of addiction, with substance use and social relationships having been positioned as mutually exclusive since at least the late 1700s (1). Contemporary addiction scholarship has done much to dispel such notions, with anthropological and ethnographic works exploring social bonds as profound components of substance use, or else as being minimally affected by it (2–4). Everyday survival for some people who use drugs frequently depends upon the maintenance of (often fragile) social networks – with certain forms of use entailing specific configurations of relatedness, intimacy, and care.

The Covid-19 pandemic has made such survival strategies even more precarious. Social distancing measures have, for instance, created ripple effects on drug supply chains; the ability of individuals to procure desired drugs and injecting equipment, and the operation/accessibility of harm reduction and healthcare services, amongst many other unintended consequences (5–7). Fluctuating availability of substances is likely to affect individual tolerance and may lead to increased risk of overdose (8). Some intervention, harm reduction, and recovery services have faced significant challenges in transitioning from in-person contact to online and phone support (9). Some have increased the amount of allowable unsupervised take-home opioid replacement therapy to facilitate social distancing measures, whilst others have flooded the market with Take Home Naloxone (THN) (7, 10, 11). Intensive experiences of isolation, known to be detrimental to well-being and recovery, have been exacerbated by the pandemic, with disastrous effects on the mental and physical health of many people who use drugs (12). Through its threats to social bonds and relatedness, therefore, the pandemic has deepened the difficulties encountered by many on a day-to-day basis.

And yet, alongside its inherently social aspects, substance use is also intimately connected to solitude, whether that be in everyday moments such as the high, or distilled across longer spans of time, so that life itself comes to feel solitary. Solitude therefore occupies an essential place within substance user sociality, coming to be connected with experiences of loneliness, boredom, emptiness, and senses of time as endless or repetitive. At the same time, it is important to recognize that the experience of solitude can be sought-after, and that this itself can provide a motivation of substance use. Recent theorisation of solitude has challenged its inevitable characterization as pathological (13), highlighting the importance of time spent alone for well-being (14, 15). Moreover, collective desire for solitude can itself be a source of shared experience (16). It is therefore necessary to distinguish between solitude as deliberate withdrawal, and isolation as an involuntary loss (or non-existence) of social ties, implying an absence of or alienation from social relationships. The state of being alone can be intentional or unintentional; destructive or restorative; situational or existential [c.f. (17)]. The challenge of theorizing solitude for people who use drugs is how to explore it as commonplace while avoiding tropes of substance use as inherently and inevitably isolating. This paper seeks to address the question of how isolation and solitude can form an analytical framework to better explore the experiential, temporal, and material impacts of the pandemic – and social distancing – on people who use drugs.

SOLITUDE AS SOCIAL DISTANCING

Social bonds between people who use drugs are often characterized as being governed by need – predominantly financial or logistical – with SUDs viewed as compromising the trust, intimacy, co-operation, and care that characterizes close relationships. Ethnographic studies of people who use drugs, however, offer countless examples of relationships that easily fit into "normative" configurations of sociality and friendship and extend far beyond pragmatism, though like all relationships they might at times be mediated by self-interest, self-preservation, and necessity [c.f. 2, 4]. Under "conditions of scarcity," people who are dependent on drugs must often carefully negotiate self-preservation against the possibility of becoming socially isolated (2). For such users, isolation from one's social network often entails heightened risk of withdrawal, as procuring substances becomes much more difficult (18); the risk of overdose is increased if one uses alone (19); and there are myriad harms associated with economic and social precarity (20–22). Social bonds therefore offer protection against the dangers of isolation, although relationships based around substance use cannot be reduced to pragmatic aspects, nor be easily generalized. Aaron Goodfellow (4), for instance, notes that although heroin use was almost always a central aspect of relationships between heroin users, relationships were not inexorably defined by it. While social bonds could be fragile and fractious, relationships between heroin users comprised unanticipated, novel, and at times "normative," forms of relatedness that offered profound senses of meaning, purpose, and fulfillment.

Isolation can, as such, lead to increased or riskier substance use, partly because the social relations and interactions that offer purpose and meaning are unattainable. In addition to the harmful effects of isolation mentioned above, too much time on one's own can foment powerful senses of boredom, anxiety, and loneliness, as well as precipitate the return of painful memories, against which substances provide a means of relief. For those in recovery, too, the draw toward substances is often coupled with boredom, loneliness, and feelings of hopelessness, with everyday life ceasing to feel meaningful. Diverse studies on boredom (23–35); waiting (25, 26, 28, 31, 36); and notions of being "stuck" (34), draw attention to the distinctly temporal dynamics that characterize such experiences, many noting in particular that future hopes and aspirations appear inaccessible. Clouded senses of the future are further exacerbated by economic precarity (24, 28–30, 34) and experiences of subjugation (31, 33) that provoke a sense of the present as endlessly, and inescapably, repeating. Temporal repetition can easily become oppressive and anxiety-inducing, leading to "thinking too much" and being overwhelmed by difficult or distressing memories (26, 33, 34).

CASE STUDY

This was often the case for many of the authors' research participants, across a variety of research settings. [1] During Roe's ethnographic research, which largely took place in 2017 in an East coast county in Scotland, themes of isolation, boredom, anxiety, and senses of time as endlessly repeating arose in dozens of interviews and conversations with people who used drugs (37). Accompanying a small number of individuals in their everyday lives over a period of several months further illuminated the connection between isolation, the affective-temporal states isolation occasioned, and participants' continuing substance use.

One such participant was Tamsin, a woman in her early thirties who had been using heroin since the beginning of her twenties, and a variety of other substances since she was

[1]Full ethical clearance was granted by the University of St Andrews' ethics committee for the research presented in this paper.

a young teenager.[2] Tamsin described having made countless attempts to become abstinent over approximately 5 years, which accompanied a fluctuating engagement with various recovery and counseling services. Although she mentioned having had a methadone prescription in the past, she was not involved with NHS Addiction Services during the time of the research.

For Tamsin, the stresses of everyday life could be moderated through specific forms of substance use, usually in which heroin was combined with various other psychoactive substances, such as benzodiazepines and alcohol. Although Tamsin also frequently used heroin on its own, she described its effects as minimal and unobtrusive. By comparison, the intoxication she sought through poly-drug use had potent effects on her consciousness, emotional state, and perception of time. Tamsin often described how feeling bored, isolated, and alone often led to escalated use of heroin and other drugs.

The below conversation with Tamsin took place during Roe's initial research, during a casual visit to a park near her home. It was one of many in which Tamsin described isolation and boredom as both "claustrophobic" and connected to specific forms of substance use (37).

Laura: Do you mind being on your own?

Tamsin: Not really, like I can be by myself, I'm not one of those people that cannae stand being alone.[3] Ken I don't mind my own company, most of the time, but it just gets kind of boring sometimes.[4] Especially if you're not in a good place, like, mentally. [Laughing] The walls start closing in.

Laura: How do you mean?

Tamsin: Well, like, if you're feeling shit about things anyway, nothing's happening, folk are being cunts. I start feeling claustrophobic, especially if I'm trying to keep aff it.[5] Start thinking about shit.

Laura: Like what kind of stuff?

Tamsin: Dunno, just stuff. Bad things, traumatic shit. I think it's why I use.

Laura: Do you think you use when you get bored?

Tamsin: I use because I have to, mostly, but aye, I guess boredom is a big thing. It's good for killing time. [...] Everything's the same, day in, day out; same old shit.

Laura: That makes sense. Does it make time pass quicker, do you think, or do you just stop noticing it? The time, I mean.

Tamsin: [hesitating] I'm not sure. It depends, maybe. Downers like Vallies just slow everything right down, in a nice way though.[6] Relax you. [...] Things just fall away, ken, nothing matters.

Tamsin illustrates above that senses of being alone with nothing to do – along with resulting feelings of boredom and entrapment – can be countered with specific substances. Tamsin gestures toward the return of traumatic or painful memories in such circumstances, which she here implies are distanced with substance use – temporarily forgotten or remembered less sorrowfully. Similarly, there were other occasions in which Tamsin described her use of substances as removing her from the present, which was often experienced as stressful, dull, and repetitive. In this context, substances can be used to forge new affective-temporal scripts, in which the slowness and emptiness of time – rather than being laborious and intolerable – is dwelled in, and other concerns or crises are rendered second to the high. At other points, Tamsin noted that getting high provided breathing space from daily life, a sentiment echoed by several other participants in the research. This desirable form of solitude differed from isolation, answering a desire that Tamsin once framed by saying "I just want to get away from everyone and everything." Substances could therefore counter the negative aspects of isolation by enabling a more peaceable sense of aloneness and solitude and, perhaps paradoxically, by enabling one to "isolate" oneself from trauma, pain, and boredom. Tamsin gives a sense of retreating into herself and into alternative temporalities, evoking a form of social distancing that would seem to give new meaning to the term. The space created from others was not merely physical, as we have come to understand by "social distancing," but rather a means of inhabiting, albeit temporarily, a world of one's own.

Natascha Dow Schüll (38) makes a similar observation in her research with compulsive "slot," or "fruit" machine gamblers. While popular representations of gambling often focus on gamblers' desperate attempts to turn around a losing streak by "winning big," or the thrill of risking it all on a single turn of the wheel, Schüll notes that what machine gamblers value most of all is the solitude of what they call "the zone": a state of detachment from everyday life that they experience when immersed in the machine. In this space of predictable, pleasurable repetition, the messiness of human relationships and caring responsibilities melts away, replaced by solitary communion with the machine. Such desires for solitude, understood as a means of managing the problem of being with others, and the pursuit of activities that transform solitary experience into something pleasurable which steps out of time, have striking parallels with the solitude many of our respondents describe pursuing in drugs.

Without undermining the sociality of using substances, and the myriad forms of relatedness made possible through substance use, solitude come to the fore as a meaningful and sought-after experience (35). Even where substances are taken in the company of others, moments of solitude can be achieved through the high. It should also be acknowledged that isolation and solitude can be sought outside of taking substances and becoming intoxicated, and instead permeate everyday life. Substance users also spoke of isolating themselves from family, friends, and other social contact even where it was known to be destructive or detrimental to their health and well-being. Tamsin, for instance, notes the ability of substances to make "things fall away" but at other times gestured toward the satisfaction to be found in simply "letting things fall apart" (37).

Isolation and solitude overall have multiple dimensions, both negative and positive, that are avoided and pursued to varying

[2] All names and identifying features have been removed in order to protect the anonymity of the individuals who appear in this paper. All conversations and interviews presented were audio recorded with full written consent and permission was obtained for printing.

[3] 'Cannae' means 'cannot' or 'can't.'

[4] 'Ken' means 'know' and is often used to mean 'you know?'

[5] Tamsin went through periods of attempted abstinence, which she referred to as 'keeping aff [off] it.'

[6] 'Vallies' is a slang term for Valium.

extents by people who use drugs. Social relationships, substance use, and solitude can each serve as intertwining buffers to the harmful aspects of isolation. In the context of Covid-19, in which isolation presents genuine threats for people who use drugs, even dangerous patterns of poly-substance use can be understood as specific means of countering experiences of isolation, loneliness, frustration, boredom, and despair.

ISOLATION AND SOLITUDE IN COVID-19

Social isolation for people who use drugs takes on new significance in light of the pandemic, particularly in the face of nationwide lockdowns and social distancing measures. In certain cases, actions taken to prevent the spread of the virus have been beneficial to substance users – such as services delivering essentials of food and medication to users who are shielding – while other measures have worsened the difficulties faced by users on a day-to-day basis (39). Homeless substance users offered temporary accommodation for the duration of the crisis, for instance, have found themselves facing intensified isolation, due to being removed from social networks and known spaces (40). Smith (41) similarly notes that homeless people in London were disadvantaged by their relocation to different parts of the city, away from the familiar terrain and social relationships that offered access to things like food and companionship. Some even favored rough sleeping over private lodgings. The authors noted similar trends in working with homeless substance using populations in Scotland (although there were equally those that enjoyed the sociability of shared accommodation, as opposed to the isolation of sleeping rough) (42). These challenges are by no means new, but are nonetheless greatly exacerbated in the current context, wherein already precarious social relationships and circumstances are further fractured and destabilized.

Isolation during Covid-19 has also been noted in numerous emerging studies as leading to both increased and riskier substance use, and frustrating attempts to recover (43–47). In a survey conducted by the Scottish drug treatment and education charity Crew, isolation, boredom, and stress were cited as reasons for increased substance use in Scotland, with 58% of 300 participants reporting an increase in their use (44). A survey undertaken by the New Zealand Drug Foundation, similarly, found increases in use – boredom and anxiety being reasons most commonly given – although lockdown enabled some to reduce their use (45). A recent study by the Well-being Trust cites isolation, stress and financial hardship as significantly increasing the likelihood of higher drug-related deaths [c.f 47]. Issues of isolation have been further compounded by major disruptions to drug supply chains across the world, with decreased availability and increased prices prompting the use of alternative substances – in turn heightening the risk of changes in individual tolerance and overdose (7, 46).

The authors have observed similar shifts in patterns of substance use in Scotland, including, for example, a significant rise in the use of crack cocaine, benzodiazepines, and alcohol. In discussions with active and recovering substance users, deepened senses of isolation, loneliness, anxiety, and boredom – combined with fluctuating availability of substances – acted as catalysts for more frequent and more chaotic using.

CASE STUDY

In a series of phone conversations in May, June, and July of this year, several of Roe's research participants discussed the everyday difficulties occasioned by lockdown restrictions and social distancing measures. During one such phone call, Tamsin detailed her own experiences of lockdown, describing overlapping senses of isolation, boredom, and anxiety as harming her efforts to remain abstinent.[7] In response to being asked about her experiences during the pandemic, she had answered:

I was totally climbing the walls, like. It drives me a bit mental, being cooped up. I need to be doing things or else I just get bored… Aye, I was still going out to score, but I was so anxious about it, ken, I wouldn't have done it if I couldn't of. I was at my mum's for a bit, but it was hard going. I stayed with my pal, but we fell out when she fucking robbed me. […] I've not really been seeing anyone, ken, trying to stick to the rules and everything. It's hard going, like. I was doing okay before, but this knocked me back, like my anxiety is a lot worse. […] I slipped near the beginning, and it's fucked me. Never ends, eh?

The conversation meandered through a number of other topics, eventually progressing to the impact of the pandemic on local drug supply. On this matter, Tamsin described a lack of available heroin and the need to resort to alternative substances:

I couldn't get heroin a few times, but I got crack, eh, just to stop me fae rattling.[8] The heroin's been shit quality. There was fake Vallies going about too. I was injecting crack, so my veins are probably fucked. More fucked. […] I never liked crack, I never really got high off it. I was on my own, which wasn't the best idea, probably. My drug debts are a lot worse too, it's stressful.

The conversation then turned to the effects of substances and, when prompted, Tamsin reasoned that substances permitted a sense of uncertainty toward the negative aspects of isolation and the overall stresses of the pandemic:

My using's been pure chaotic lately, but I've been that stressed. […] It just helps you get away from it all, ken. I don't know, I don't have to think. It kind of just gets you out of what's happening.

From conversations with Tamsin and a number of other substance users, it became apparent that the isolation experienced during and after lockdown both highlighted and exacerbated pre-existing difficulties and crises: "You just feel, like, what's the point? […] Things just always seem to get worse" as Tamsin put it. Substances continued to offer Tamsin a means of "self-isolating" or "shielding" from trauma, anxiety, and boredom, which were worsened in this case by her literal self-isolation.

[7] During the lockdown, Roe contacted research participants by phone in order to keep in touch and maintain the research relationship while in-person fieldwork was impossible. The conversation with Tamsin in June was specifically audio recorded at her request, and excerpts are printed here with full consent.

[8] 'Fae' means 'from' and 'rattling' means 'withdrawing.'

Tamsin's experiences are of course specific to her own situation, although it is notable that much of what arose in the above phone call was echoed by other substance users. Four other individuals spoken to by Roe during this time emphasized the worsened precarity of their living situations; the fluctuating difficulty of obtaining regular substances; the need to resort to alternative substances to avoid withdrawal; and the use of substances to counter the adverse effects of prolonged isolation, boredom, and anxiety on their mental health and well-being. These issues are far from isolated to substance users in Scotland, but have been evidenced in several recent international studies on the impacts of the pandemic upon substance using populations. Banducci and Weiss, for example, in working with individuals with posttraumtic stress disorder (PTSD) and SUDs in the US, observed that substances were used to counter isolation, stress and the "monotony" of daily life under stringent social distancing measures (48). The turmoil wrought by the pandemic, they go on to argue, complicates recovery in part by rendering the future uncertain. Researchers based in a residential treatment center in Los Angeles similarly reported that treatment retention was hampered by clients' struggles with adverse affective states such as boredom, anxiety, and depression (49).

Day-to-day risks of withdrawal, overdose, and economic precarity were and continue to be amplified by the pandemic, alongside exaggerated senses of repetitive time, a lack of temporal direction, and an inaccessibility of the future. Social distancing measures continue to deprive people who use drugs of the social relationships and sources of interaction that offer meaning and purpose. The intense isolation occasioned by the pandemic therefore exacerbates the boredom and frustration within which substance use often emerges, while heightening circumstances of social isolation that are associated with acute loneliness (25, 50, 51), senses of uselessness (29, 30), and hopelessness. In short, already fragile social and temporal structures have been further fragmented by the pandemic, as exemplified by Tamsin's testament to her fractious relationship with her friend, and her account of the present as both chaotic and unending.

Within this turbulent milieu, substances continue to offer a form of solace, enabling both breathing space and solitude. Substances provide a means of gaining distance from the present, in addition to enabling a heuristic of temporal relief that in turn allows for new affective-temporal possibilities. The intensified flux in substance availability and affordability, however, problematises even this aspect of everyday life, as further restrictions on choice produce unanticipated and harmful effects. Relatively recent trends in innovative and opportunistic ways of combining multiple substances have arguably laid the groundwork for adaptive responses to shifting drug markets.

Counteracting isolation among people who use drugs was recognized by the Scottish Government as a priority during the pandemic. The "Staying Connected Scotland Fund" provided tablet computers, smart phones, data SIM cards and subscriptions to teleconferencing services to enable participation in mutual aid and peer support groups (52). While this fund has been an invaluable way of bridging the "digital divide," it is important to consider that a third of the population in Scotland lives alone, an even higher proportion among people who use drugs (53). This is compounded by many in this group being older with less engagement with online communications. Further, privacy when using online communications can be unattainable where people are street homeless or in shared temporary housing. Finally, we have no real idea of how long social distancing measures will need to be maintained, and we have evidence indicating that prolonged isolation is associated with 60–70% increase in mortality (54). In appreciation of this set of circumstances, clinicians and care-workers may now need to build in strategies to overcome isolation, balance the risks of isolation against the risk of exposure to Covid-19 and bridge the cultural unfamiliarity or discomfort with virtual social networking as a replacement for conventional human contact.

Our focus here on the disruption to interpersonal relationships among people who use drugs in Scotland speaks directly to the problems of internalized stigma and shame, which act as barriers to the formation of collective or community identities and ties. It is essential to recognize the impact of social capital, or the depth and extent of social networks, trust, and norms, as a protective factor against opioid overdose at the community level (55). To what extent will social isolation further increase community fragility, and through this increase the vulnerability of a group already beleaguered by the highest drug related death rate in the EU?

CONCLUSION

Isolation and solitude, overall, comprise important – yet often overlooked or misconstrued – aspects of substance use, ones which take on particular significance in the context of the pandemic. Social relationships between people who use drugs are equally often mischaracterised as purely pragmatic or based predominantly on need, although there is increasing recognition that these, as with all relationships, are often grounded in bonds of care, love, trust, and solidarity (2, 4). Relationships need not be defined through substances, though substance use itself can produce forms of social, physical, and emotional intimacy that facilitate everyday survival (56). Circumstances of precarity, vulnerability and crises – such as the pandemic – can, however, serve to complicate and disrupt social relationships, exposing individuals to the harms of isolation. Intensified experiences of isolation during the pandemic have served to prompt heightened and often riskier substance use, which enables both a "shielding" against adverse affective states such as boredom, anxiety, despair, and trauma, and the pursuit of a desirable form of solitude. The isolation that has arisen from social distancing measures, and the collateral harms outlined above, have made such solitude all the more necessary and yet, with the disruption to daily life, all the more difficult to achieve.

Where isolation, boredom, and loneliness are problematic to the person who uses drugs, what then is the solution? As mentioned earlier, digital technology such as video-conferencing and virtual groups have been advanced as key interventions to mitigate the enforced isolation many are experiencing as a result of necessary social distancing. Virtual social support has doubtlessly been invaluable to some in reducing the impacts of isolation, though the ability to access virtual spaces is mediated by inequality and circumstance. There are similarly issues such as the loneliness paradox, where technology gives us the semblance of connectedness, without the substance of meaningful therapeutic relationships. Indeed, this has been observed by the authors in clinical practice where patient's expectations were raised through having access to a therapist virtually, only to be let down when they were unable to access the same therapist regularly. The current UK guidance on managing the isolation the pandemic has wrought is to stay connected and to access practical help, but with little indication of how this is to be done (57). For many people struggling with their substance use, following this advice would have been problematic pre-Covid-19. It is unlikely to be any easier now.

What remains clear is the necessity of attending to the complex dynamics of relatedness, isolation, and solitude that structure experiences of both substance use and social distancing. Fostering social connection and community surface as paramount in reducing the harmful aspects of isolation, though we argue that such approaches can be strengthened through a nuanced appreciation of the place that solitude occupies in substance user sociality. Addressing the impacts of the pandemic must begin with a full and dialogic engagement with lived experience and a commitment to involving those who use drugs in the design and implementation of policy and practice. In addition to the daunting and ever-present challenge of tackling systemic inequality and deprivation, the multitude of complex, diffuse, and often contradictory experiences must, somehow, be accounted for, both in responses to the pandemic and beyond.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Datasets comprised of ethnographic research are exempt from digital upload in University of St Andrews. Requests to access these datasets should be directed to Laura Roe, lr383@st-andrews.ac.uk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University Teaching and Research Ethics Committee (UTREC) University of St Andrews. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

The ethnographic research that informs the paper was conducted by LR. LR, JP, JT, RI, SF, and AB contributed to the conception of the paper and made substantial contributions to the drafting and revision of the work. Each had final approval on the version for publication and agrees to be accountable for all aspects of the work.

FUNDING

This work was supported by the Economic and Social Research Council [ES/V011383/1].

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 25 January 2021
doi: 10.3389/fpsyt.2021.621497

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Gambling in COVID-19 Lockdown in the UK: Depression, Stress, and Anxiety

Steve Sharman[1,2*], Amanda Roberts[3], Henrietta Bowden-Jones[4,5,6] and John Strang[1]

[1] National Addiction Centre, Institute of Psychiatry, Psychology and Neuroscience, Kings College London, London, United Kingdom, [2] School of Psychology, University of East London, London, United Kingdom, [3] School of Psychology, University of Lincoln, Lincoln, United Kingdom, [4] National Problem Gambling Clinic, London, United Kingdom, [5] Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, [6] Faculty of Brain Sciences, University College London, London, United Kingdom

To combat the spread of COVID-19, the UK Government implemented a range of "lockdown" measures. Lockdown has necessarily changed the gambling habits of gamblers in the UK, and the impact of these measures on the mental health of gamblers is unknown. To understand the impact of lockdown on gamblers, in April 2020, after ~6 weeks of lockdown, participants ($N = 1,028$, 72% female) completed an online questionnaire. Gambling engagement data was collected for pre-lockdown via the Brief Problem Gambling Screen (BPGS) allowing participants to be classified as Non-Gamblers (NG), Non-Problem Gamblers (NPG) or Potential Problem Gamblers (PPG). The Depression, Stress, and Anxiety Scale (DASS21) was used to measure depression, stress, and anxiety scores both pre- and during-lockdown. Results indicate that depression, stress and anxiety has increased across the whole sample. Participants classified in the PPG group reported higher scores on each sub scale at both baseline and during lockdown. Increases were observed on each DASS21 subscale, for each gambler group, however despite variable significance and effect sizes, the magnitude of increases did not differ between groups. Lockdown has had a significant impact on mental health of participants; whilst depression stress and anxiety remain highest in potential problem gamblers, pre-lockdown gambler status did not affect changes in DASS21 scores.

Keywords: gambling, COVID-19, depression, stress, anxiety, disordered gambling

OPEN ACCESS

Edited by:
Giuseppe Bersani,
Sapienza University of Rome, Italy

Reviewed by:
Carla Cannizzaro,
University of Palermo, Italy
Stefania Chiappini,
University of Hertfordshire,
United Kingdom

***Correspondence:**
Steve Sharman
Stephen.p.sharman@kcl.ac.uk

Specialty section:
This article was submitted to
Addictive Disorders,
a section of the journal
Frontiers in Psychiatry

Received: *26 October 2020*
Accepted: *04 January 2021*
Published: *25 January 2021*

Citation:
Sharman S, Roberts A, Bowden-Jones H and Strang J (2021) Gambling in COVID-19 Lockdown in the UK: Depression, Stress, and Anxiety. Front. Psychiatry 12:621497. doi: 10.3389/fpsyt.2021.621497

INTRODUCTION

The global COVID-19 pandemic has had a significant impact on the lives of people around the world. In the UK, government measures implemented to stop the spread of the virus resulted in much of society being in "lockdown" from late March, with measures only being eased in late June and early July. Lockdown impacted on individuals, families, and wider society from different perspectives; interestingly, some of these impacts may have led to changes in addictive behaviors due to reduced accessibility of substances, withdrawal, increased craving, removal of positive reinforcers, and reduced access to medical or psychological support (1).

Gamblers were potentially at greater risk of gambling-related harm (2), as lockdown potentially exacerbated established risk factors for disordered gambling, including social isolation (3–5), lack of social support (6), boredom, (7, 8), and financial insecurity (9–11).

Furthermore, depression, stress, and anxiety disorders are common in gamblers; elevated levels of depression and anxiety are frequently observed in treatment-seeking disordered gamblers (12–15). A meta-analysis and systematic review of co-morbid mental health disorders in treatment seeking gamblers identified 36 studies, and reported that 23.1% of gamblers presented with a current mood disorder, 17.6% with an anxiety disorder, and 29.9% with a major depressive disorder (16). Further studies have found that severity of gambling problems was significantly associated with severity of depressive symptoms (17, 18). Within those who gamble, problem gamblers scored more highly on depression and anxiety scores than non-problem gamblers (19). Additionally, depressive symptoms are also more common in those who gamble when recruiting from population samples. In a systematic review, Lorains et al. (20) identified 11 studies that recruited from general populations and reported an average effect size of 23.2% for major depression, 37.4% for any anxiety disorder, and 11.1% for generalized anxiety disorder.

Whilst co-morbidities between gambling, depression and anxiety are well-evidenced, the direction of the effect is less clear. Depression can precede gambling, with gambling used to escape from or relieve negative emotions, however the converse is also true; gambling can lead to financial and social difficulties, that in turn lead to depression (21). Similarly, stress has also been identified as both a reason to gamble (22, 23), and a consequence of gambling (24, 25), whilst altered stress physiology can render an individual predisposed to development of gambling disorder (26, 27). For a comprehensive overview of gambling and stress, see Buchanan et al. (28).

The unprecedented nature of lockdown in the UK means the short- and longer-term impacts of lockdown on depression, anxiety and stress in gamblers are unknown. This study aims to provide the first analysis of mental health change in gamblers, as a function of pre-lockdown gambling disorder severity.

Specially, the study has the following aims:

- To measure whether lockdown has affected depression, stress and anxiety.
- To understand if lockdown has affected depression, stress and anxiety as a function of gambler risk category.

MATERIALS AND METHODS

Even prior to the enduring research climate which has restricted face-to-face social interaction, remote data collection had become more frequently utilized in social science research (29), and has previously been used for gambling research (30, 31). Online participant pools offer reliable, large-scale recruitment allowing rapid recruitment to studies (32). The present study was programmed in Qualtrics (https://www.qualtrics.com) and was then shared to the online participant recruitment pool, Prolific Academic. Registered Prolific users were then able to respond to the study advert, and assuming eligibility, complete the study. Prolific Academic was chosen over other crowd-sourcing platforms as participants recruited from Prolific Academic have been found to be more naïve and less dishonest than those recruited from alternative platform Amazon's Mechanical Turk (MTurk), and to produce higher quality data than alternative crowd-sourcing platform CrowdFlower (33).

All data were collected in a single online session. Data were collected across a week-long time window at the end of April 2020. In the single session, questions asked about behaviors covering two distinct time periods; the first time-period refers to a specified period prior to the government recommended social distancing measures and is henceforth referred to as pre-lockdown. Questions also asked participants to self-report behavior since being asked to socially isolate, referred to henceforth as during-lockdown.

Participants

Participants were recruited through Prolific Academic. To maximize responses, the only eligibility criteria specified was that participants were required to be a current UK resident, and were adhering to some measure of social distancing, therefore were affected by lockdown. Thirteen participants were excluded as they were not engaged in any form of social distancing, resulting in a final sample of 1,028 participants (72.1% female; age $M = 33.19$, SD = 11.66, range 18–73). Age did not differ significantly between males ($M = 32.68$, SD = 12.26) and females ($M = 33.46$, SD = 11.45) [$t_{(990)} = 0.94$, $p = 0.35$]. All participants included in analyses were engaged in some level of measures to prevent the spread of COVID-19, either social distancing, social isolation, or social shielding. For convenience, the term social distancing is used henceforth to include all levels distancing measures. Participants were most commonly social distancing in a household with 2–3 other people (40.5%), and least commonly distancing alone (15%). Most were distancing with family (76.46%); 76.17% had been distancing for between 2 and 4 weeks, and 64.1% were employed, at the time of survey completion.

Measures

Participants completed the short form of the Depression, Anxiety, and Stress Scale [DASS 21, (34)]. The DASS 21 is a self-completion measure that is comprised of 3 scales, each measuring a different dimension. Each scale has seven items measuring depression (dysphoric mood states), anxiety (arousal states), and stress (negative affectivity). Construct validity of the DASS 21 has been tested in a UK non-clinical sample, with a quadripartite model returning optimal fit (RCFI = 0.94), when considering three distinct subscales and overall factor of general psychological distress (35).

Problem gambling status was measured using the Brief Problem Gambling Screen [BPGS-5, (36)]. The BPGS consists of five yes/no binary questions, and was used due to its brevity, and robust psychometric properties. Model development indicated that five item model demonstrated high specificity (99.9%) and sensitivity (90.8%), and greater clarification accuracy than other two, three or four item models (36). A score of 1 or more indicates problem gambling, and a need for further assessment (37). The BPGS was used to group participants into non-gambler, non-problem gambler and potential problem gambler groups for subsequent analysis.

Procedure

Data were collected in April 2020. Participants were invited to partake in the study through having a registered Prolific Academic account. Participants gave online consent, and were paid £6.28 p/h, pro-rata for estimated study completion time, resulting in a payment of £1.78 per participant, considered "fair" by Prolific Academic. After providing consent, participants completed basic demographic questions, before completing the DASS-21 and the BPGS. Participants also completed questions regarding COVID-19 symptoms and gambling behavior, reported elsewhere. The study protocol was approved by the School of Psychology Research Committee at the University of Lincoln, ref: 2020-2392, and the University of East London University Research Ethics Committee, ref: ETH1920-0207.

Data Analysis

Raw scores on the DASS21 were analyzed between groups using repeated measures ANOVA models. Positively skewed data were SQRT(+1) transformed prior to statistical comparison. Where transformations did not correct skewness, equivalent non-parametric tests were used. A standard alpha of 0.05 was used, however Bonferroni adjusted alpha values were adopted to correct for multiple comparisons, where appropriate. To report the magnitude of differences between groups, eta squared was reported as a measure of effect size. Effect sizes were reported as either small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), or large ($\eta^2 = 0.14$), (38). Change scores for DASS scales were calculated and compared using ANOVA models across gambling behavior change categories. Error bars represent the standard error mean [SD/sqrt (N)]. Sample distribution across depression, anxiety, and stress severity categories from the DASS were analyzed between pre- and during-lockdown using chi-squared models. Analyses of adjusted z score residuals identified *post-hoc* differences in chi-squared models using appropriately adjusted *p* values (39). For sub-group analyses, participants were grouped in to Non-Gamblers (NG, $n = 523$), Non-Problem Gamblers, as defined by indicating past-year gambling but scoring zero on the BPGS (NPG, $n = 362$) or Potential Problem Gamblers, as defined by scoring > 0 on the BPGS (PPG, $n = 143$).

RESULTS

Whole Sample

DASS scales showed significant increases between pre-lockdown and during-lockdown for depression, anxiety, and stress (**Table 1**). For depression, chi-squared analysis indicated that risk category distribution across the three DASS subscales in the whole sample was significantly different between the two time periods [$\chi^2_{(4)} = 36.3$, $p < 0.001$]. Analysis of adjusted z score residuals indicates significant decreases in the "normal" category ($p < 0.001$) and increases in the "extremely severe" category ($p < 0.001$). The omnibus model for anxiety was significant [$\chi^2_{(4)} = 12.79$, $p = 0.012$]; *post hoc* tests did not indicate any category change distribution change significant at the adjusted alpha of 0.005, although the increase in "extremely severe" was significant at 0.05. The omnibus model for stress was significant [$\chi^2_{(4)} = 52.18$, $p < 0.001$]; *post hoc* tests indicate a significant increase in the "extremely severe" category ($p < 0.001$).

TABLE 1 | DASS scale scores, whole sample.

DASS scale	Pre-lockdown		During-lockdown		Test statistics		
	M	SD	*M*	SD	*t*	(df)	*p*
Depression	2.18	1.05	2.43	1.15	9.47	1027	<0.001
Anxiety	1.77	0.97	1.84	1.09	2.7	1027	0.007
Stress	2.45	0.86	2.55	1.04	4.39	1027	<0.001

Non-gamblers, Non-problem Gamblers, and Potential Problem Gamblers

When analyzing between gambler groups, DASS scale scores reported for pre- and during-lockdown were compared between groups. Data were analyzed in repeated measures ANOVAs with factors of Time (pre- and during-lockdown), and Group (NG, NPG, PPG).

Depression

For depression, the repeated measures ANOVA model showed a significant main effect of Time [$F_{(1, 1025)} = 55.83$, $p < 0.001$, $\eta^2 = 0.052$]. Using a Bonferroni corrected alpha of 0.016, the NG and NPG groups reported significant increases in depression between pre- and during-lockdown (lowest $t = 5.13$, $p < 0.001$). The PPG group reported an increase significant at 0.05, but not at the adjusted alpha [$t_{(142)} = 2.28$, $p = 0.024$], **Figure 1**.

The factor Group was also significant [$F_{(2, 1025)} = 7.93$, $p < 0.001$, $\eta^2 = 0.015$]. The PPG group reported higher depression scores than both the NG and NPG groups (lowest $t = 2.5$, highest $p = 0.013$) for both pre- and during-lockdown. The NG and NPG groups did not differ from each other at either timepoint. The Time*Group interaction was not significant [$F_{(2, 1025)} = 2.3$, $p = 0.10$, $\eta^2 = 0.004$]. The mean change score was calculated by subtracting scale score for pre-lockdown from the scale score for during-lockdown. Using a corrected alpha of 0.016, depression change scores did not significantly vary between any groups (highest $t = 1.79$, lowest $p = 0.07$).

Anxiety

For anxiety, the repeated measures ANOVA model showed a significant main effect of Time [$F_{(1, 1025)} = 3.95$, $p = 0.047$, $\eta^2 = 0.004$]. All groups reported an increase in anxiety between pre- and during-lockdown. The increase was significant for the NPG group [$t_{(361)} = 2.64$, $p = 0.009$], but not the NG or PPG groups (lowest $t = 0.11$, $p = 0.91$), **Figure 2**.

The factor of Group was significant [$F_{(2, 1025)} = 9.74$, $p < 0.001$, $\eta^2 = 0.019$]. The PPG group reported significantly higher anxiety scores than the NPG and NG groups (lowest $t = 3.03$, highest $p = 0.003$) for both pre- and during-lockdown. The NG and NPG groups did not differ at either timepoint. The Time*Group interaction was not significant [$F_{(2, 1025)} = 0.89$, $p = 0.411$, $\eta^2 = 0.002$]. The mean change score for anxiety did not differ between groups (highest $t = 1.91$, lowest $p = 0.057$).

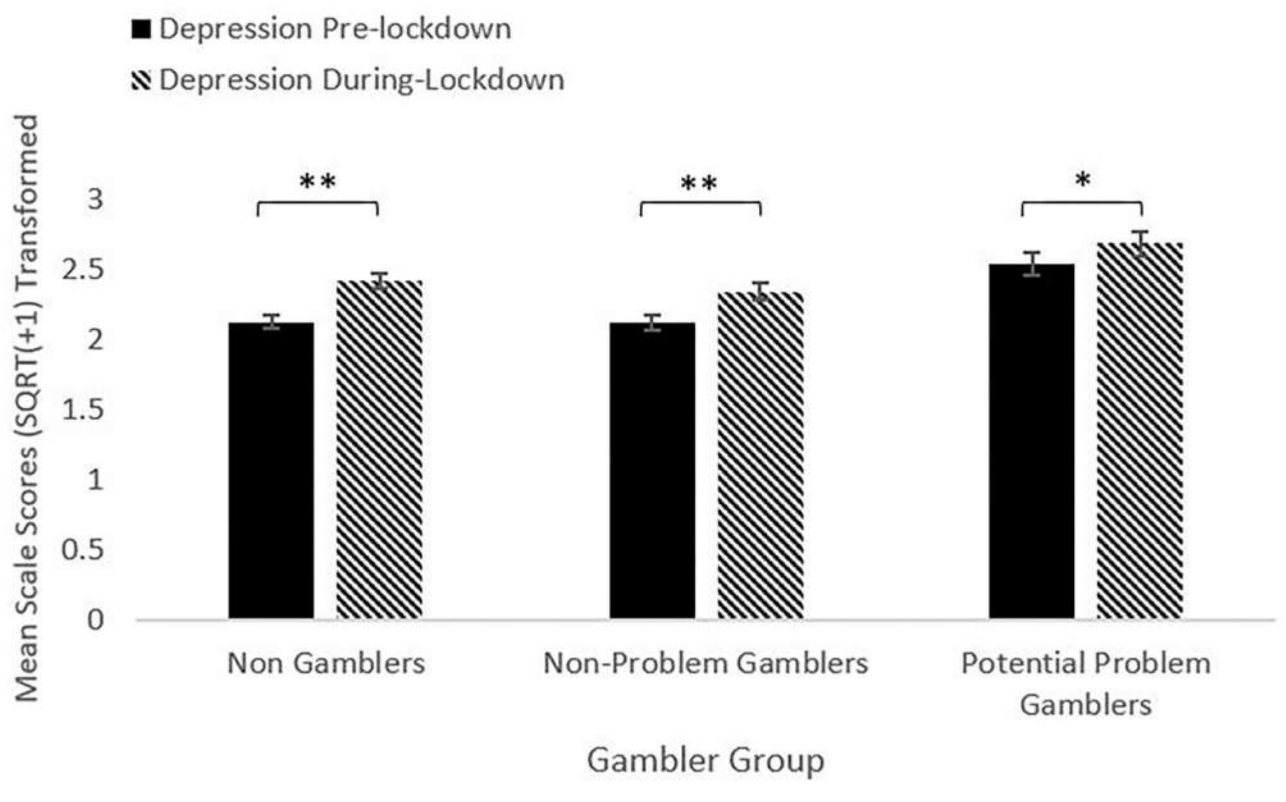

FIGURE 1 | Depression pre- and during-lockdown by gambler group (**$p < 0.001$, *$p < 0.05$).

Stress

For stress, the repeated measures ANOVA model showed a significant main effect of Time [$F_{(1, 1025)} = 11.89$, $p < 0.001$, $\eta^2 = 0.011$]. All groups reported an increase in stress between pre- and during-lockdown. The increase was significant for the NG and NPG groups (lowest $t = 3.03$, highest $p = 0.003$), but not for the PPG group [$t_{(142)} = 0.91$, $p = 0.37$], **Figure 3**.

The main effect of Group was also significant [$F_{(2, 1025)} = 6.97$, $p = 0.001$, $\eta^2 = 0.013$]. The PPG group reported higher stress scores than the NG group at both periods (lowest $t = 2.76$, highest $p = 0.006$). The PPG group reported higher stress scores than the NPG group pre-lockdown [$t_{(503)} = 3.19$, $p = 0.002$], but not for during-lockdown [$t_{(503)} = 1.88$, $p = 0.061$]. The NG and NPG group did not differ at either time period. The Time*Group interaction was not significant [$F_{(2, 1025)} = 0.36$, $p = 0.70$, $\eta^2 = 0.001$]. The mean change score for stress did not differ between groups at the adjusted alpha level, although change scores between the NG and PPG groups [$t_{(664)} = 2.38$, $p = 0.018$] and the NPG and PPG groups [$t_{(503)} = 2.09$, $p = 0.038$] were significant at 0.05.

DISCUSSION

The current study sought to provide some initial data on the influence of government enforced social isolation in response to the COVID-19 pandemic on depression, stress and anxiety in gamblers and non-gamblers in the UK. Recruiting a UK based online sample, preliminary results indicate the across the whole sample, levels of depression, anxiety, and stress have increased in lockdown, and that those who were classified as Potential Problem Gamblers reported, in general, higher levels of depression, stress, and anxiety.

Depression

Across the whole sample, reported levels of depression increased significantly between pre- and during-lockdown. Within gambler groups, both the Non-Gambler (NG) and Non-Problem Gambler groups (NPG) reported significant increases in depression; the Potential Problem Gambler group (PPG) reported an increase that was significant when applying an alpha of 0.05, but not at the adjusted alpha level. However, the PPG group reported significantly higher baseline levels of depression pre-lockdown, and significantly higher during-lockdown depression scores. This finding is consistent with previous research that shows higher levels of depression in gamblers (12–15). Furthermore, although gamblers were more depressed both pre- and during- lockdown, and all groups increased depression scores, the change scores, (i.e., the pre- to during-lockdown increases) did not differ between groups, indicating that the increase in depression was relatively uniform across the sample, and did not differ in magnitude between gambler groups.

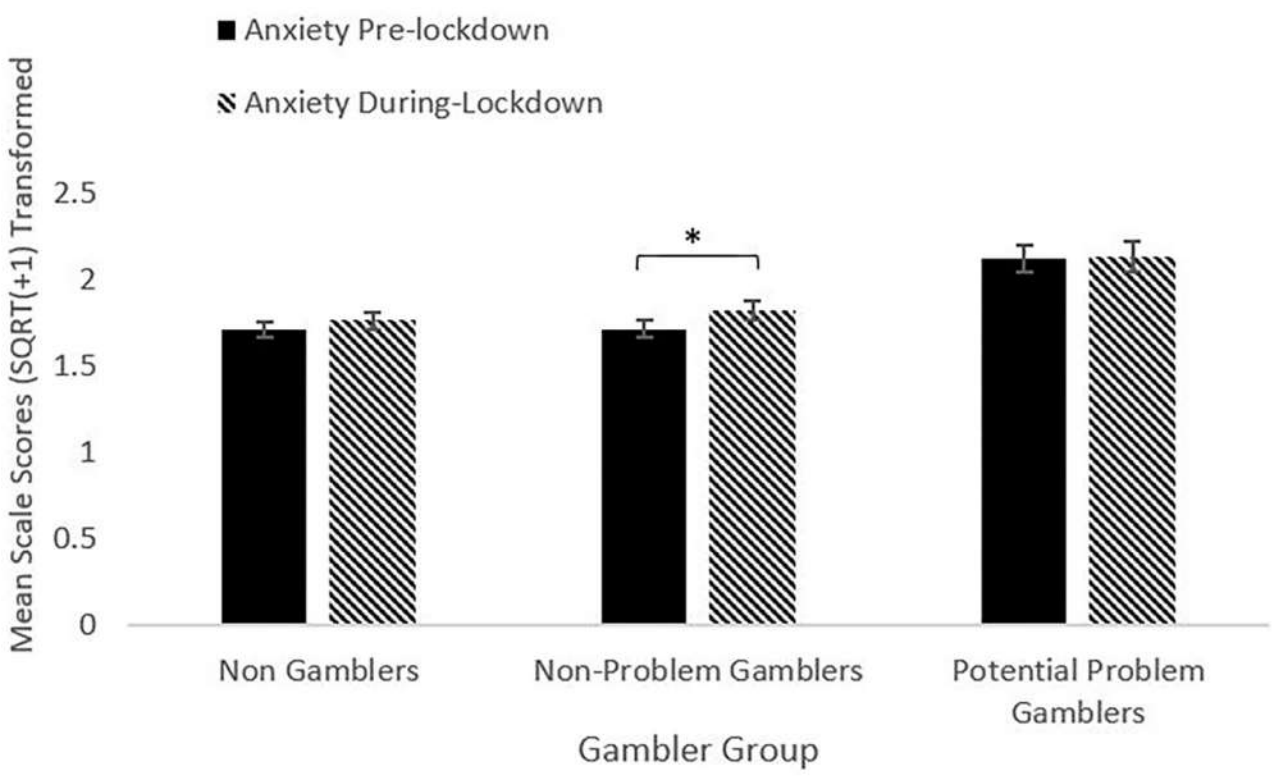

FIGURE 2 | Anxiety pre- and during-lockdown by gambler group (*$p < 0.05$).

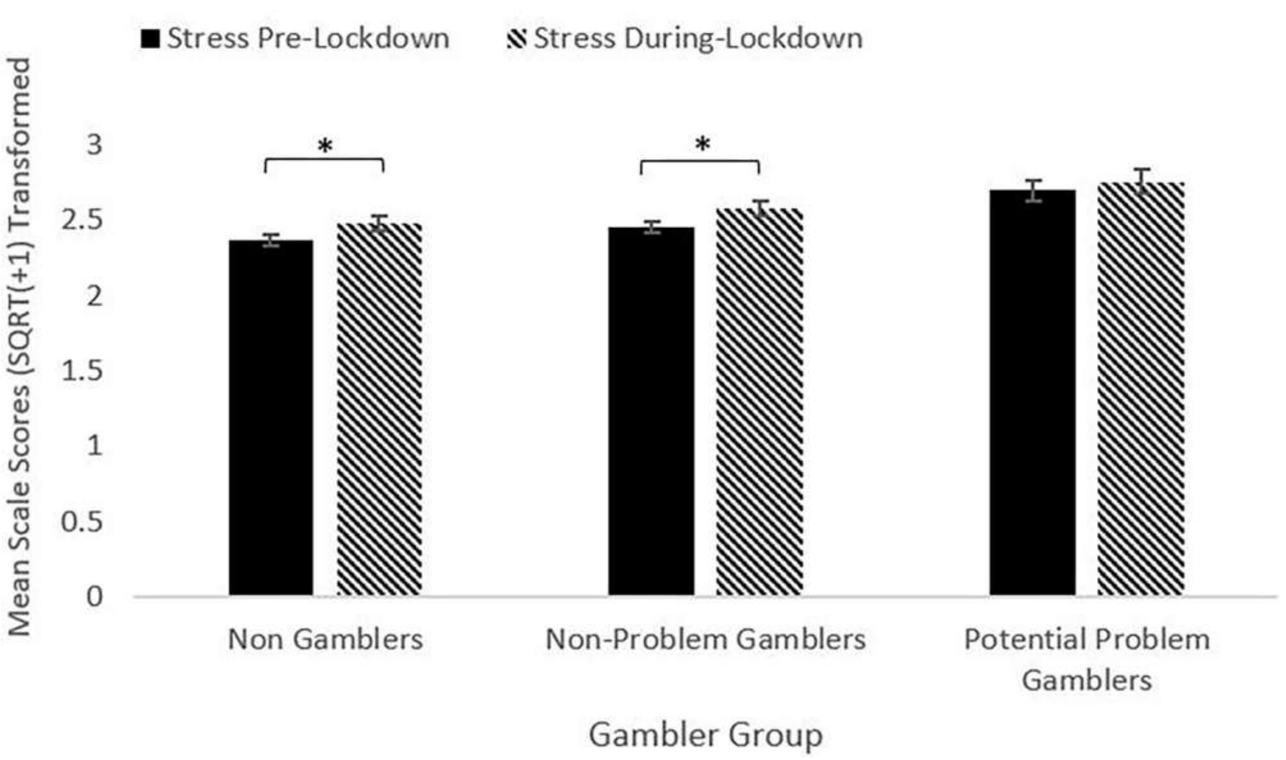

FIGURE 3 | Stress pre- and during-lockdown by gambler group (*$p < 0.05$).

Anxiety

Across the whole sample, anxiety increased significantly between pre- and during-lockdown. When examining between gambler groups, all groups reported increases in anxiety, however only the NPG group reported a significant increase. As with the depression scores, the PPG group reported higher anxiety scores at both baseline (pre-lockdown), and during lockdown than other groups, supporting previous research indicating higher levels of anxiety in gamblers (19, 20). However, although the PPG group reported higher levels of anxiety and both pre- and during-lockdown, and the NPG group reported the only significant increase, the magnitude of change in anxiety did not differ between gambler groups.

Stress

Results indicate that across the whole sample, stress increased between pre- and during-lockdown. Within gambler groups, all groups reported increased stress levels, however only the increases in the NG group and the NPG reached significance. Although the only group not demonstrating a significant increase in stress, the PPG group nonetheless reported higher stress scores than the NG group at both pre- and during lockdown, and higher stress scores pre-lockdown that were significant, and higher stress scores that were not significantly different during-lockdown than the NPG group. This result is in accordance with previous research that found increased stress is related to gambling (22–25). The magnitude of the pre- and during-lockdown change between did not differ between groups.

Behavioral and Treatment Implications

Recently published research has given some indication of changes in gambling patterns. In Sweden, one study reported that higher levels of reported gambling problems were associated with a specific type of betting (sports betting) despite a decrease in sports betting availability (40). However, caution should be exercised when comparing Sweden to the UK due to the differences in both gambling legislation, and the reaction to the COVID-19 pandemic of the respective governments.

In the UK, figures from the Gambling Commission indicate that past 4-week gambling participation remained relatively stable in the initial stages of lockdown. However, mental health had been negatively affected, with up to 25% of respondents indicating their mental health had been negatively impacted (41). In relation to the current study, it is clear that lockdown has had a negative impact on the mental health of all participants in this study, not only the potential problem gambler group. However, this is particularly concerning for the gamblers in the study, who were already experiencing significantly higher levels of depression, stress, and anxiety, which appear to have been exacerbated by lockdown. Despite experiencing often severe levels of harm as a consequence of gambling, very few gamblers seek treatment for gambling disorder; in a recent review of treatment services for gambling in the UK, it was estimated that only 3% of disordered gamblers seek treatment (42). However, whilst not seeking treatment for the underlying disorder, gamblers do access healthcare more frequently that non-gamblers; previous research indicates that gamblers are twice as likely to consult a GP, five times more likely to be admitted as hospital inpatients, and eight times more likely to have received psychological counseling than non-gamblers (43).

It is possible that the increase in depression and anxiety in gamblers and non-gamblers could result in an increase in demand for mental health services, at a time where many face-to-face services are not available. As such, increased demand may be placed on online or telephone-based support services. Whilst reports suggest that demand for online gambling support services is increasing, future research will need to assess whether those experiencing gambling problems in lockdown are seeking help for the primary gambling disorder, or whether concurrent increases in depression and anxiety are reflected in increased demand for general mental health support. Future research can also identify if any observed increase in prescribing anti-depressant medication is related to gambling in lockdown.

LIMITATIONS

Whilst providing an important cross-sectional snapshot of the immediate influence of COVID-19 and lockdown on depression, anxiety, and stress in gamblers and non-gamblers in the UK, the study was not without limitations. The screening tool used to measure the prevalence of potential gambling problems was selected due to a combination of strong psychometric properties, and brevity. However, the BPGS is not widely used, and therefore any prevalence rates measured are difficult to put in to a national and international context. Future studies could use the Problem Gambling Severity Index [PGSI, (44)] to allow classification of gambling problems on a scale of harm, and comparison with both UK and international prevalence rates. The nine-item PGSI is only four items longer than the five-item BPGS, so would not significantly increase participant burden. Furthermore, it is acknowledged that our sample may not be representative of the UK population as a whole, or of the population of those who gamble. Additionally, the sample in the current study was heavily weighted to toward female respondents; it is therefore unknown if our findings are generalisable to the general gambling population, or whether the results are more indicative of challenges faced by female gamblers.

CONCLUSIONS

The global COVID-19 pandemic and the subsequent Government response have created an unprecedented set of circumstances for the UK public. Several factors resulting from enforced lockdown are conducive to the development, maintenance, or relapse into gambling problems. This study sought to explore the initial change is depression, anxiety, and stress in gamblers and non-gamblers in the UK, in the first weeks of lockdown. Results indicate that depression, stress, and anxiety are increasing regardless of gambler status; however, the mere fact that increases are general across all groups, should not detract from the elevated levels of depression, stress, and anxiety experienced by those experiencing gambling harm. This study provides a foundation for assessing and measuring the continuing and longer-term impacts of COVID-19 on longer term depression, anxiety, and stress in gamblers in the UK.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University Research Ethics Committee, University of East London. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SS was responsible for questionnaire design, data collection, and manuscript preparation. AR, HB-J, and JS were responsible for questionnaire design and manuscript preparation. All authors contributed to the article and approved the submitted version.

FUNDING

This study was funded by the National Addiction Centre (NAC), part of the NIHR Biomedical Research Centre for Mental Health, which is based at the Institute of Psychiatry, Psychology and Neuroscience.

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Conflict of Interest: In the last 3 years, SS has received funding from the Society for the Study of Addiction (SSA), and the NIHR. He is currently employed at the NAC, part of the NIHR Biomedical Research Centre and declares no conflicts. AR has received funding from Santander, Public Health for Lincoln, The Royal Society, The Maurice and Jacqueline Bennett Charitable Trust, East Midlands RDS and internal University of Lincoln awards. She has no conflicts of interest. HB-J is the Director of The National Problem Gambling Clinic which receives funds from the National Health Service and GambleAware. She is Honorary Professor at University College London. Board member, International Society of Addiction Medicine, Board member of the International Society for the Study of Behavioural Addictions. President Elect of the Royal Society of Medicine Psychiatry Section. JS is a researcher and clinician who has worked with a range of governmental and non-governmental organizations, and with pharmaceutical and technology companies to seek to identify new or improved treatments from whom his employer (King's College London) has received honoraria, travel costs, and/or consultancy payments, but these do not have a relationship to the study and findings reported here. For a fuller account, see JS's web-page at: http://www.kcl.ac.uk/ioppn/depts/addictions/people/hod.aspx. JS is a National Institute for Health Research (NIHR) Senior Investigator and is supported by the NIHR Biomedical Research Centre for Mental Health at South London and Maudsley NHS Foundation Trust and King's College London.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 28 January 2021
doi: 10.3389/fpsyt.2021.634464

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Impulsivity Mediates Associations Between Problematic Internet Use, Anxiety, and Depressive Symptoms in Students: A Cross-Sectional COVID-19 Study

Julija Gecaite-Stonciene [1†], Ausra Saudargiene [2,3†], Aiste Pranckeviciene [1], Vilma Liaugaudaite [1], Inga Griskova-Bulanova [4], Dovile Simkute [4], Rima Naginiene [5], Laurynas Linas Dainauskas [2], Gintare Ceidaite [3] and Julius Burkauskas [1]*

[1] Laboratory of Behavioral Medicine, Neuroscience Institute, Lithuanian University of Health Sciences, Palanga-Kaunas, Lithuania, [2] Laboratory of Biophysics and Bioinformatics, Neuroscience Institute, Lithuanian University of Health Sciences, Kaunas, Lithuania, [3] Department of Informatics, Vytautas Magnus University, Kaunas, Lithuania, [4] Department of Neurobiology and Biophysics, Institute of Biosciences, Vilnius University, Vilnius, Lithuania, [5] Laboratory of Toxicology, Neuroscience Institute, Lithuanian University of Health Sciences, Kaunas, Lithuania

OPEN ACCESS

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***Correspondence:**
Julius Burkauskas
julius.burkauskas@lsmuni.lt

† These authors have contributed equally to this work

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 27 November 2020
Accepted: 04 January 2021
Published: 28 January 2021

Citation:
Gecaite-Stonciene J, Saudargiene A, Pranckeviciene A, Liaugaudaite V, Griskova-Bulanova I, Simkute D, Naginiene R, Dainauskas LL, Ceidaite G and Burkauskas J (2021) Impulsivity Mediates Associations Between Problematic Internet Use, Anxiety, and Depressive Symptoms in Students: A Cross-Sectional COVID-19 Study. Front. Psychiatry 12:634464. doi: 10.3389/fpsyt.2021.634464

Background: Problematic internet use (PIU) is a serious global mental health issue that especially manifested during the Coronavirus disease (COVID-19) pandemic. Engagement in PIU as an impulsive coping with mental distress may pose a long-lasting threat to develop anxiety and depressive disorders. The first aim of our study was to investigate the prevalence of PIU and mental distress symptoms during the COVID-19 pandemic among university students in Lithuania. The second aim was to test the hypothesis that PIU affects anxiety and depressive symptoms through the mediating role of impulsivity.

Methods: The cross-sectional study was comprised of 619 university students (92.9% females and 7.1% males) with a mean age of 22 ± 3 years who participated in an online survey from May to November, 2020. Participants completed the following scales: the Problematic Internet Use Questionnaire-9, the Generalized Anxiety Disorder Questionnaire-7, the Patient Health Questionnaire-9, and the Barratt Impulsiveness Scale-11. K-means cluster analysis and one-way multivariate analysis of variance were used for group comparison in terms of internet use time and habit change during COVID-19 pandemic. Structural equation modeling was applied to examine the mediating effect of impulsivity in association between PIU and mental distress, while controlling for age.

Results: In sum, 45.1% of the participants reported PIU and 38.1% had markedly expressed symptoms of anxiety while 43.6% of the students reported moderate to severe depressive symptoms. During the COVID-19 pandemic 76% of the students reported at least moderate increase in their internet use time. Anxiety and depressive symptoms were significantly higher in the group of frequent internet users. The results of the structural equational modeling analysis showed a statistically significant effect of PIU on subjective anxiety symptoms and the statistically significant effect of PIU on subjective depression symptoms, both mediated via impulsivity.

Conclusions: During COVID-19 pandemic, PIU, anxiety and depression symptoms are highly prevalent among students. Findings also suggest that relationships between PIU, anxiety and depressive symptoms are mediated via impulsivity. These results underscore the importance of the inclusion of impulsivity factor in the studies analyzing longitudinal effects of PIU on mental distress during COVID-19 pandemic.

Keywords: Problematic Internet Use, anxiety, depression, impulsivity, COVID-19

INTRODUCTION

The first research on the problematic internet use (PIU) emerged two decades ago in the UK and the USA (1, 2). Since then, research has enabled the field to advance considerably, resulting in clinicians and researchers recognizing PIU across different online activities (3). PIU is now considered to comprise a diverse group of complex behaviors, ranging from excessive gambling, online shopping, cybersex and prolonged viewing of pornographic content, to exceedingly frequent email checking, social media use and cyberbullying (4, 5), all of which can cause significant impairment of everyday functioning in some individuals. In fact, PIU has an estimated prevalence reaching up to 27% among citizens and across nations (4, 6) with an increased risk for children and young people (7–9).

Students may be particularly vulnerable to internet addiction, as they have largely unfettered, unsupervised access to the internet and are responsible for their own time management. Several meta-analyses and multi-center studies suggest that prevalence rates of PIU among students might be even higher than in the general population and may range from 27.0 to 30.1% (10, 11). The recent review that examined students in Southeast Asia has also showed the prevalence of PIU to range from zero to 47.4%, resulting in significant impairment manifested as insomnia, daytime sleepiness and eye strain (12). Also, most up to date studies, performed in student populations, suggest PIU to be associated with academic procrastination (13), poor quality of life (14, 15), severe psychiatric disorders (16–18), and even suicide attempts (19). PIU, as an addictive behavioral pattern, is also found to be comorbid with other addictive disorders, such as substance abuse among youth, including cannabis and alcohol use (20) as well as gambling disorder (21, 22).

Recent guidelines on coping with mental distress caused by the Coronavirus disease (COVID-19) pandemic suggest that PIU poses a threat to develop anxiety and depressive disorders (23). However, studies also suggest that several psychiatric disorders, including depression and anxiety disorder, are conditions that may act as predisposing factors for the development and maintenance of PIU. Similarly, mental distress (i.e., anxiety and depressive symptoms) has been shown to be as a possible perpetuating factor that predicted increased levels of PIU (24, 25). This notion was partially confirmed in a longitudinal study by Wartberg et al. (26) showing that current PIU symptomatology was predicted by stronger emotional distress measured at baseline (26). However, another longitudinal study performed in a large sample of Australian adolescents ($N = 2{,}809$) showed that particularly compulsive PIU leads to emotional problems, such as difficulties pursuing goals in the presence of distress (27). Thus, in terms of causal relationship, the role of mental distress can be viewed as both the predisposing factor as well as the perpetuating/maintaining factor in the development and severity of PIU. Since the frequency of and the dependence on internet use has increased during COVID-19 pandemic (28), it is of crucial importance to pay a particular attention to PIU in order to understand the interplay between PIU and mental health problems that it may pose.

The role of impulsivity in the relationship between PIU, anxiety and depressive symptoms is still under debate (29). A study by Yücens and Üzer (30) analyzed factors related to PIU in a sample of 392 medical students in Turkey, suggesting that mental distress factors rather than impulsivity play a cardinal role in PIU (30). However, the study by Zhang (31) comprising 459 undergraduate students in China found that impulsivity in particular mediated the relationship between PIU and neuroticism (31). A recent Italian study involving 244 university students found that PIU was associated with high attentional impulsivity and depressive symptoms (32). The same relationships were observed in the study analyzing data of 1,600 Indian college students which provided evidence of associations between PIU symptoms of depression, anxiety and impulsivity (33). A study by Wang et al. (34) comprising 4,313 students showed that behavioral characteristics such as effort control and impulsivity might be related to the severity of PIU (34). On the other hand, another study analyzing a community sample of 15,023 individuals reported that personality characteristics better explain PIU rather than the impulsivity itself (35). However, in this particular study participants' depression and anxiety levels were not evaluated.

As indicated by aforementioned works, the interplay between PIU and mental distress (i.e., anxiety and depressive symptoms) in relation to impulsivity is an important relationship to investigate, as it would inform clinicians on the mechanism of the disordered behavior formation. Thus, the first aim of our study was to investigate the prevalence of PIU and symptoms of mental distress during COVID-19 pandemic among university students in Lithuania. The second aim was to test the hypothesis that PIU affects anxiety and depressive symptoms through the mediating role of impulsivity.

MATERIALS AND METHODS

Study Procedure

Students from three major universities in Lithuania were invited to participate in an anonymous online survey during

May and November, 2020. The invitation was sent through social media, university websites and the e-mail. Participants completed scales measuring PIU (the Problematic Internet Use Questionnaire, PIUQ-9), anxiety (the Generalized Anxiety Disorder Questionnaire, GAD-7), depressive symptoms (the Patient Health Questionnaire, module for depressive symptoms, PHQ-9), and impulsivity (the Barratt Impulsiveness Scale, BIS-11). Relevant socio-demographic characteristics, additional questions related to changes in internet use frequency and habits (in a five point Likert scale, where "zero" represents no change, and "five" represents extreme changes) during COVID-19 pandemic were also included. The study received the approval from the Bioethics committee and conformed to the principles outlined in the Declaration of Helsinki.

A website was created containing an introduction to the study and questionnaires. A website and data of the answers were hosted on secured servers of Lithuanian University of Health Sciences. To ensure participant's anonymity, no questions were given that would compromise their identity. The website and its design was lightweight and minimalistic, comprising one page with tabulations for separate scales, to make it easy to access, navigate and use. An online consent was provided for each participant for agreement before starting the survey. No incentives were given upon completion.

Measures

PIU was evaluated employing the nine-item PIUQ-9 questionnaire (36). The PIUQ-9 is a short self-report instrument, which measures three aspects of PIU – an obsession, a neglect, and a control disorder. Nine-scale items are evaluated using a five-point Likert scale, ranging from "Never" to "Always/Almost always." Total scores range from 9 to 45, with higher scores indicating higher risk of PIU. The previous studies demonstrated appropriate psychometric properties of the PIUQ-9 across a number of European languages and cultures (36, 37). Based on the previous study in a sample of Lithuanian students, a cut-off value of >20 was used for screening markedly expressed PIU symptoms. In the present study, the PIUQ-9 also demonstrated good internal consistency, Cronbach's alpha was 0.84.

The PHQ-9 (38) is a brief self-report tool for screening, diagnosing, monitoring and measuring the severity of depression. Nine items of the questionnaire are based on the depression diagnostic criteria of Diagnostic Statistical Manual-IV; possible response options range from "Not at all" to "Nearly every day." The total scores range from zero (0) to 27 with higher scores indicating more expressed depressive symptoms and a cut-off of $\geq$10 indicates moderate to severe depressive symptoms (35). The PHQ-9 is recognized as a sensitive measure for depression screening (39). Previous research indicated that the PHQ-9 is acceptable for use in major sociodemographic groups not only in clinical settings but also in the community (40). Scale was also previously used in students' research (41), and demonstrated potential value for the online screening programs (42). Internal reliability of the scale in the present sample was excellent with a Cronbach's alpha of 0.84.

The GAD-7 (43) is a seven item self-report instrument that is used to assess the severity of generalized anxiety disorder and anxiety symptoms. Each item asks the individual to rate the severity of his or her symptoms over the past 2 weeks using a four-point Likert scale with possible responses ranging from "Not at all" to "Nearly every day." The total scores range from zero (0) to 21 with higher scores indicating more expressed anxiety symptoms. The GAD-7 was validated for the use in general (44) and students' populations (45, 46). It is recognized as a sensitive instrument for screening of anxiety disorders (47), with a cut-off of $\geq$10 indicating moderate to severe anxiety (43). Cronbach's alpha of the scale in the particular sample showed good internal reliability ($\alpha = 0.91$).

The BIS-11 is a self-report scale, designed to assess personality and behavioral aspects of impulsivity (48). The scale consists of 30 items describing common impulsive or non-impulsive (for reverse scored items) behaviors and preferences. The items are scored on a four-point Likert type scale ranging from "Rarely/Never" to "Almost always/Always." A higher total score indicates more expressed personality and behavioral aspects of impulsivity. The BIS-11 is the most widely cited instrument for the assessment of impulsiveness that was extensively used for impulsivity research in various populations and settings (49). A recent study of the psychometric properties of the BIS-11 in a Lithuanian adult sample demonstrated good construct validity, appropriate internal consistency, test-retest reliability, and prognostic value of BIS-11 in predicting addictive and delinquent behaviors such as smoking, alcohol consumption and law breaking (50). Cronbach's alpha of the scale in the current sample was 0.82.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows (version 20) and SPSS AMOS (version 20) (IBM Corp., Armonk, NY, USA). Before conducting the analysis, the data of the PIUQ-9, BIS-11, PHQ-9, GAD-7, and age were screened for missing values and normality. The normality of the distributions was assessed at the univariate and multivariate levels. Internal consistency was examined using corrected item-total correlations and Cronbach's alpha coefficient. Correlations were analyzed using Pearson's correlation coefficient and Spearman's r correlation coefficient.

Two-step cluster analysis was performed to group individuals into two clusters based on the questions reflecting habit changes due to COVID-19 pandemic: (a) the amount of time spent using internet and (b) purpose of the internet use. The One-way Multivariate Analysis of Variance (MANOVA) was conducted between two clusters (those with regular and those with increased frequency and changed purpose of internet use during COVID-19 pandemic) to investigate differences in the means of PIU, impulsivity, depressive and anxiety symptoms.

The structural equation model (SEM) was designed to test the mediating effect of impulsivity on the relationship between PIU, anxiety symptoms and depressive symptoms. The model fit was evaluated using the Chi-square test and the following indices: standardized root mean square residual (SRMR), goodness of fit index (GFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA).

RESULTS

The cross-sectional study comprised 619 students (7.1% males, mean age 22 ± 3 years). The engagement rate of 45.8% was comparable with previously reported engagement rates in students' surveys (31). Majority of the students studied health and veterinary sciences (36.7%) and social sciences (30.2%). Detailed baseline characteristics of study population are presented in **Table 1**. In brief, 45.1% of included participants reported PIU, 38.1% of the participants had markedly expressed symptoms of anxiety, while 43.6% of students reported significant depressive symptoms. PIU correlated positively with anxiety (Pearson's $r = 0.288$, $p < 0.001$), depressive symptoms (Pearson's $r = 0.356$, $p < 0.001$), and impulsivity (Pearson $r = 0.394$, $p < 0.001$).

During the COVID-19 pandemic the amount of time spent using the internet (mean 4.7 ± 2.3 h) increased: 35.1 and 40.9% of students reported its substantial increase and moderate increase, respectively. The main purpose of the internet use was social networking (62.8%) and academic activities (24.1%). The increase in the amount of time spent on-line correlated positively with the lowered mood during COVID-19 pandemic (Spearman's rho = 0.215, $p < 0.001$) and depressive symptoms (Spearman's rho = 0.126, $p = 0.002$). The changes in the internet use habits correlated positively with the lowered mood during COVID-19 pandemic (Spearman rho = 0.182, $p < 0.001$).

Two-step cluster analysis included scores of time spent on-line and scores of internet use habit changes during the COVID-19 pandemic. The first cluster described respondents, who reported no changes in the amount of time spent online and habits of internet use during the COVID-19 pandemic. The second cluster included respondents, who reported increase in their amount of time spent on-line and changed habits in internet use during the pandemic. The ratio of the larger cluster size to smaller cluster was 1.23 with the average Silhouette measure of cohesion and separation of 0.6 showing good cluster quality.

Results of the MANOVA are shown in **Table 2**. The multivariate effect of the clusters on PIU, impulsivity, anxiety and depressive symptoms [Pillai's Trace = 0.022, $F_{(4.614)} = 3.50$, $p = 0.008$, Partial Eta Squared = 0.022]. During the COVID-19 pandemic anxiety and depressive symptoms were significantly higher in the second cluster of the frequent internet users (p's < 0.05).

Assessment of the univariate and multivariate normality was performed for the variables used in the SEM model. Multivariate outliers of the PIUQ-9, the BIS-11, the PHQ-9, the GAD-7 and age were removed using the Mahalanobis distance measure (critical value 20.51, Chi-squared test $p = 0.001$). Multivariate kurtosis and critical ratio were 2.96 and 4.40, implying multivariate normality in this sample.

The results of the SEM analysis supported the hypothesized structural model (Chi-square value = 1.676, df = 3, $p = 0.642$, SRMR = 0.0104, GFI = 0.999, *CFI* = 1.00, *RMSEA* = 0.000). The model revealed the statistically significant effect of the PIUQ-9 on the GAD-7 (standardized direct path coefficient 0.200, 95% CI [0.124–0.292], $p = 0.010$; standardized indirect path coefficient 0.087, 95% CI [0.050;0.128], $p = 0.010$; standardized total effect 0.288, 95% CI [0.210–0.361], $p = 0.010$) and the statistically significant effect of the PIUQ-9 on the PHQ-9 (standardized direct path coefficient 0.240, 95% CI [0.155–0.320], $p = 0.001$; standardized indirect path coefficient 0.116, 95% CI [0.083;0.162], $p = 0.010$; standardized total effect 0.356, 95% CI [0.271–0.431], $p = 0.010$), mediated via impulsivity. The model accounted for 12.4% of the total amount of the GAD-7 variance and for 20.0% of the total amount of the PHQ-9 variance. **Figure 1** shows the mediating role of impulsivity on the relationship between PIU, anxiety and depressive symptoms.

TABLE 1 | Baseline characteristics of study participants.

Characteristic	Total ($n = 619$)
Gender, *n* (%)	
Male	44 (7.1%)
Female	575 (92.9%)
Age, mean ± SD	21,73 ± 2,571
Field of study, *n* (%)	
Mathematics and computer science	12 (1.9%)
Physical and biological sciences	61 (10%)
Engineering and technology	15 (2.4%)
Health and veterinary science	227 (36.7%)
Agricultural sciences	12 (1.9%)
Social sciences	187 (30.2%)
Humanities sciences	94 (15.2%)
Arts sciences	11 (1.8%)
The Problematic Internet Use Questionnaire score, mean ± SD	20,64 ± 6,346
The Patient Health Questionnaire, module for depressive symptoms score, mean ± SD	9,49 ± 5,497
The Generalized Anxiety Disorder Questionnaire score, mean ± SD	8,17 ± 5,394
The Barratt Impulsiveness Scale score, mean ± SD	42,42 ± 8,227
Compared to the pre-pandemic coronavirus disease period, how did the time you spent using internet change? I spend …. time using internet, *n* (%)	
A lot more time	217 (35.1%)
More time	253 (40.9%)
The same amount of time	132 (21.3%)
Less time	14 (2.3%)
A lot less time	3 (0.5%)
How much did the coronavirus disease situation change your internet use habits? (When answering this question do not think about time spent using internet, but the nature and purpose of your internet use), *n* (%)	
Not at all	124 (20.0%)
A little	281 (45.4%)
Fairly	116 (18.7%)
Quite a lot	77 (12.4%)
A lot	21 (3.4%)

DISCUSSION

In the current study, we aimed to investigate the prevalence of PIU and mental distress symptoms during COVID-19 pandemic among university students in Lithuania. As the second aim, we

TABLE 2 | One-way multivariate analysis of variance (MANOVA) for the differences in problematic internet use and mental distress symptoms.

Indices	First Cluster (No change in internet use time and habits) *n* = 342	Second Cluster (Increased internet use time and habits *n* = 277)	$F_{(1, 617)}$ *F*-test statistics with the degrees of freedom df1 = 1 (for the between-groups estimate of variance) and df2 = 617 (for the within-groups estimate of variance)	Partial Eta Squared	*P*
The Problematic Internet Use Questionnaire score, mean ± SD	20.0 ± 6.3	21.4 ± 6.3	7.52	0.012	0.006
The Patient Health Questionnaire, module for depressive symptoms score, mean ± SD	8.9 ± 2.3	10.3 ± 2.3	10.23	0.016	0.001
The Generalized Anxiety Disorder Questionnaire score, mean ± SD	7.8 ± 5.2	8.7 ± 5.6	4.62	0.007	0.032

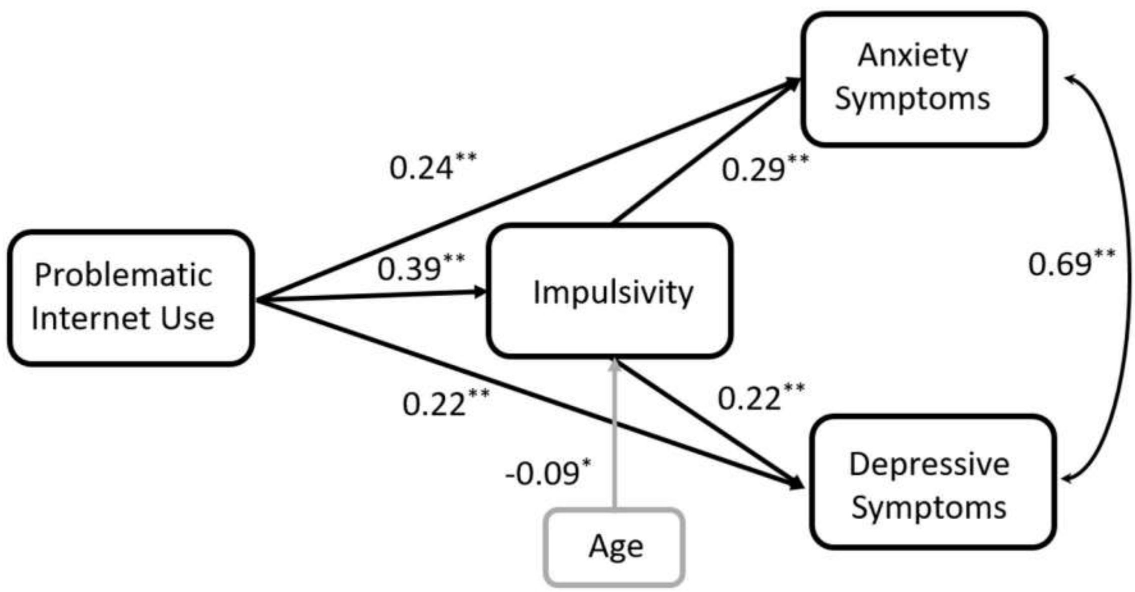

FIGURE 1 | Structural equation model (SEM) testing of the mediational effect of impulsivity on the relationship between PIU, anxiety and depressive symptoms controlling for age. Chi-square value = 1.676, df = 3, $p = 0.642$, SRMR = 0.0104, GFI = 0.999, CFI = 1.00, RMSEA = 0.000. Path coefficients are standardized (*$p < 0.05$, **$p < 0.001$).

tested the hypothesis that PIU affects anxiety and depressive symptoms through the mediating role of impulsivity.

Our study is among very few which analyzed the prevalence of PIU particularly in the population of young Lithuanian adults during the COVID-19 pandemic. Ninety five percent of individuals aged between 25 and 34 years reported using the internet daily, according to the National Statistic Department of Lithuania. However, most of the studies on the prevalence of PIU and associated risk factors focused on children and adolescents (51–54).

With regard to the first aim, we found that approximately 45% of students reported internet use behaviors and frequency that might be categorized as problematic, while around 38% and 44% reported significant symptoms of anxiety and depression during the COVID-19 pandemic, respectively. The prevalence of PIU was meta-analyzed in 2017, reporting 30.1% prevalence of PIU in medical students (10). Around one third of medical students also reported significant PIU in other recent studies by Anand et al. (11) and Shadzi et al. (55). The recent study, employing the same instrument for PIU with the same cut-off values, completed in Lithuanian students during Sept-Nov 2019 (37), found that 31.9% had symptoms of significant PIU. Thus, our study shows that the level of PIU is substantially higher during the COVID-19 pandemic than before this period. In addition, those subjects, who spent more time on the internet during COVID-19 pandemic, also had increased depressive and anxiety symptoms. This is an important finding for the further studies investigating effect of COVID-19 pandemic on individual psychological problems and well-being.

The present study also found positive correlations between PIU, depressive and anxiety symptoms as well as impulsivity. As hypothesized, both direct effect and indirect effect were significant, suggesting impulsivity as a mediator in the relationship between PIU and anxiety symptoms. Impulsivity also partially mediated the relationship between PIU and depressive symptoms, since both direct and indirect effects remained significant in the final SEM model. Our results were in line with Bisen and Deshpande (33) and Marzilli et al. (32) who reported significant links between PIU and depression, anxiety and impulsivity in students' populations. In the studies by Wang et al. (34) and Zhang (31) impulsivity was also a significant marker for PIU in the students. A higher score of internet addiction was also present in more depressive, more impulsive young adolescents in the study by Obeid et al. (56). Indirectly, our findings contributed to the current knowledge of high prevalence of PIU in depressive and anxiety disorders (57–60). The current research adds to the existing knowledge by examining the mediating role of impulsivity in the relationship between PIU and mental distress. However, due to a limited sample size, it was beyond our study scope to differentiate the impulsivity effect on depression and anxiety in the specific subgroups such as a group of students whose main purpose for using the internet is shopping or watching pornography or gambling. Recent studies show that these groups in particular might be prone to increased PIU symptoms (61–64).

Our study has several limitations worth noting. First, the study was based on the convenience sampling in university students in Lithuania, thus the generalizability of the results should be considered with caution. Second, the sample size precluded us from analyzing data from several perspectives including gender, purpose for the internet use and possible co-morbidity differences, as other studies show these to be the important characteristics to consider (61, 62, 64–66). The sample was mainly comprised by the female students and reflects the gender balance gap in the respective science specialities. It is important to note that the tendency of women participating in the surveys more often than men are documented in the earlier works as well (67, 68), possibly due to personality or gender role differences. However, the patterns of impulsive behavior (69) and PIU (70) has been observed to be distinct regarding the gender. Specifically, men tend to be more vulnerable to PIU symptoms (71) and have usually more severe symptoms (72), yet not difference among genders has also been reported (73). The interplay between impulsivity and gender is even more complex. Even though women tend to make impulsive choices more so than men, the eventual level of impulsivity depends on tasks and subject samples (69). Thus, the generalizability of our results to the men population is limited. Third, due to the cross-sectional nature of the study, we could not draw causal interpretations with regards to the relationship between PIU and mental distress, while considering the role of impulsivity. Thus, future longitudinal studies with larger and more diverse samples are highly encouraged. Despite the limitations, the current study was one of the first examining the prevalence of PIU among university students during COVID-19 pandemic as well as its interplay with mental distress and impulsivity.

CONCLUSIONS

Almost half of the university students experienced significantly expressed PIU, anxiety or depression symptoms during the COVID-19 pandemic. Findings also suggest that the relationships between PIU, anxiety and depressive symptoms are partially mediated via impulsivity. These results underscore the importance of inclusion of impulsivity factor in the studies analyzing the longitudinal effect of PIU on mental distress during COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The study dataset is available upon request to Julius Burkauskas.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Bioethics Center at Lithuanian University of Health Sciences. The participants provided their online consent to participate in this study.

AUTHOR CONTRIBUTIONS

JB, IG-B, and AP conceived and designed the study. LLD and GC designed the survey platform. JG-S, VL, DS, and RN were responsible for data collection and evaluation. Statistical analyses were performed by AS. JG-S prepared the manuscript together with AP. All authors provided critical revision to its further development, read, and approved the final manuscript.

FUNDING

This project has received funding from the Research Council of Lithuania (LMTLT), agreement No S-GEV-20-5.

ACKNOWLEDGMENTS

We would like to express our deepest gratitude to the students who completed our survey. We thank the COST Action CA16207 European Network for Problematic Usage of the Internet, supported by COST (European Cooperation in Science and Technology: www.cost.eu) for the inspiration to explore this topic.

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Conflict of Interest: JG-S serves as a consultant at FACITtrans. In the past several years JB has been serving as a consultant to Cogstate, Ltd.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 02 February 2021
doi: 10.3389/fpsyt.2021.622917

Alcohol- and Cigarette-Use Related Behaviors During Quarantine and Physical Distancing Amid COVID-19 in Indonesia

Enjeline Hanafi[1], Kristiana Siste[1], Albert Prabowo Limawan[1], Lee Thung Sen[1], Hans Christian[1], Belinda Julivia Murtani[1], Adrian[1], Levina Putri Siswidiani[1] and Christiany Suwartono[2]*

[1] *Department of Psychiatry, Faculty of Medicine Universitas Indonesia, Cipto Mangunkusumo Hospital, Jakarta, Indonesia,*
[2] *Atma Jaya Catholic University of Indonesia, Jakarta, Indonesia*

OPEN ACCESS

Edited by:
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Reviewed by:
Astrid Müller, Hannover Medical School, Germany
Rachel Sutherland, National Drug and Alcohol Research Centre (NDARC), Australia

***Correspondence:**
Kristiana Siste
ksiste@yahoo.com

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *29 October 2020*
Accepted: *06 January 2021*
Published: *02 February 2021*

Citation:
Hanafi E, Siste K, Limawan AP, Sen LT, Christian H, Murtani BJ, Adrian, Siswidiani LP and Suwartono C (2021) Alcohol- and Cigarette-Use Related Behaviors During Quarantine and Physical Distancing Amid COVID-19 in Indonesia. Front. Psychiatry 12:622917. doi: 10.3389/fpsyt.2021.622917

Background: In light of the coronavirus disease 2019 (COVID-19) pandemic, Indonesia implemented large-scale social restrictions (*pembatasan sosial berskala besar*/PSBB) to combat the spread of COVID-19, which might influence addictive behaviors. The current study aimed to explore the fluctuation of substance use during the pandemic and association of physical distancing and related factors toward consumption of alcohol and cigarettes.

Method: An online survey was conducted from April 28 to June 1, 2020. Data regarding sociodemographic information, physical distancing profile, alcohol and cigarette usages, Alcohol Use Disorders Identification Test (AUDIT), Cigarette Dependence Scale (CDS), Symptom Checklist-90, and Pittsburg Sleep Quality Index (PSQI) were collected. A total of 4,584 respondents from all 34 provinces in Indonesia completed the survey. Data were summarized descriptively and analyzed using chi-square, ANOVA, and multinomial regression on SPSS 23.0 for Windows.

Results: This study found that during the COVID-19 pandemic in Indonesia alcohol consumption was 9.50% and daily cigarette smoking was 20.3%. Around 44.5% and 47.6% of respondents reported stable alcohol consumption and cigarette consumption, respectively. The mean AUDIT score was 3.52 ± 4.66 and the mean CDS score was 24.73 ± 8.86. Physical distancing was not correlated to any substance use changes. Increased alcohol consumption was negatively correlated with being unmarried and positively correlated with a higher PSQI score. Decreased alcohol use positively correlated with living in PSBB-implementing provinces and higher AUDIT scores when compared to stable alcohol drinking. Increased cigarette smoking was positively correlated with being male, unmarried, and higher CDS scores. Reduced cigarette smoking was negatively correlated with living in provinces implementing PSBB, higher CDS scores, and phobic anxiety, hostility, and psychoticism subscales of SCL-90.

Discussion and Conclusion: The prevalence of alcohol and cigarette consumption changes showed a similar trend with other available studies in other countries. This study established that substance use was mainly sustained with a smaller proportion of respondents amplifying their substance usages. The changes were correlated with PSBB policy but not the practice of physical distancing. Psychiatry and addiction services in Indonesia should be strengthened to cope with the increased burden of psychological distress. Future studies should conduct more comparisons to determine whether the overall rising intensity of consumption was maintained post-pandemic and delineate acute psychopathologies' effects on substance use.

Keywords: physical distancing, large-scale social restriction, alcohol, cigarette, prevalence

INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) declared a pandemic of a novel coronavirus, known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The spread and severity of this condition continues to impact the world to date. World Health Organization has reported more than 23 million confirmed cases and 800,000 confirmed deaths in 216 countries (1). Indonesia, the fourth most populous country in the world, reported more than 150,000 confirmed cases and 6,500 deaths due to the coronavirus disease 2019 (COVID-19) as of late August 2020 (2, 3).

In response to the pandemic, the Indonesian government announced the implementation of large-scale social restrictions (*pembatasan sosial berskala besar*/PSBB) to accelerate COVID-19 eradication. In the PSBB, schools, workplaces, and public places were closed, and mass transport was reduced. Activities involving large gatherings, including those for religious purposes, were restricted, and people were advised to stay at home (4). According to a study conducted by the Indonesian Psychiatrist Association from April to August 2020, which included 4,010 subjects (aged 17–29 and over 60 years), ∼64.8% of the respondents experienced at least one psychological problem. Among the respondents with psychological problems, almost 65% experienced anxiety, 61.5% had depressive symptoms, and 74.8% reported post-traumatic complaints during the pandemic (5). Social (and physical) distancing and quarantine or isolation was meant to prevent further COVID-19 transmission; however, it could lead to the worsening of several negative psychological symptoms (6). In some individuals, this could also lead to unfavorable behavior such as substance abuse in order to relieve symptoms (7). A previous study found a relationship between the SARS outbreak in Beijing in 2003 and alcohol abuse/dependence symptoms 3 years later among hospital employees and described one of the risk factors as being a history of quarantine (8). Changes in substance use levels might vary as increased consumption is possible due to heightened emotional distress, isolation, and unemployment, and a decrease in its consumption is possible due to reduced availability, higher prices, and financial restrictions.

In 2018, The Indonesian Basic Health Research showed that the prevalence of alcohol drinking among Indonesians older than 10 years old during the past year was 3% (9). Furthermore, the prevalence of heavy episodic drinking (consumption of at least 60 grams or more of pure alcohol on at least one occasion in the past 30 days) during the past year among Indonesians older than 15 years was 6.5% in 2016. It was reported that the overall prevalence of alcohol use disorders was 0.8%, while alcohol dependence was 0.7% (10). These rates are lower than the WHO South-East Asia Region's prevalence of 3.9% for alcohol use disorders and 2.9% for alcohol dependence (10). The Indonesian 2018 Basic Health Research stated that the prevalence of past-year tobacco consumption in those aged above 15 years was 33.8% (11), where the prevalence of daily tobacco smoking was 24.3%, and that of e-cigarette use was about 2.8% (12). Considering the already high prevalence of substance use among Indonesians prior to the pandemic and the distress caused during PSBB, it is essential to determine substance (alcohol and cigarette) consumption changes. The study aimed to explore in detail the fluctuation in usage of substances, particularly of alcohol and cigarettes, during the pandemic. We hypothesized that the pandemic and PSBB affected alcohol and cigarette consumption behavior. Complementarily, this study would also explore the effect of physical distancing and other factors, including psychopathologies and sleep disturbance, during this pandemic on the use of alcohol and cigarettes. The results of this study would be beneficial for the development of evidence-based strategies for the management of substance use post-COVID-19 or in the new normal period.

METHODS

Respondents and Procedure

The questionnaire was opened from April 28 to June 1, 2020 employing an online survey platform, *Google Form*. Online data collection was initiated about 42 days after the declaration of PSBB. The research team disseminated the link address for the online survey through several social media platforms. Furthermore, the online survey link was shared with Indonesian state-owned companies, university lecturers and students, and respondents, who were encouraged to disseminate the link for this online survey.

Before participating in the survey, respondents were asked to provide informed consent after the study purpose, respondent criteria, and data management were presented to them. Email for correspondence was provided for any inquiries. This online survey comprised a demographic section (e.g., age, gender, formal education, occupation, current residency, marriage, and household income), substance use consumption detail [alcohol and daily cigarette consumptions since the start of the COVID-19 pandemic (first reported case of COVID-19 in Indonesia was on March 2, 2020), their perceived change of current use compared to before the pandemic (unchanged, increased, or decreased), and the option of 'do not use' denoted have not used ever in life], physical distancing profile (practice and location), the Alcohol Use Disorders Identification Test (AUDIT), Cigarette Dependence Scale (CDS), Symptom Checklist 90 (SCL-90), and Pittsburg Sleep Quality Index (PSQI). Each questionnaire item was set as mandatory; thus, respondents with missing data were unable to submit. However, *Google Form* did not allow for calculation of the response rate as it did not record the total number of surveys accessed. In this study, physical distancing was defined as studying or working from home, alternating school or working days, and/or the practice recommended by the Indonesian COVID-19 Response Acceleration Task Force. Current residency information was collected based on provinces and further categorized based on status of PSBB implementation in that province according to the *Indonesian National Board for Disaster Management* by April 28 2020, which consisted of DKI Jakarta, West Java, East Java, Central Java, Banten, West Kalimantan, North Kalimantan, Gorontalo, West Sumatera, Riau, and South Sulawesi. Household income was classified based on gross national income classification by the World Bank.

This study's inclusion criteria were that respondents were aged above 21 years, currently residing in Indonesia, and able to understand Indonesian. Several responses, which were non-consenting ($n = 23$), duplicates ($n = 5$), and currently not residing in Indonesia ($n = 13$), were excluded. The email addresses of the respondents were collected to prevent multiple responses from an individual, and they were only accessible to the research team and were removed after the elimination of duplicate responses. Overall, there were 4,584 responses (56.1% males) with respondents from all 34 provinces and 7 islands (Java 62.7%, Sumatera 18.3%, Borneo 8.6%, Sulawesi 5.8%, Nusa Tenggara 2.7%, Papua 1.7%, and Maluku 0.3%) across Indonesia.

Instruments

The Alcohol Use Disorders Identification Test

This questionnaire was developed as a screening instrument to identify the effects of dependence and harmful use of alcohol, designed to be used in primary health care, and was the only alcohol screening test applicable for international use. This questionnaire comprises 10 questions focusing on the recent use of alcohol; scoring ranges from 0 to 40 with a score 8–14 interpreted as harmful alcohol use and ≥15 as a possibility for dependence (13). The WHO collaborative study showed that the AUDIT is a valid instrument in six countries (sensitivity 92% and specificity 94%) (14). In this study, the AUDIT demonstrated acceptable internal consistency ($\alpha = 0.80$) among alcohol drinkers.

Cigarette Dependence Scale-10

This self-reported questionnaire aids in determining the severity of nicotine dependence (15). Each question has five multiple-choice answers. Question number 1 asked cigarette dependency with scoring 0 to 100 being divided into five intervals (0–20, 21–40, etc.). Question number 2 asked the number of cigarettes smoked which ranges from 0 to more than 30 rolls divided into five intervals (0–5, 6–10, etc.). Question number 3 used Likert scale with values from 1 to 5, as "very easy" to "impossible." Meanwhile, the Likert Scale used in the rest of the questions were as "completely disagree" to "highly agree." The output of this questionnaire is in a numeric form with no determined cutoff number, and a higher score indicates more severe nicotine dependence. Evaluation of the Indonesian version of CDS showed that a modification of the CDS from 12 to 10 questions improved the instrument's statistical value with good reliability (Cronbach's alpha = 0.91, ICC = 0.91) (16). The excluded items were question number 3 (first cigarette of the day) and 9 (too much smoking). Thus, CDS-10 was used in this study. In this study, the CDS demonstrated acceptable internal consistency ($\alpha = 0.92$) among cigarette smokers.

Symptom Checklist-90

The self-reported questionnaire comprises 90 statements scored on a 5-point Likert scale, 0 (=Never) to 4 (=Always), within the last 30 days. The Indonesian version of the SCL-90 showed good validity, 82.9% sensitivity, and 83.0% specificity (17). This questionnaire is used to assess psychopathological symptoms, including somatization (distress concerning physical problems), obsessive-compulsive (relating to irresistible, repetitive, and unwanted impulses, thoughts, and actions), interpersonal sensitivity (negative expectations, self-doubt, and feeling inferior in a relationship with other people), depression (dysphoria, loss of pleasure, pessimism, etc.), anxiety (nervousness, apprehension, dread, and trembling), hostility (aggression, irritability, and rage), phobic anxiety (irrational or excessive fear relating to persons, places, objects or situations), paranoid ideation (thought of hostility, grandiosity, and suspiciousness and need for control based on fear), psychoticism (extremely isolated and core symptoms of schizophrenia, including hallucination and thought control), an additional subscale (poor appetite, sleep disturbance, fear of dying, and overeating), and an overall global symptom index (GSI) (18–20). In this study, SCL-90 demonstrated acceptable internal consistency, ranging from $\alpha = 0.84$ to 0.93 across the 10 domains and $\alpha = 0.99$ for the GSI, among alcohol and cigarette users.

Pittsburgh Sleep Quality Index

The PSQI is a commonly used instrument in assessing sleep quality in clinical or non-clinical populations (21, 22). The questionnaire is comprised of 24 items, of which 20 are multiple choice questions and four are open-ended questions. Furthermore, five items required the assessment of a partner or another individual on the respondent's sleeping pattern. The 19 self-answered questions on PSQI can be pooled into seven components and each weighted between 0–3 (maximum 21), scores >5 indicate poor sleep quality. The Indonesian version of PSQI was validated with a reliability of $\alpha = 0.79$, content validity 0.89, and specificity of 81% (23). In this study, PSQI demonstrated acceptable internal consistency ($\alpha = 0.83$) among alcohol and cigarette users.

Data Analysis

Descriptive analyses were performed for all data; demographic data were presented against substance consumption characteristics during the COVID-19 pandemic. The association between sociodemographic factors and substance consumption characteristics was generated by Chi-square. Psychometric data were analyzed using One-way ANOVA, and significant groups were further tested using Tukey's or Games-Howell *post-hoc* analysis depending on the Levene's-test of equal variance results. Finally, all variables were scrutinized simultaneously using multinomial regression analysis with unchanged substance consumption set as the reference category. All statistical tests were performed using SPSS 23.0 for Windows (IBM, USA). Data were deemed significant if $p < 0.05$.

Ethics and Approval

This study was approved by the Institutional Ethics Committee of the Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital (KET-413/UN2.F1/ETIK/PPM/00/02/2020). All respondents provided written informed consent.

RESULTS

Prevalence and Sociodemographic of Alcohol and Cigarette Usages

The prevalence of the consumption of alcohol and daily cigarette smoking during the COVID-19 pandemic found in this study was 9.50% ($N = 436$) and 20.31% ($N = 931$). Regarding alcohol use, 44.5% reported no change in usage, while 29.8% reported reduced usage, and 25.7% reported increased usage. The data for cigarette smoking showed that 47.6% reported maintained usage, 32.3% reported reduced usage, and 20.1% reported increased usage.

Among alcohol drinkers ($N = 436$), the mean age was 30.4 ± 6.8 with 60.3% being male, 43.3% unmarried, and 43.8% lived in PSBB-implementing provinces. Married alcohol drinkers reported a significantly larger proportion of increased drinking (40.2%) than unchanged (35.4%) or reduced (24.3%) alcohol consumption. Those living in provinces implementing PSBB reported a higher proportion of decreased (35.6%) drinking than increased (22.0%). Among smokers ($N = 931$), the mean age was 33.3 ± 7.3 with 93.5% being male, 73.9% unmarried, and 41.7% lived in provinces implementing PSBB. Most male smokers either maintained, 48.4%, or decreased, 32.9%, their cigarette consumption. A significantly higher proportion, about 49.4%, of unmarried smokers recounted an unchanged number of cigarettes smoked, and only around 18.0% reported increased smoking. The data are shown in **Supplementary Table 1**.

Descriptive Psychometric Data

Respondents disclosing increased alcohol consumption tended to be significantly older than those who reported stable and decreased drinking [$F_{(2, 433)} = 10.16$, $p \leq 0.001$]. The mean AUDIT score was 3.52 ± 4.66 and, categorically, 10.1% respondents reported harmful alcohol use and 4.4% reported alcohol dependence. Those with reduced alcohol consumption had significantly higher AUDIT scores than those with stagnant and increased alcohol consumptions [$F_{(2, 433)} = 7.99$, $p \leq 0.001$]. The mean CDS-10 score was 24.73 ± 8.86. This study demonstrated a significant difference of CDS-10 scores among smoking pattern changes [$F_{(2, 928)} = 35.72$, $p \leq 0.001$]. Respondents that reported an increase in cigarette smoking scored 28.72 ± 9.03 which was significantly higher than the scores of those with constant smoking (24.89 ± 8.863) and those that disclosed reduced cigarette consumption (22.01 ± 7.720). Of the 436 alcohol drinkers and 931 cigarette smokers, 45.9 and 43.8% had poor sleep (PSQI score > 5), consecutively. PSQI scores did not significantly differ among changes in the use of both substances (shown in **Supplementary Table 2**).

Overall Correlates of Substance Consumption Changes

The multinomial regression data are shown in **Table 1**. The perceived stable consumption pattern was used as the reference category. Living in provinces implementing PSBB (aRRR = 2.14, $p = 0.008$) and higher AUDIT scores (aRRR = 1.11, $p \leq 0.001$) were positively correlated with decreased alcohol consumption, when compared to those who reported stable alcohol use. Attaining a university degree (aRRR = 2.38, $p = 0.045$) and higher PSQI scores (aRRR = 1.11, $p \leq 0.04$) were correlated with higher risk of increased rather than stable alcohol consumption; while those who were single were less likely to report increased alcohol use (aRRR = 0.31, $p \leq 0.001$). Male respondents (aRRR = 2.70, $p = 0.006$) and those who were single (aRRR = 1.69, $p = 0.03$) were positively correlated with increased cigarette consumption than those with stagnant smoking. Living within PSBB-implementing provinces (aRRR = 0.68, $p = 0.03$) was linked with lower odds of decreased smoking than stagnant cigarette consumption. Higher CDS score was more likely to predict increased than stagnant cigarette consumptions (aRRR = 1.06, $p \leq 0.001$) but less likely for decreased smoking (aRRR = 0.95, $p \leq 0.001$) compared to stable cigarette use. Those with higher scores in phobic anxiety (aRRR = 0.70, $p = 0.03$), hostility (aRRR = 0.71, $p = 0.03$), and psychoticism (aRRR = 0.72, $p = 0.04$) subscales were more likely to disclose decreased than unchanged cigarette consumption levels.

DISCUSSION

Overall, less than a tenth of our sample disclosed consuming alcohol during the pandemic, while one-fifth reported daily cigarette smoking over the same period. Traditionally, Indonesia's alcohol consumption has been documented to be lower than that of other countries. In this study as well, most of the respondents reported that they did not consume alcohol but there was an observable increase compared to a survey by the National Board of Narcotics in 2018 that found only around 3.0% of the total Indonesian adult population consumed alcoholic beverages in the past year (24). The generally low alcoholic consumption might be attributed to the fact that the majority of the Indonesian population practices Islam as a religion and considers the consumption of alcohol to be immoral (25). In comparison, the prevalence of 20.3% daily cigarette smoking during the pandemic was relatively maintained compared to the daily tobacco smoking rate, 24.3%, in 2018 (9). In support of this, cigarettes and tobacco are not forbidden by Islamic teachings, leading to its wider consumption by the public.

TABLE 1 | Multinomial regression of sociodemographic and psychometric variables against perceived changes of substance use during the pandemic.

Variables	Perceived alcohol consumption change[a]				Perceived cigarette consumption change[a]			
	Decreased		Increased		Decreased		Increased	
	aRRR[c]	95% CI	aRRR[c]	95% CI	aRRR[c]	95% CI	aRRR[c]	95% CI
Male[b]	0.94	0.56–1.72	1.04	0.63–2.24	0.64	0.30–1.36	2.70**	1.32–5.50
Age	0.99	0.94–1.04	1.04	0.99–1.09	0.99	0.96–1.01	1.01	0.98–1.05
Education								
University Graduates	0.64	0.31–1.33	2.38*	1.02–5.58	1.23	0.83–1.81	1.44	0.89–2.32
Diploma	1.96	0.67–5.71	3.15	0.94–10.48	0.69	0.38–1.27	0.83	0.41–1.69
Up to Senior High			Ref				Ref	
Occupation								
Professionals	0.48	0.16–1.44	0.48	0.10–2.29	0.54	0.12–2.47	2.93	0.41–21.03
Office Workers	1.49	0.56–3.98	1.54	0.37–6.34	0.58	0.19–1.77	2.42	0.42–13.90
Civil Servants	0.52	0.11–2.58	0.48	0.07–3.48	0.27	0.05–1.40	2.90	0.37–22.49
Unemployed	1.06	0.13–8.81	1.67	0.20–14.03	-	-	-	-
Students			Ref				Ref	
Marital status								
Single	1.15	1.27–3.59	0.31***	0.16–0.59	1.03	0.67–1.58	1.69*	1.04–2.75
Married/Divorced			Ref				Ref	
Income								
Low	0.59	0.16–2.18	1.61	0.41–6.29	1.52	0.63–3.69	2.69	0.84–8.61
Lower-Middle	0.87	0.39–1.98	2.39	0.99–5.79	0.6	0.33–1.10	1.73	0.80–3.75
Upper-Middle	1.24	0.61–2.50	1.45	0.66–3.17	0.78	0.44–1.38	1.89	0.91–3.91
High			Ref				Ref	
Province								
Implement PSBB	2.14**	1.27–3.59	1.07	0.62–1.87	0.68*	0.48–0.96	1.14	0.77–1.69
Not Implement PSBB			Ref				Ref	
Physical distancing								
Practice	0.87	0.50–1.53	1.03	0.58–1.84	0.95	0.67–1.33	1.14	0.77–1.68
Do Not Practice			Ref				Ref	
COVID-19 confirmed/suspected cases within household								
Present	1.82	0.61–5.46	1.53	0.46–5.08	0.86	0.36–2.05	0.55	0.17–1.77
Absent			Ref				Ref	
AUDIT	1.11***	1.05–1.18	1.05	0.99–1.12			-	
CDS			-		0.95***	0.94–0.97	1.06***	1.04–1.08
PSQI	1.07	0.97–1.18	1.11*	1.01–1.23	1.02	0.96–1.09	1.03	0.96–1.11
SCL-90								
GSI	0.99	0.63–1.57	0.8	0.47–1.36	1.32	0.97–1.79	0.99	0.67–1.46
Depression	0.95	0.60–1.51	1.18	0.69–2.01	0.75	0.55–1.03	0.99	0.67–1.48
Anxiety	1.00	0.62–1.62	1.36	0.78–2.39	0.83	0.61–1.14	0.99	0.67–1.48
Obsessive-Compulsive	1	0.60–1.66	1.28	0.71–2.30	0.76	0.54–1.07	1	0.65–1.52
Phobic Anxiety	1.02	0.64–1.63	1.19	0.70–2.05	0.70*	0.51–0.96	1	0.67–1.49
Somatization	1.04	0.66–1.65	1.22	0.72–2.07	0.78	0.57–1.14	1.02	0.69–1.51
Interpersonal Sensitivity	1.14	0.70–1.85	1.48	0.84–2.61	0.81	0.58–1.14	1.02	0.67–1.56
Hostility	1.01	0.63–1.64	1.27	0.72–2.23	0.71*	0.52–0.97	1.08	0.73–1.60
Paranoid Ideation	1.01	0.63–1.61	1.07	0.63–1.83	0.74	0.54–1.03	1.02	0.68–1.52
Psychoticism	0.91	0.57–1.45	1.26	0.73–2.17	0.72*	0.52–0.99	0.98	0.66–1.47
Additional	0.99	0.61–1.61	1.22	0.70–2.12	0.76	0.55–1.05	1.02	0.68–1.52
−2 Log likelihood			814.7, $p \le 0.001$				1772.8, $p \le 0.001$	
Nagelkerke R^2			0.27				0.19	

[a] *Reference category is stable (alcohol/cigarette) change;* [b] *Female is the reference;* [c] *aRRR, adjusted relative risk ratio;* *$p < 0.05$; **$p \le 0.01$; ***$p \le 0.001$.

This study demonstrated the changing patterns of usage of two substances among Indonesian adults during the PSBB period in Indonesia, from April to July 2020. Generally, most respondents reported unchanged intensity of consumption, and both cigarette and alcohol usage had a larger proportion of respondents reporting decreased consumption than increased. The changes of alcohol consumption observed in this study is similar to Australian and Polish data, with the highest proportion being stable alcohol drinking, followed by reduced usage, and the least was increased consumption (26, 27). Furthermore, we found that physical distancing did not account for any fluctuation in alcohol usage, although the implementation of the PSBB regulation within provinces did correlate with decreased alcohol consumption. The PSBB introduced much wider policies apart from social and mobility limitations to include stores' closures, which would have impacted alcohol products' availability. During this period, nearly half of the affected Indonesians reported minimizing going out of their homes, over 80% believed they were susceptible to COVID-19 (28), and the government had been debunking hoaxes on alcohol ingestion as a coronavirus prevention (29). Perplexingly, a higher AUDIT score was associated with reduced alcohol than maintenance; although, over 80% of the respondents were consuming alcohol reasonably, which could then suggest that social limitations such as diminished availability and accessibility had stronger suppressive effects. It is necessary to keep in mind that alcohol consumption comprises a spectrum from social drinking to pathological drinking behavior (30). In contrast to some studies (31, 32) in the Western hemisphere where alcohol was stockpiled during the lockdown, it is unlikely that alcohol hoarding occurred in Indonesia due to the scarcity of alcohol and limited availability due to the pandemic. This could be a reason for the reduced alcohol consumption among the respondents in this study, as shown by the low AUDIT score on average. The perceived decrease in alcohol consumption might be in line with the WHO statement that the current situation is a unique opportunity to reduce drinking considerably (33). Thus, obedience to limit physical contact, fear of COVID-19 infection, and low rates of alcohol dependence might be attributed as the reasons leading to decreased alcohol consumption in Indonesia.

In contrast to previous findings, being single was associated with lower risk of reporting increased alcohol than stable alcohol consumption in our study. Concordantly, some studies have suggested that social distancing and staying home during the COVID-19 pandemic could disrupt couples' and families' routines and lead to domestic violence escalation, ultimately resulting in additional marital distress (34, 35) and driving up alcohol consumption. In addition, marriage to a spouse with alcohol use disorder has been known to increase the risk for alcohol-related disorders (36). Moreover, attainment of university education is correlated with twice the risk of increased than stable alcohol drinking during the pandemic in Indonesia, although this did not seem to be influenced by financial affluence as no significant relationship was observed between income bands. Previously, it was shown that those with a college degree as opposed to those without demonstrated higher increases of at-risk drinking between adolescence and adulthood and the pattern was specific to alcohol and not tobacco or marijuana (37, 38). Among college students, research also noted positive correlation of alcohol consumption and higher subjective level of well-being and self-efficacy (39, 40). These could imply substance preference and unique demographic or academic characteristics influencing alcohol use among those able to attain a university degree in the face of stressors. Another probable consequence of this stressor was sleeping disturbance that was quite prevalent among the respondents. Poor sleep quality correlated significantly to increased alcohol use and this similar pattern was observed with internet addiction among Indonesian adults during the pandemic (41). Alcohol acutely acts as a sedative on non-alcoholic people, which will shorten sleep latency but perturb the rapid eye movement (REM) sleep cycle. Among alcoholics, studies documented that continued use and abuse results in tolerance to its sedative effects, and as such, they develop irregular sleep-wake cycles, deprived REM sleep duration, and daytime sleepiness (42). In turn, poor sleep quality is also suggested to trigger excessive alcohol use (43). Consequently, pervasive sleep disturbance had been recorded during the COVID-19 pandemic and lockdown period across the globe (44), which might intensify alcohol use in vulnerable individuals.

In this study, cigarettes were the more commonly used substance during the COVID-19 pandemic. However, approximately two-thirds more respondents reported a decrease in cigarette smoking than increase during the pandemic. Contradictorily, a Chinese study reported a slight increase (0.8%) in cigarette smoking prevalence during COVID-19 (45), while an Australian study indicated that cigarette smoking tended to decrease (26). On the other hand, another study described similar proportions of decreased and increased cigarette smoking (46) and a multinational study reported a nearly unchanged pattern in consumption of tobacco cigarettes (47). Globally, there were differences in the changes in cigarette consumption during the pandemic; however, we observed a higher degree of the population reporting regular consumption in Indonesia, with increased smoking least mentioned. Unlike alcohol, the tax for a cigarette in Indonesia is lower, 58.5%, (12) than the set global cigarette tax (70%) (48). Hence, cost-wise, a cigarette is much more accessible in Indonesia and sales of cigarettes might be less affected by the economic crisis, which partly explained the unchanged intensity of cigarette smoking in nearly half of the smokers and the non-significant relationship to household income seen in this study. Additionally, the gap between reduced and increased addictive substance consumption was more notable among smokers (32.3 vs. 20.1%) than among alcohol drinkers, which could be partly attributed to the intensive public education on the negative association between smoking and COVID-19 (49).

Expectedly, gender was significantly correlated with changes in cigarette consumption and our study sample indicated that males were nearly three times more likely than females to report increased smoking than stable cigarette consumption. To a certain degree, this could be attributed to the heightened male's, than female's, activation of the reward pathway from nicotine (50) and the oppressive societal and religious norms subjected upon women (51). Previous evidence suggested that stress response is a driving force of tobacco initiation and relapse in women (52). However, it might not principally affect current female smokers' tendency to modify their tobacco smoking since it provided lower rewarding sensation than for males (53). Furthermore, unmarried respondents were at least 50% more likely than married respondents to have increased than unchanged smoking during the pandemic. A previous study also reported a similar pattern of lower smoking prevalence in married households (54). Respondents who reported an increase in cigarette consumption during the pandemic had the highest scores on CDS-10, which signified heightened dependence. Higher CDS-10 scores were significantly linked to higher risk of reporting increased than stagnant cigarette usage but less likely to report decreased than unchanged cigarette smoking. Thus, indicating that respondents with advanced dependence require further assistance and incentives to reduce their smoking. Especially during this pandemic, cigarette smoking has been linked with the upregulation of angiotensin-converting enzyme-2 in lung cells (55, 56) and weakened immune system (57); it was also reported that patients with smoking history were associated with more progressed COVID-19 symptoms (58). Moreover, cigarette smoking has been linked to aggravating neuropsychiatric symptoms, systemic inflammation, coagulation, and other clinical symptoms in COVID-19 patients through nicotine and nicotinic-cholinergic system interaction (59, 60). The rising cigarette consumption in some respondents might be driven by factors other than psychopathologies, as neither significant difference in SCL-90 scores nor correlation in the regression analysis were seen. Decreased cigarette smoking was correlated with higher scores in phobic anxiety, interpersonal sensitivity, and psychoticism, which might be driven by lowered nicotine consumption (61). This interpretation remained limited within the context of current data and should be investigated in future studies.

This study had some limitations. First, the study only covered participants who could access this survey through the internet. Subjective bias could also have occurred as this survey used self-reported questionnaires. Previous national data on the substance use pattern before the COVID-19 pandemic were limited, restricting an in-depth analysis of the current situation. The current study also did not employ a random sampling approach due to the limited timeframe. This study could not identify if respondents had only initiated consuming the substances during the study period and determine the previous level of use (acceptable, dependent, or hazardous). History of remission, withdrawal, or relapse (if any) was not collected as well. The details of distinct types of alcohol (e.g., wine, beer, spirits, etc.) and cigarettes (e.g., combustible or e-cigarette) were not explored in this study. Further follow-up studies are required to assess the shortcomings of this study and the consequences of pandemic policies (e.g., physical distancing) on addiction in the long term. However, to the best of our knowledge, this is the first study to investigate the changes of substance use during the COVID-19 pandemic in Indonesia. This study could be used as a reference to modify the nationwide approach to the COVID-19 pandemic and addiction across prevention and intervention policies. Despite minimal personal mobilization and heightened fear toward COVID-19, (28) the majority of respondents could maintain their alcohol and cigarette consumptions, with a smaller proportion of respondents enhancing their consumption during the pandemic. Therefore, stakeholders should ensure the maintenance and intensification of psychiatric and addiction services during and after the pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Ethics Committee of Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EH and KS conceived, designed, and supervised the study. EH, KS, AL, HC, and LTS contributed data or analysis tools. EH, KS, AL, LTS, HC, A, LPS, and BM collected the data. EH, KS, AL, LTS, HC, and CS performed the data analysis. EH, KS, AL, LTS, HC, A, LPS, and BM wrote the manuscript. KS and CS secured funding for the study. All authors contributed to the article and approved the submitted version.

FUNDING

This study received funding from the Ministry of Research and Technology/Center of National Research and Innovation of Republic of Indonesia through the Konsorsium Riset dan Inovasi Untuk Percepatan Penanganan Corona Virus Disease 2019 (Covid-19) (Ref.: 106/FI/PKS-KCOVID-19.F/VI/2020). The funders had no role in the design, data collection, analysis and interpretation of data, write-up, and/or publication of this study.

ACKNOWLEDGMENTS

The authors would like to thank all the research assistants, universities, and state-owned companies in disseminating the survey.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.622917/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Public Health

ORIGINAL RESEARCH
published: 02 February 2021
doi: 10.3389/fpubh.2020.623205

Increased Screen Use on Days With Increased Perceived COVID-19-Related Confinements—A Day Level Ecological Momentary Assessment Study

Ann-Kathrin Arend, Jens Blechert, Björn Pannicke and Julia Reichenberger*

Department of Psychology, Centre for Cognitive Neuroscience, Paris-Lodron-University of Salzburg, Salzburg, Austria

OPEN ACCESS

Edited by:
Ornella Corazza,
University of Hertfordshire,
United Kingdom

Reviewed by:
Siddharth Sarkar,
All India Institute of Medical Sciences, India
Konstantinos E. Siomos,
University of Thessaly, Greece

****Correspondence:***
Ann-Kathrin Arend
ann-kathrin.arend@stud.sbg.ac.at

Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: *29 October 2020*
Accepted: *21 December 2020*
Published: *02 February 2021*

Citation:
Arend A-K, Blechert J, Pannicke B and Reichenberger J (2021) Increased Screen Use on Days With Increased Perceived COVID-19-Related Confinements—A Day Level Ecological Momentary Assessment Study. Front. Public Health 8:623205. doi: 10.3389/fpubh.2020.623205

Introduction: Coronavirus 2019 (COVID-19) quickly evolved into a global pandemic in early 2020, and most countries enforced social confinements to reduce transmission. This seems to dovetail with increasing, potentially problematic, screen use habits, such as gaming and "binge-watching." Yet, the subjective experience of the common confinements may vary not only between individuals depending on age, sex, and living conditions (i.e., living alone) but also within individuals from day to day: confinements might interfere with habitual activity schedules more strongly on some days than on others. Such dynamic confinement experience has not been studied in relation to screen use yet but might guide targeted intervention.

Method: In total, 102 participants ($n = 83$ female, $n = 80$ university students) completed 14 days of ecological momentary assessment during a COVID-19-related lockdown in Germany and Austria. Each evening, they indicated the extent to which they felt restricted by confinements in their social and work lives and whether they engaged in unusually high and intense levels of television watching, social media use, news consumption, internet surfing, and gaming. They also reported on how much they experienced their day to be structured.

Results: Experienced work confinements were positively associated with social media usage. Further, work confinements were positively associated with gaming in males and with news consumption, especially in individuals living alone. Social confinements were positively associated with watching television especially in younger participants and with social media consumption in younger participants. Higher experienced day structure was related to less television watching, gaming, and internet surfing but more news consumption.

Discussion: Screen use behaviors increased with higher confinements within person, dependent on sex, age, and living situation. Such knowledge allows tailoring on the person level (who should be addressed?) and the time level (when should interventions be scheduled?) as the negative consequences of excessive screen use behaviors on mental and physical health are well-documented. One potential low-threshold intervention might be day-structuring.

Keywords: COVID-19, confinements, screen use, day structure, ecological momentary assessment (EMA)

INTRODUCTION

Throughout 2020, the coronavirus 2019 (COVID-19) evolved into a global pandemic with a negative impact on physical and psychological health [e.g., increased anxiety and depression; (1)]. To slow down the spreading of the coronavirus and to stabilize overstrained healthcare systems, most countries enforced partial lockdowns and confinements on social interaction. However, these lockdowns were associated with higher levels of stress, anxiety, and depression especially in younger individuals (2).

Besides having to deal with the uncertainty about the possible consequences of COVID-19 infections, such as medical complications, citizens were faced with novel situations as they experienced a loss of their usual routine and had to adapt to social and work confinements (e.g., reduced social contact, home-office, and -schooling). This might cause boredom, frustration, and feelings of isolation (3). Additionally, the reduction of recreational outdoor activities and social contact limits the available sources for habitually used positive reinforcement and thus protective factors of psychological health (4–6). To sum, these deprivations in concert with the breakdown of daily routines experienced during COVID-19-related confinements have the potential to increase reinforcing (indoor) behaviors that are still accessible and easily available. To illustrate, it has previously been shown that potentially problematic behaviors, such as increased consumption of food (7, 8), alcohol (9), or cannabis (10), become more likely during COVID-19-related confinements.

Another potential source of easily accessible and highly reinforcing activities, especially in highly technologized societies, may be intense screen use behaviors, such as watching television, gaming, internet surfing, or social media usage (11, 12). To exemplify, studies showed that the overall screen time increased during lockdown in children and adolescents (13, 14), as well as in office workers and students (15–19). More specifically, recent studies reported increased screen use habits, such as gaming (20), watching television, or even binge-watching (7, 21, 22), as well as social media use [e.g., (21, 23, 24)], during COVID-19-related confinements (8).

Such excessive screen use behaviors can be associated with negative effects on psychological well-being during COVID-19-related confinements: students were negatively affected in their sleep quality, sleep duration, physical well-being, and mental health by excessive screen time (15); increased social media use was associated with a greater tendency to be diagnosed with depression or anxiety (24); finally, more time consuming news led to higher levels of anxiety and stress (3, 25). Moreover, individuals during adolescence and young adulthood may be especially vulnerable to develop excessive, impulsive–compulsive screen use behaviors corresponding to the concept of "behavioral addiction" (11, 26). Hence, examining screen use behaviors during COVID-19 confinements seems important to prevent the negative health outcomes mentioned above.

The COVID-19 situation and related confinements have been very dynamic with new regulations introduced almost on a daily basis. Moreover, within individuals, the *subjective* experience of these *objective* confinements might have varied significantly from day to day: individuals may have experienced confinements as more impacting on days where they used to engage in activities that are now restricted (e.g., outdoor recreation, social gatherings on weekends, or work meetings on work days). Similarly, the confinements might have affected different life areas (e.g., individuals may experience more work-related confinements during the week but suffer more from social confinements on the weekend, depending on their usual routines). This creates much variability within individuals (i.e., day-to-day variability in experienced confinements). As some new findings showed, such situational factors [i.e., varying degrees of experienced confinements; (18)] may contribute to increased screen use. Hence, it may be most appropriate to assess various perceived COVID-19-related confinements and screen use on a daily basis using ecological momentary assessment (EMA) that accounts for this within-person variance.

Additionally, between individuals, confinements may have different effects depending on different professions or living situations (e.g., some individuals stopped working or lost their job, whereas others had to work in home-office). Thus, also between-person variables need to be acknowledged: demographic and environmental factors, i.e., age, sex, or living alone, have been linked to excessive screen use [i.e., online gamers typically are male, young, university graduates, and live alone; (27)].

It has been shown that the *subjective* experience of social isolation is as likely to predict negative effects on well-being, compared with *objective* social isolation (28). Thus, we focused on the subjective experienced degree of social and work confinements from day to day and their association with increases of screen use behaviors, but additionally assessed whether the participants lived alone or together with others, as individuals who lived alone might have been objectively more isolated during the lockdown period.

On that background, the present naturalistic study examined the relationship of daily varying experiences of COVID-19-related confinements with screen use behaviors, as well as the moderating roles of demographic, environmental, and situational factors, in this relationship across 14 days of day level EMA. Based on the literature reviewed above, it was hypothesized that increased subjective work and social confinements would be associated with an increased probability for screen use behaviors (television watching, social media usage, internet surfing, gaming, and news consumption) within person. Additionally, we hypothesized that age, sex, and living situation (alone or with others) may moderate the increase of different screen use behaviors with regard to the experience of increased confinements. As it was recommended that a more structured daily routine should be followed to avoid excessive engagement in screen use behaviors (12), we hypothesized that days marked by a more structured daily routine would be negatively associated with the probability for increased engagement in screen use behaviors on that day.

MATERIALS AND METHODS

Participants

In total, 102 participants ($n = 83$ female) were included. The participants were recruited via social media postings and mailing lists in Germany and Austria. All participants completed the study during a COVID-19-related lockdown (from March to May 2020) in both countries. Participants were recruited for an EMA study on the influence of COVID-19-related confinements on eating behavior. The sample mainly consisted of university students (78.4%), followed by employees (15.7%) and few self-employed, homemakers, pupils, and retirees (5.9%). Thus, mainly young adults participated in the study (age: $M = 25.5$, $SD = 9.20$, range 18–71 years; 25th percentile 20.0, 75th percentile 26.3 years). Most participants reported to live with others ($n = 86$), whereas the rest lived alone ($n = 16$). The ethics committee of the University of Salzburg approved the study, and all participants signed an informed consent form approved by the ethics committee of the University of Salzburg.

Measures

Sociodemographic Measures

Participants reported sociodemographic data via an online questionnaire (i.e., sex, age, whether they live alone or together with others, and other unrelated measures).

EMA Measures

Participants completed five EMA signals a day, repeatedly asking about emotions, stress, eating behavior, and other variables that are not of interest for the present study. At the last signal of each day, participants indicated the extent to which they felt restricted by confinements in their (a) social and (b) work lives via visual analog scales in the form of continuous rating sliders ("How much did you feel confined in your social life today?" and "How much did you feel confined in your work life today?": from *not at all* [0] to *very much* [100]). Further, they reported whether they engaged, more than they usually do, in one or several of five screen use behaviors ("Did you engage in one or more of the following activities in your leisure time today? In comparison with usual intensified and increased..." television watching, social media use, news consumption, internet surfing, and gaming: *yes* or *no* for each screen use behavior). Finally, the participants reported how much they experienced their day to be structured ("How structured was your day?": from *not at all* [0] to *very much* [100]).

Procedure

At the start of the study, all participants signed the informed consent form and completed an online questionnaire asking about the abovementioned sociodemographic factors. Via phone, participants were instructed on how to install and use the customized EMA application *PsyDiary*. The duration of the EMA protocol lasted for 14 days, with five signal-contingent prompts per day[1]. At the last prompt of each day (at 09:00 pm), participants answered the questions regarding confinements in social and work lives, engagement in unusually high and intense levels of screen use behaviors, and the experienced day structure. In general, participants could delay the signal response for up to 1 h while later responses were treated as missing. All participants were compensated for their participation with 3–5 course credits (depending on their EMA compliance) and a personalized feedback of their data.

Statistical Analyses

A multilevel modeling (MLM) approach was used to account for nesting of within-person (prompts, level 1, e.g., day-to-day variation in experienced confinement) and between-person (individuals, level 2, e.g., sociodemographic data) variance. Thus, social and work confinements, as well as screen use behaviors, were modeled as level 1 variables, whereas sex, age, and living situation (i.e., living alone or together with others) were modeled as level 2 variables. To account for the binomial distribution of the outcome measures (i.e., reports of increased television watching, social media use, news consumption, gaming, and internet surfing), the Bernoulli–MLM models were used. Level 1 variables (social and work confinements and day structure) were person-mean centered (centered within person), and continuous level 2 variables (age) were grand-mean centered (centered around the group mean).

In a first step, MLM Null-models (including only a random intercept for participants) were tested for significance. Significance of these tests indicated a nested data structure. Thus, MLMs with random effect structure were preferable to general linear regression models. Therefore, random intercepts and random slopes for each participant were added to the fixed factors (work and social confinements), to model variance between and within individuals.

To account for the expected moderating roles of sex, age, and living situation on certain screen use behaviors, additional interaction models were conducted. To exemplify, increased gaming was modeled as a dependent variable with COVID-19-related confinements, and sex and their interaction as independent variables. For all outcomes, additional models with multilevel interactions separately including sex, age and living situation were calculated. All MLMs were setup with nested random effect structure (30) and analyzed in HLM7 (31).

[1]The assessments of the other prompts were focused on eating behavior. The data are reported elsewhere (29).

Additionally, we used Rstudio (32) and the packages lme4 (33) and nlme (34) to recalculate our models and test whether all assumptions of MLMs were met for our data. Linearity of the data was checked upon visual inspection by plotting the residuals of each model vs. the observed outcome values. Homogeneity of residual variance was checked by a variation of the Levene's test: the residual variance from each participant was extracted, and an ANOVA of the between subject residuals was calculated (for each model). Normal distribution of residuals was checked upon visual inspection of Q–Q plots of the random effects of each model.

Data from $n = 3$ participants were excluded from the analyses due to insufficient data quantity, as they answered <50% of all EMA prompts.

RESULTS

Descriptive Data

In total, 1,257 EMA evening prompts were answered and used for analyses. On average, 12.2 out of 14 EMA prompts per participant were answered, equaling to a good compliance of 87.4% (SD = 13.1, range 50–100%). On average, participants reported mild to moderate confinements in their social ($M = 33.2$, $SD = 28.1$, range 0–100) and work lives ($M = 24.4$, $SD = 30.0$, range 0–100) and moderately structured days ($M = 49.7$, $SD = 27.5$, range 0–100). Increased screen use behaviors compared with usual were reported, as can be seen in **Table 1**.

TABLE 1 | Amount of increased and intensified screen use behaviors compared with usual.

Increased screen use behavior	Percentage of all observations Yes, more than usual–no, as/less than usual		*n* Yes–no	
TV	40.7%	49.3%	511	746
Social media	43.8%	46.2%	550	707
News[3]	29.7%	70.3%	373	884
Internet	23.9%	76.1%	301	956
Gaming[4]	9.07%	90.9%	114	1,143

Frequency of prompts (out of the 1,257 prompts answered by all participants) with increased screen use behaviors compared with usual. Assessed in the evening (09:00 pm–10:00 pm) on 14 consecutive days.

[3]*Homogeneity of variance for the percentage of increased news consumption of all answered EMA prompts was not given between participants who lived alone compared with those who lived with others. Still, participants who lived alone did not significantly differ from participants who lived with others, in their reports of increased news consumption [$t_{(27)} = -1.87$, SE = 6.74, p = 0.072].*

[4]*Homogeneity of variance for the percentage of increased gaming of all answered EMA prompts was not given between men and women. Men reported increased gaming for a significantly higher percentage of their answers (M = 30.1%, SD = 36.5%) than women (M = 4.4%, SD = 14.1%) [$t_{(19)} = -3.02$, SE = 8.52, p = 0.007]. Only 17.4% (n = 15) of the women, but 81.3% (n = 13) of the men reported increased gaming at least once throughout the 14 days of EMA.*

EMA Measures

Effects of Work Confinements[2]

Higher experienced work confinements were positively associated with a higher probability of social media usage within participants ($\beta_{01} = 0.006$, $SE = 0.002$, $p = 0.004$). An association of work confinements and reports of increased gaming ($\beta_{01} = -0.003$, $SE = 0.001$, $p = 0.024$) was moderated by sex, yielding a positive association of work confinements and increased gaming only in males ($\beta_{11} = 0.006$, $SE = 0.002$, $p = 0.006$), as can be seen in **Figure 1A**. Further, work confinements were positively associated with reports of news consumption, especially in participants who lived alone ($\beta_{11} = -0.015$, $SE = 0.006$, $p = 0.009$), as can be seen in **Figure 1B**. No further associations of work confinements and increases in other screen use behaviors were found, and no further interactions of work confinements and age, sex, or living situation were found regarding the different dependent variables of increased screen use behaviors.

Effects of Social Confinements[2]

Higher social confinements were positively associated with higher probability of reports of increased television watching within participants ($\beta_{01} = 0.007$, $SE = 0.003$, $p = 0.019$). This association was moderated by age so that it was stronger in younger participants ($\beta_{11} = -0.001$, $SE = 0.0002$, $p = 0.004$), as can be seen in **Figure 2A**. Social confinements were also significantly associated with higher probability of reports of increased social media consumption in younger than in older participants ($\beta_{11} = -0.001$, $SE = 0.0002$, $p = 0.001$), as can be seen in **Figure 2B**. No further associations of social confinements and increases in other screen use behaviors were found, and no further interactions of social confinements and age, sex, or living situation were found regarding the different dependent variables of increased screen use behaviors.

All reported significant main effects of social and work confinements on increased screen use behaviors remained significant after combining social and work confinements into one model to control for shared variance. For detailed tables of all models and results, see **Supplementary Materials**.

Effects of Day Structure[2]

A higher experienced day structure was related to a lower probability of reports of increased television watching ($\beta_{01} = -0.012$, $SE = 0.003$, $p < 0.001$), gaming ($\beta_{01} = -0.005$, $SE = 0.002$, $p = 0.014$), and internet surfing ($\beta_{01} = -0.006$, $SE = 0.002$, $p = 0.008$) within participants, but to a higher probability news consumption within participants ($\beta_{01} = 0.005$, $SE = 0.002$, $p = 0.049$).

DISCUSSION

The present study examined the impact of subjectively perceived work and social COVID-19-related confinements on the increase of different screen use behaviors in daily life using day level EMA across 14 days. Due to the highly dynamic COVID-19 situation and the fact that confinements might interfere with habitual activity schedules more strongly on some days than on others, we were explicitly interested in within-person relationships of these variables, but also examined the role of potential moderators

[2]For all reported models, the assumptions of linearity (upon visual inspection of plots), homogeneity of residual variance (all p's > 0.500), and normal distribution of residuals (upon visual inspection of plots) were met.

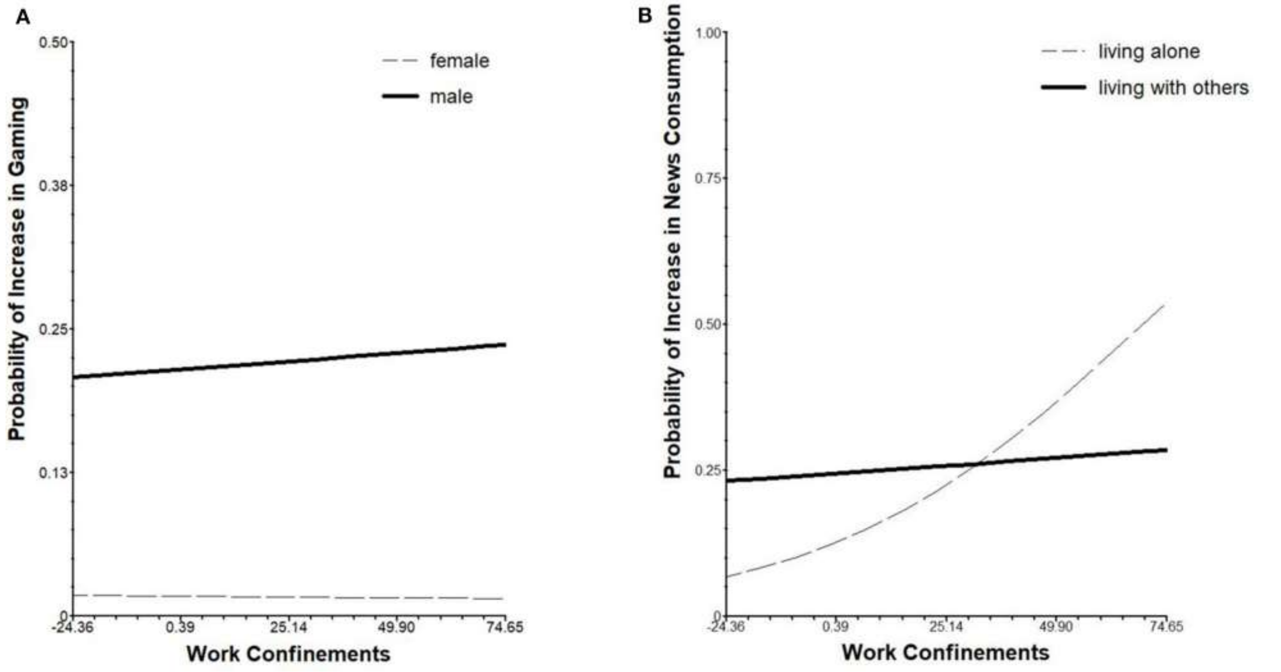

FIGURE 1 | From left to right: **(A)** simple slopes of the probability for increased gaming in relation to experience of work confinements moderated by sex, **(B)** simple slopes of the probability for increased news consumption in relation to experience of work confinements moderated by living situation. Scaling of the x-axis is based on the entire range of person-mean centered scores of work confinements.

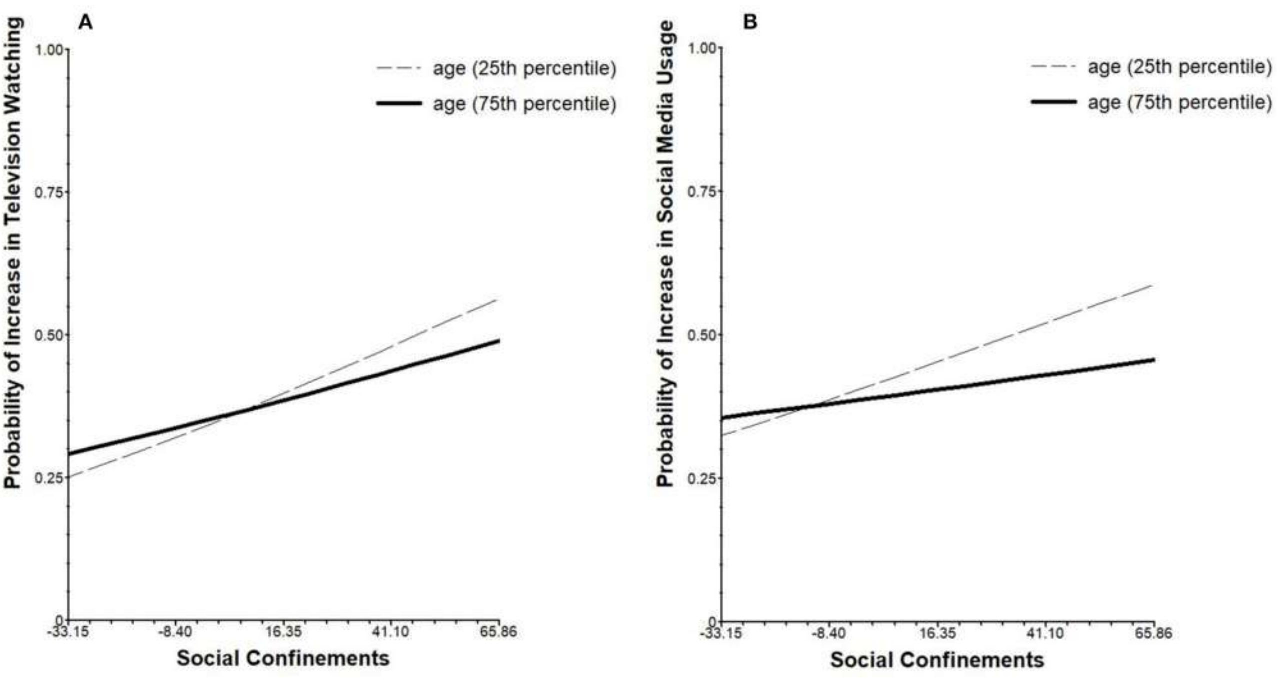

FIGURE 2 | From left to right: **(A)** simple slopes of the probability for increased television watching in relation to experience of social confinements moderated by age, **(B)** simple slopes of the probability for increased social media usage in relation to experience of social confinements moderated by age. For visualization only, the 25th percentile (20.0 years) and 75th percentile (26.3 years) of the participants are displayed to highlight the interaction of age and social confinements. Scaling of the x-axis is based on the entire range of person-mean centered scores of social confinements.

of these associations, such as age, sex, and living alone vs. with others.

Results showed that participants reported increased screen use during leisure time, mostly social media and television watching, followed by news consumption, other internet usage, and gaming. In line with previous research, screen use increased during COVID-19-related confinements compared with usual every day conditions [e.g., (13–17, 19)]. Potentially, the low prevalence of increased gaming in our study is due to our mostly female sample, as previous research showed excessive gaming being prevalent mostly in male individuals (27). Indeed, increased gaming was reported by most male individuals in our sample but only few female participants, so that future studies might profit from a sample with a higher percentage of male individuals.

Increased screen use during COVID-19 may have positive and negative side effects. On the one hand, increased screen use may aid individuals in coping with the COVID-19 crisis. On the other hand, it may worsen psychological well-being. To illustrate, increased social media use might enable individuals during the COVID-19-related confinement to stay in contact with others and overcome social distancing (23), and increased news consumption may help individuals to stay informed and cope with COVID-19-related uncertainty (35, 36). Still, excessive screen use is related to decrease physiological and psychological well-being, and increased news consumption may even be related to greater fear about infection.

Moreover, our results showed that the effects of COVID-19-related confinements differ within individuals on a day-to-day basis as the subjectively experienced degree and the life domain of confinements vary: work confinements were positively associated with the probability of increased social media usage, whereas social confinements were positively associated with the probability of increased television watching within participants. This suggests that COVID-19-related confinements may not be seen as temporally stable or as an "all or nothing" factor, but significant day-to-day variations exist and those go along with variations in screen use. To exemplify, within-person confinements might interfere with personal recreational habits on one-day (i.e., leading to increased television watching) and with important job tasks on another day (i.e., leading to increased social media usage), yet on another day, the confinements may not interfere with any activities or duties at all (e.g., weekend day at home with family). Hence, instead of focusing on confinements as a dichotomous state (confined, non-confined), a more fine-grained assessment may be more appropriate for explaining screen use behavior and for intervening on it in case of problematic levels.

Regarding interventions, one potential protective factor might be a well-structured day, which has already been recommended by previous research (12): our data showed that the degree to which participants experienced their day to be structured was negatively associated with increased screen use behaviors (television watching, gaming, and internet surfing) within participants. Only news consumption was positively associated with the degree of day structure, but news consumption might inherently structure the day. Thus, the present study calls for targeted prevention and intervention and sheds some light on a potential low-threshold intervention in the form of day-structuring and planning. Such interventions might aid individuals in managing excessive screen use behaviors by preplanning different duties and recreational activities beforehand to minimize the degree of confinements actually experienced later on, due to a lack of preparation.

Further, our results provided new insights by showing who is more affected in their screen use behaviors by COVID-19-related confinements than others are: increased gaming was reported by males more on days with more work confinements. Increased news consumption was seen especially in individuals who live alone on days with more work confinements. Additionally, increased television watching and social media usage were reported by younger participants on days with more social confinements. Thus, to some degree, our results underpin previous studies [e.g., (27), (37)] showing that young, male, and individuals who live alone, may be most vulnerable for certain excessive screen use behaviors and thus represent an important target population for prevention and intervention strategies.

Increased screen use behaviors may further be problematic, as subgroups of especially vulnerable individuals may be at risk of developing chronic and excessive usage patterns. Previous research showed that such behaviors relate to poorer psychological and physical well-being (3, 15, 24, 25). Additionally, these behaviors may become addictive over time, so that several researchers argued that addiction-related disorders need special attention during the COVID-19 pandemic (38). Such mostly sedentary behaviors additionally seem to constitute a risk factor for weight gain during the COVID-19 pandemic (39). These points should be considered in prevention and intervention approaches in order to help individuals adapt their health behaviors. Several guidelines have been developed recently, providing advices on how to manage excessive behaviors (i.e., screen use) during the COVID-19 pandemic [e.g., (12, 40)] and to prevent and treat addictive behavior-related disorders (38). Still, the current study calls for targeted preventions and interventions toward particularly vulnerable individuals (i.e., between-person relationships regarding sex, age, and living alone).

Limitations and Future Research

The study mainly sampled university students at younger age who are at risk for developing chronically excessive behaviors, such as internet addiction (37), and experiencing a decline in psychological well-being during the COVID-19 pandemic, even more so in female university students (41). Nevertheless, this limits the generalizability of the present findings and calls for a replication in a sample with more diverse socio-economic characteristics. Additionally, the current study only covered 14 days of EMA assessment, mainly to limit participant burden and enhance compliance. However, long-term trajectories may be interesting, particularly with regard to the potential chronicity of addictive-like behaviors.

Clinical Impact and Future Directions of Research

In case of prolonged COVID-19-related confinements (i.e., potential upcoming lockdowns), a direct application of our findings would be to tailor a day-structuring intervention to counteract excessive screen use behaviors in vulnerable individuals. The possible intervention techniques would be planning of recreational activities, for example, through implementation intentions (42), situational specific action plans with an if-then structure. According to our data, especially young adults might profit from such interventions to limit increased television watching, whereas males may limit increased gaming.

Especially children and adolescents showed excessive screen use behaviors during COVID-19-related confinements [i.e., (13, 43–45)]; future research could examine if day-structuring might also be preventative in these subgroups. Simultaneously, a day-structuring intervention might even be useful to reduce other potentially problematic behaviors during COVID-19-related confinements, but this remains to be examined in future research. Moreover, day-structuring might also aid in deliberate integration and realization of healthy recreational activities, which might add to the overall psychological and physiological well-being during COVID-19-related confinements.

Apart from day-structuring, cognitive interventions might also be useful: results of the current study suggest that the subjective experience of COVID-19-related confinements seems especially important when it comes to increased screen use behaviors. Previous research makes it seem likely that the subjective experience of quarantine as either enforced vs. voluntary resembles an important differentiation with regard to health outcomes (3). Hence, applying framing of confinement measures as appeals to each and everyone's responsibility for the community (e.g., to avoid transmission, to protect the beloved ones), and emphasizing some positive aspects (e.g., time for family, time to recover from work stress) might also aid in avoiding increased screen use behaviors. As a result, future research should build on these findings and develop targeted and temporally precise interventions to tackle the negative psychological outcomes of COVID-19-related confinements.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics committee of the University of Salzburg. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

A-KA, JB, BP, and JR were involved in designing the present study. A-KA, BP, and JR contributed to the data acquisition and preparation. A-KA conducted the data analyses and wrote the first draft of the present manuscript. JB and JR revised the present manuscript. All authors approved the submitted version.

FUNDING

This work was supported by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (ERC-StG-2014 639445 NewEat).

ACKNOWLEDGMENTS

We thank Beatrice Ammer, Teresa Angleitner, Selina Bergmann, Nadine König, Verena Lebitsch, Natalia Logides, and Lisa Rachbauer for their assistance in collecting data for this study. Further, we thank all participants for their participation in this study.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2020.623205/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 09 February 2021
doi: 10.3389/fpsyt.2021.628631

The Early Impact of the COVID-19 Lockdown on Stress and Addictive Behaviors in an Alcohol-Consuming Student Population in France

Valentin Flaudias[1,2†], Oulmann Zerhouni[3†], Bruno Pereira[1,2], Cheryl J. Cherpitel[4], Jordane Boudesseul[5], Ingrid de Chazeron[1,2], Lucia Romo[6,7], Sébastien Guillaume[8], Ludovic Samalin[1,2], Julien Cabe[1,2], Laurent Bègue[9], Laurent Gerbaud[10,11], Benjamin Rolland[12], Pierre-Michel Llorca[2], Mickael Naassila[13‡] and Georges Brousse[1,2‡]*

[1] CHU Clermont-Ferrand, Pôle Psychiatrie B, Clermont-Ferrand, France, [2] Université Clermont Ferrand, EA NPsy-Sydo, BP 10448, Clermont-Ferrand, France, [3] Laboratoire Parisien de Psychologie Sociale, Département de Psychologie, University Paris Nanterre, Ad Hoc Lab, Nanterre, France, [4] Alcohol Research Group, Emeryville, CA, United States, [5] Facultad de Psicología, Instituto de Investigación Científica, Universidad de Lima, Lima, Peru, [6] EA4430 CLIPSYD, UFR SPSE, Paris Nanterre University, Nanterre, France, [7] CMME, GHU Paris Psychiatrie et Neurosciences, U de Paris, Paris, France, [8] Department of Emergency Psychiatry and Post-Acute Care, CHRU Montpellier/INSERM U1061, University of Montpellier, Montpellier, France, [9] LIPC2S, Université Grenoble Alpes, Grenoble, France, [10] Service de Santé Publique, CHU de Clermont-Ferrand, Clermont-Ferrand, France, [11] Université Clermont Auvergne, CNRS-UMR 6602, Institut Pascal, Axe TGI, Groupe PEPRADE, Clermont-Ferrand, France, [12] Service Universitaire d'Addictologie de Lyon (SUAL), Pôle MOPHA, CRNL, Inserm U1028, CNRS UMR5292, Université Lyon 1, Centre Hospitalier Le Vinatier, Bron, France, [13] Université de Picardie Jules Verne, Unité INSERM UMR 1247, Groupe de Recherche sur l'Alcool & les Pharmacodépendances, Centre Universitaire de Recherche en Santé, Amiens, France

OPEN ACCESS

Edited by:
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****Correspondence:***
Valentin Flaudias
vflaudias@chu-clermontferrand.fr

† These authors have contributed equally to this work and share first authorship

‡ These authors share last authorship

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *12 November 2020*
Accepted: *14 January 2021*
Published: *09 February 2021*

Citation:
Flaudias V, Zerhouni O, Pereira B, Cherpitel CJ, Boudesseul J, de Chazeron I, Romo L, Guillaume S, Samalin L, Cabe J, Bègue L, Gerbaud L, Rolland B, Llorca P-M, Naassila M and Brousse G (2021) The Early Impact of the COVID-19 Lockdown on Stress and Addictive Behaviors in an Alcohol-Consuming Student Population in France. Front. Psychiatry 12:628631. doi: 10.3389/fpsyt.2021.628631

Background: This study evaluated factors linked with perceived stress related to the COVID-19 pandemic and lockdown and addictive behaviors prior to and during lockdown in a sample of students who indicated engaging in alcohol consumption behaviors before lockdown.

Methods: Cross-sectional study. French students from four universities participated in this study, and 2,760 students reported alcohol use. During the first week of lockdown, students reported their perceived levels of stress regarding COVID-19. Substance use and addictive behaviors were reported before and during lockdown, and media exposure, demographical, living conditions, and environmental stressors were reported during lockdown.

Results: Women reported greater levels of stress (95% CI: 1.18 to 1.93, $p < 0.001$). Highly-stressed students also report less social support (95% CI: −1.04 to −0.39, $p < 0.001$) and were more likely to worry about the lockdown (95% CI: 0.27 to −0.65, $p < 0.001$). Alcohol-related problemswere more prevalent among the most stressed students (95% CI: 0.02 to 0.09, $p = 0.004$) as well as eating problems (95% CI: 0.04 to 0.36, $p = 0.016$) and problematic internet use (95% CI, 0.06 to 0.14, $p < 0.001$). Students reporting the highest levels of stress also indicated more compulsive eating during the previous seven days (95% CI, 0.21 to 1.19, $p = 0.005$).

Conclusions: The level of stress was strongly related to four categories of variables: (i) intrinsic characteristics, (ii) addictive behaviors before lockdown, (iii) lockdown-specific conditions, and (iv) addictive behaviors during the lockdown. Several variables linked to COVID-19 were not directly linked with perceived stress, while perceived stress was found to correlate with daily life organization-related uncertainty and anticipated consequences of lockdown. Importantly, social support seems to be a protective factor on high level of stress.

Keywords: COVID-19, Coronavirus, stressors, LockDown, addiction, alcohol, public health

INTRODUCTION

As of September 13, 2020, at least 917,417 confirmed deaths and more than 28,637,952 cases of infections by Coronavirus disease 2019 (COVID-19) have been reported worldwide (1). Persistence of the disease is observed globally, with a resurgence of cases in Europe (11% more new cases over the last 7 days at the time of writing this article). Technical guidance[1] and public policies have varied across countries. However, about a third of the human population have been advised or constrained to stay home except for essential activities, and as a result nearly three billion people have endured lockdown (1). While pandemics are primarily a physical health concern, they also have a massive impact on social and mental health. During a lockdown characterized by uncertainty regarding the future, being unable to have a normal personal and interpersonal life creates an unstable and potentially anxiety-producing and threatening environment (2, 3). Public health concern regarding the potential detrimental effects of long-term lockdowns on mental health therefore have recently surged in interest (4).

In particular, issues linked to alcohol consumption are of primary importance; previous scientific claims having indicated the risk of a significant public health crisis in the future due to increased alcohol consumption during the lockdown (5–7). Perceived stress is indeed known to be an important factor in the development and maintenance of an alcohol use disorder, particularly among young adults (8). A recent French study showed that the COVID-19 lockdown was associated with a substantial proportion of participants reporting increased intake of high-caloric or salty food as well as online activity and consumption of tobacco, alcohol, and cannabis (9). Furthermore, these individuals shared several additional features, including increased stress. Consistent with this, recent data on a French sample from an European study (10) showed that psychological distress occurred in a third of respondents during lockdown. However, vulnerability to the epidemic (e.g., susceptibility to contracting COVID-19) did not appear to be a major determinant of psychological distress during the lockdown. Because a rapid daily environment degradation can have a negative impact on mental health (11, 12), this sudden increase in environmental pressure causing major uncertainties and adverse emotional experiences is likely to promote potentially harmful coping strategies and foster risky behavior.

College students are particularly vulnerable to stress-related disorders (12) or addictive disorders (13). Currently, a large body of literature has shown that students are at high risk for alcohol abuse and alcohol use disorder (14, 15). In addition, college students are at a particularly precarious time of their life (16–18), with limited financial resources and therefore likely to be living in stressful and perhaps highly dense housing conditions during the lockdown. Moreover, university students have had to adapt to an unprecedented shift in remote teaching and exams, which has also likely contributed to increasing their perceived stress level. As a result, they are at an increased risk of developing addictive behaviors, particularly problematic alcohol consumption (18). Students who use alcohol have been shown to be at greater risk of developing an addiction when exposed to daily stressful situations (19). However, to our knowledge, no studies have examined the addiction-related behaviors of students who use alcohol during an intensely stressful event.

Here, we evaluate the perceived stress related to the COVID-19 pandemic and lockdown in a sample of students who indicated being alcohol consumers before lockdown.

We are interested in the effect of lockdown-induced stress on students' drinking behavior. In view of the effects of stress on self-regulatory behavior, high stress should be associated with an increase in alcohol consumption among students, but not necessarily with the emergence of addictions to new substances (20, 21). Thus, this population is particularly at risk of developing self-regulation difficulties in stressful situations. Recent theories of self-regulation do not make it possible to identify the extent to which these self-regulation difficulties could influence other addictive behaviors in this population. For this, we assessed factors associated with perceived stress and addictive behaviors prior to and during lockdown.

It was hypothesized that during the first week and the 15 subsequent days of lockdown after the survey, addictive behaviors would be associated with the level of perceived stress related to the COVID-19 pandemic and the lockdown, but also to addictive behaviors as assessed prior to lockdown.

We conducted a survey in a population of students who indicated they engaged in alcohol consumption prior to lockdown, and assessed (i) characteristics of participants,

[1]Here, technical guidance refers to advice given to the population in France to curb the pandemic at the level of individual behaviors (e.g., coughing into one's elbow, respecting social distance, how to put on a mask), while public policies refers to collective aspects of health policy (e.g., lockdown, telecommuting, closing of restaurants, and non-essential shops).

conditions of the lockdown and the resulting change in lifestyle and social support; (ii) characteristics of students' addictive behaviors before lockdown; (iii) perceived stress related to fear induced by COVID-19, the conditions of the lockdown and exposure to media; (iv) levels of anxiety and depression during this period; and (v) addictive behaviors during lockdown. Specifically, we explored alcohol, tobacco and cannabis consumption in addition to gaming, internet use and problematic eating behaviors (compulsion or restriction) during the first week of lockdown and the intention the following 15 days after the survey. Furthermore, we explored whether student profiles would appear as a function of their level of perceived stress, with variables of interest contributing the most to different levels of perceived stress, thus allowing us to identify potential risk factors.

METHODS

Participants and Procedure

The present study was an ancillary project drawn from a larger database; this database was previously examined (22) to show the impact of stress factors induced by COVID-19 on problematic eating behaviors for all students in the database. An online questionnaire was sent to students of four French universities (University of Clermont Auvergne, University of Picardie Jules Verne, University of Paris Nanterre and University of Grenoble-Alpes) and distributed over a single 2-day period, from 26 to 27 March 2020 (The beginning of the lockdown was declared on 17 March, 2020). The STROBE guidelines were used to ensure the reporting of this cross-sectional study (23).

Students were contacted via the university digital work environment of the University Clermont Auvergne (37,367 students), the University of Picardie (30,288 students), and Paris Nanterre (500 psychology students). The survey was also shared on the Facebook page, "University of Grenoble Alpes" (4,626 views). The number of students potentially targeted by this survey was 72,781. All participants responded anonymously. Since there is no strict exclusion criterion in the literature on alcohol consumption and since we tried to have the broadest sample possible, our inclusion criterion was all participants who drink alcohol occasionally or regularly (24). Participants were asked the question "Do you drink alcohol at all? Participants who answered "yes" were then given the AUDIT and the questions on alcohol consumption. Only students who reported drinking were included in the analyses. This study was approved by the Ethics Committee of the University of Clermont Auvergne.

Measures

The online questionnaire gathered the following data: Sociodemographic characteristics (characteristics included age, gender, whether the student had a scholarship (for financial need) and level of education), level of social support, perceived stress, level of anxiety and depression, lockdown and COVID-19-specific information, addictive behaviors before lockdown, and addictive behaviors during lockdown. **Table 1** describes the instruments used to obtain these data.

Statistical Analyses and Measures

First, descriptive analyses were performed, and only students who reported drinking were included in subsequent analyses. Descriptive analyses were performed according to the level of perceived stress assessed with the PSS10, which was categorized into three groups: low (score inferior or equal to 32.5), medium (score between 32.5 and 65 included), and high stress (score superior to 65). To assess the impact on student stress levels, demographic and other characteristics described above were compared for medium and high stress groups with the low stress group, using a univariate mixed-effects multinomial logistic regression with university as random effect to consider variability between and within each university. Then, to evaluate a model in which all the variables can significantly modulate the level of perceived stress, multivariable analysis was carried out, and covariates were selected according to univariate results and clinical relevance. For multiple comparisons, variables were included in the multivariable regression (i.e., the multilevel mixed-effect multinomial logistic model) when they were significant in univariate for a type I error at 0.005. Close attention was paid to examining multicollinearity and interactions between covariates: (1) studying the relationships between the covariables, (2) estimating the variance inflation factor, and (3) measuring the impact of adding or removing variables in the multivariable model. For the multivariable analysis, we set the level of significance at 0.05, applying a Sidak's type I error correction due to multiple comparisons (low stress vs. medium and low stress vs. high). The results were expressed as coefficients and 95% confidence intervals.

Finally, multidimensional analyses as a factorial mixed data analysis (FMDA) were performed (i) to illustrate student profiles according to the level of perceived stress and (ii) to highlight potential factors associated with perceived stress. These statistical methods were useful for analyzing assets as elements of qualitative and quantitative variables in order to uncover the underlying relationships and structures of the variables measured (latent constructs) and to aggregate subjects into clusters such that each cluster represents a topic.

Analyses were performed with Stata 15.0 (StataCorp, College Station, US) for random-effects models and software R (package ade4) for factorial analyses.

RESULTS

In total, 5,738 students (women = 74.2%, mean age = 21.2, SD = 5.17) from four French universities participated in this study (see **Table 2**). The response rate of the survey was 7.9%. Two thousand seven hundred sixty students reported alcohol use (48% of the total sample) and were included in subsequent analyses (women = 70,1%, men = 21.3, SD = 4.71).

TABLE 1 | Description of assessments used in this study.

Dimensions	Scale	Description	Range score
Social support	Social provisions scale scores, SPS10 (25)	The SPS10 assesses five forms of social provisions with 10 items: attachment, guidance, social integration, reliable alliance, and reassurance of worth. Each item is rated on a four-point Likert scale	A continuous scale score is computed from the responses to the 10 questions. Higher scores can be interpreted as indicating higher levels of social support
Perceived stress	A French version of the visual analog scale of the Perceived Stress scores, PSS10 (26–28)	The PSS10 evaluates the degree to which an individual perceives life as unpredictable, uncontrollable and overloading. The PSS10 also assesses the degree to which external demands seem to exceed the individual's perceived ability to cope	A score on the scale below 21 indicates that the person knows how to manage stress (less stress group), while a score between 21 and 26 indicates that the person knows most of the time how to manage stress (mild stress group). A score above 27 indicates that life is a perpetually threatening environment for the person (high stress group). We used the same categorization adapted to the version of the scale used in this study (*inferior to 32.5 for low, between 32.5 and 65 include for mild stress group and superior to 65 for high stress group*) (26)
Level of anxiety and depression	Hospital Anxiety and Depression scale, HADS (29)	The HADS is a 14-item measure of state-anxiety and depression	Each item is scored from 0 to 3, with higher scores indicating greater anxiety or depression
Lockdown and COVID-19-specific information (see **Appendix A** for more details)	- Two scales were developed: (i) A specific, 13-item scale of stressors associated with COVID-19 and the lockdown (ii) A media exposure to COVID-19 and health information scale (5 items). - Data on conditions of lockdown was also assessed	(i) This scale assesses specific lockdown concerns (11 items) and concerns about being infected by COVID-19 for oneself or loved ones (2 items). (ii) This scale assesses specific media exposure to COVID 19 - Condition of lockdown included the number of children under 12 and the number of adults with whom the respondent is confined and the type of their housing (personal housing with no roommates, apartment-sharing, university dormitories, at their parents' house). Having a loved one infected, hospitalized or deceased because of COVID-19 was also accessed (This score is calculated from 0 to 3 by summing each category)	(i) This scale is rated from 0 to 6 per item, with 0 being the lowest stress level and 6 the highest. An average score is calculated by the mean of the rate of each item. The total score ranges from 0 to 6. (ii) This scale is rated from 0 to 4 per item, with 0 being the lowest stress level and 4 the highest. The total score ranges from 0 to 4. An average score is calculated
Addictive behaviors before lockdown	- Fagerström test (30) for tobacco, - Alcohol Use Disorder test (AUDIT) scores for alcohol (31), - Cannabis Abuse Screening Test (CAST) (32) for cannabis, - SCOFF (33) for food compulsion and restriction - body dissatisfaction and impulse regulation subscales of the Eating Disorder Inventory, 2nd edition (EDI2) (34), - Internet Gaming Disorder Scale (IGDT10) (35) and the Compulsive Internet Use Scale (CIUS) (36) for internet use disorders	Validated scales	Higher scores indicating greater problematic addictive behavior
Addictive behaviors during lockdown (see **Appendix B** for more details)	A self-developed questionnaire about Addictive behaviors during lockdown	Behaviors were determined using a developed questionnaire about the quantity of substance used on a daily or weekly basis (alcohol, tobacco, or cannabis). Data on time spent playing and/or being on the internet as well as eating habits were collected for the past 7 days and on participants'intentions for the next 15 days	Higher scores indicating greater problematic addictive behavior.

TABLE 2 | Intrinsic characteristics of the study participants.

	Intrinsic characteristics
	Mean (SD) or *n* and %
N	5,671
Age	21.2 (4.50)
Gender	1,431 (25.4%)
Women	
Men	4,210 (74.6%)
Scholarship	2,766 (48.8%)
Yes	
No	2,905 (51.2%)
Education levels (only *N* were reported) compared with 1st year	1,862 (32.8%)
1st year (L1)	
2nd year (L2)	963 (17%)
3rd year (L3)	979 (17.3%)
4rth year (M1)	586 (10.3%)
5th year (M2)	478 (8.4%)
Doctorate/PhD	177 (3.1%)
Advanced Technical or Marketing Degree (BTS/DUT)	353 (6.2%)
IUT (3-year course–University Institute of Technology)	273 (4.8%)
SPS10	3.38 (0.482)
HADSA	8.97 (4.35)
HADSD	5.6 (3.56)
PSS	1,174 (20.7%)
Low stress	
Mild stress	2,843 (50.1%)
High stress	1,655 (29.2%)

Relationship of Demographic, Lockdown, and COVID-19-Specific Information, and Addictive Behaviors Before and During Lockdown With the Level of Perceived Stress

The characteristics of the population are reported in **Table 3**, and only variables with p-values below 0.005 are displayed. Five hundred and ninety-eight (22%) students had a low level of perceived stress, 1,405 (51%) had a mild level of perceived stress, while 757 (27%) had a high level of perceived stress.

Women comprised 49.8% ($N = 295$) of the low stress group compared with 71.85% ($N = 1{,}003$) in the mild stress group (95% CI, 0.75 to 1.15, $p < 0.001$) and 82.9% ($N = 622$) in the high stress group (95% CI, 1.35 to 1.85, $p < 0.001$).

The Mild Stress Group vs. the Low Stress Group

Compared to the low stressed students, mildly stressed students included a higher proportion of women, had a higher Hospital Anxiety and Depression scale–HADS (37) score for both anxiety (95% CI, 0.31 to 0.39, $p < 0.001$) and depression (95% CI, 0.19 to 0.28, $p < 0.001$) and indicated less social support (95% CI, −1.04 to −0.54, $p < 0.001$). This level of stress was also associated with stress about the lockdown, worries about lifestyle changes due to confinement (95% CI, 0.59 to 0.80, $p < 0.001$) and concerns about potential infection for a close relative (95% CI, −0.26 to −0.15, $p < 0.001$). A significant effect of media exposure on perceived stress was also found (95% CI, 0.174 to 0.520, $p < 0.001$). Regarding pre-lockdown addictive behaviors, a higher Cannabis Abuse Screening Test (CAST) (38) score (95% CI, 0.19 to 0.87, $p = 0.002$), Compulsive Internet Use Scale (CIUS) (39) score (95% CI, 0.08 to 0.14, $p < 0.001$) and SCOFF (33) score (95% CI, 0.36 to 0.57, $p < 0.001$) was also found for the mild stress group compared to the low stressed group.

With regard to the addictive behaviors displayed during lockdown, students reported more compulsive eating over the past week (95% CI, 0.48 to 0.79, $p < 0.001$) as well as more intention to do so in the next 15 days (95% CI, 0.65 to 1.49, $p < 0.001$) for the mild stress group compared to the low stress group. More restricted eating in the last week (95% CI, 0.2 to 0.44, $p < 0.001$) as well as more intention to restrict eating in the next 15 days (95% CI, 0.20 to 0.39, $p < 0.001$) and more intention to play online gaming in the next 15 days (95% CI, 0.01 to 0.01, $p = 0.006$) was also found for the mild stress group compared to the low stressed group.

The High Stress Group vs. the Low Stress Group

Similar results were found when the low stress students were compared to the most highly stressed students, with the exception that the high stress group generally held more scholarships (95% CI, 0.10 to 0.54, $p = 0.004$). In this population, the most stressed students had a greater number of relationships affected by COVID-19 (95% CI, 0.08 to 0.39, $p = 0.003$). In addition, their Alcohol Use Disorder test (AUDIT) scores (40) was higher (95% CI, 0.04 to 0.09, $p < 0.001$), which was strongly related to the level of perceived stress as well as the Internet Gaming Disorder Scale (IGDT10) (41) (95% CI, 0.06 to 0.13, $p < 0.001$) and Fagerström (30) scores (95% CI, 0.11 to 0.37, $p < 0.001$).

Mixed-Effect Multinomial Logistic Regression Analysis to Identify Variables Linked With the Level of Perceived Stress

Using a multilevel mixed-effects multinomial model where all the previously significant variables were included as predictors, twelve independent variables were significantly associated with higher levels of stress (only comparisons between higher stress levels and lower stress levels are reported in this section; see **Table 4** for more details). Students with a higher level of stress were more likely to be women (95% CI, 1.18 to 1.93, $p < 0.001$). The level of depression and anxiety was higher among the most stressed students (depression: 95% CI, 0.21 to 0.33, $p < 0.001$; anxiety: 95% CI, 0.43 to 0.54, $p < 0.001$), who also had less social support (95% CI, −1.04 to −0.39, $p < 0.001$). Highly stressed students were more likely to worry about the lockdown (95% CI, 0.27 to −0.65, $p < 0.001$). Additionally, alcohol-related problems were stronger among the most stressed students (AUDIT score: 95% CI, 0.02 to 0.09, $p = 0.004$) as well as eating problems (SCOFF score; 95% CI, 0.04 to 0.36, $p = 0.016$) and problematic use of the internet (CIUS score; 95% CI, 0.06 to 0.14, $p < 0.001$).

TABLE 3 | Participants characteristics by perceived level of stress.

				Perceived stress scale category							
				Low vs. Mild				Low vs. High			
	Low mean (SD) or n and %	Mild Mean (SD) or n and %	High M (SD) or n and %	Coef.	*P*-value	95% CI		Coef.	*P*-value	95% CI	
N	598	1,405	757								
Intrinsic characteristics											
Age	21.6 (5.04)	21.3 (4.54)	21.2 (4.74)	−0.14	0.161	−0.033	0.005	−0.019	0.174	−0.037	0.006
Gender				0.951	<0.001	0.752	1.150	1.598	<0.001	1.347	1.347
Women	295 (11%)	1003 (37%)	622 (22%)								
Men	298 (11%)	393 (14%)	128 (5%)								
Scholarship				0.121	0.221	−0.072	0.315	0.320	0.004	0.103	0.536
Yes	252 (9%)	630 (23%)	378 (14%)								
No	344 (12%)	772 (28%)	378 (14%)								
Education levels (only *N* were reported) compared with 1st year											
1st year (L1)	155	416	239								
2nd year (L2)	93	225	120	−0.065	0.680	−0.374	0.244	−0.140	0.425	−0.482	0.203
3rd year (L3)	111	251	142	−0.129	0.391	−0.424	0.165	−0.145	0.383	−0.469	0.180
4rth year (M1)	60	171	87	0.114	0.525	−0.238	0.466	−0.007	0.971	−0.398	0.383
5th year (M2)	64	122	69	−0.304	0.097	−0.663	0.054	−0.320	0.117	−0.719	0.079
Doctorate/PhD	21	55	21	−0.033	0.905	−0.572	0.506	−0.441	0.177	−1.08	0.199
Advanced technical or marketing degree (BTS/DUT)	47	92	51	−0.323	0.116	−0.725	0.079	−0.359	0.118	−0.808	0.091
IUT (3–year course–University Institute of Technology)	47	73	28	−0.531	0.012	−0.945	−0.115	−0.934	<0.001	−1.447	−0.421
SPS10	3.57 (0.399)	3.44 (0.425)	3.28 (0.521)	−0.790	<0.001	−1.042	−0.538	−1.493	<0.001	−1.763	−1.224
HADSA	5.17 (2.74)	8.42 (3.45)	12.6 (2.95)	0.349	<0.001	0.308	0.389	0.646	<0.001	0.597	0.694
HADSD	3.36 (2.45)	5.15 (2.95)	7.96 (3.84)	0.237	<0.001	0.194	0.279	0.502	<0.001	0.454	0.550
Addictive behaviors before lockdown											
Fagerstrom	0.378 (0.780)	0.463 (0.841)	0.553 (0.886)	0.118	0.056	−0.003	0.240	0.239	<0.001	0.107	0.370
AUDIT	6.04 (3.80)	6.61 (4.66)	7.51 (5.57)	0.032	0.006	0.009	0.054	0.068	<0.001	0.044	0.092
SCOFF	0.883 (0.875)	1.31 (1.04)	1.80 (1.17)	0.464	<0.001	0.357	0.572	0.860	<0.001	0.742	0.978
IGTD10	2.33 (2.87)	2.72 (3.30)	3.50 (3.98)	0.038	0.017	0.007	0.068	0.098	<0.001	0.065	0.130
CIUS	6.84 (3.81)	8.59 (3.94)	9.86 (4.30)	0.113	<0.001	0.087	0.138	0.187	<0.001	0.159	0.216
CAST				0.527	0.002	0.186	0.868	0.644	0.001	0.278	1.010
Yes	46 (2%)	176 (6%)	105 (4%)								
No	550 (20%)	1226 (44 %)	651 (24%)								
Lockdown specific scales Number of children present during lockdown with the participant	0.134 (0.417)	0.141 (0.485)	0.150 (0.489)	0.027	0.803	−0.183	0.237	0.067	0.567	−0.163	0.300
Number of adults present during lockdown with the participant	1.94 (1.15)	1.92 (1.06)	1.91 (1.12)	−0.012	0.787	−0.100	0.075	−0.028	0.573	−0.127	0.070
Type of housing during lockdown (only *N* were reported) compared with personal housing											
Personal housing (no roommates)	292	689	377								
Apartment–sharing	75	187	91	0.054	0.727	−0.248	0.355	−0.063	0.716	−0.406	0.279
University dormitories	62	97	58	−0.381	0.032	−0.729	−0.033	−0.293	0.141	−0.683	0.097
Parents' house	169	432	231	0.029	0.803	−0.200	0.259	0.006	0.962	−0.249	0.261
Media exposure	1.98 (0.570)	2.10 (0.593)	2.18 (0.654)	0.347	<0.001	0.174	0.520	0.553	<0.001	0.364	0.741
Having a loved one infected, hospitalized or deceased because of COVID−19	0.451 (0.710)	0.510 (0.705)	0.585 (0.749)		0.176	−0.044	0.240		0.003	0.082	0.389
Stressors Lockdown	2.63 (1.107)	3.33 (0.904)	3.79 (0.901)	0.692	<0.001	0.588	0.797	1.269	<0.001	1.136	1.402

(Continued)

TABLE 3 | Continued

				Perceived stress scale category							
				Low vs. Mild				Low vs. High			
	Low mean (SD) or n and %	Mild Mean (SD) or n and %	High M (SD) or n and %	Coef.	*P*-value	95% CI		Coef.	*P*-value	95% CI	
Stressors COVID−19	3.25 (1.47)	3.77 (1.34)	3.99 (1.35)	0.247	<0.001	0.180	0.315	0.339	<0.001	0.260	0.417
Addictive behaviors during lockdown											
Drinking frequency last week	2.68 (1.33)	2.65 (1.32)	2.68 (1.32)	−0.014	0.706	−0.087	0.059	0.001	0.994	−0.081	0.082
Drinking quantity last week	1.60 (1.14)	1.82 (1.86)	2.03 (1.90)	0.091	0.025	0.012	0.170	0.110	0.011	0.026	0.194
Drinking intention next 15 weeks (Yes/No)				−0.021	0.828	−0.214	0.171	−0.033	0.763	−0.249	0.183
Yes	322 (12%)	768 (28%)	416 (15%)								
No	274 (10%)	634 (23%)	340 (12%)								
Drinking frequency intention next 15 days	1.44 (0.610)	1.49 (0.634)	1.54 (0.683)	0.133	0.213	−0.076	0.343	0.230	0.050	−0.001	0.460
Standard drinks per occasion intention	2.70 (2.39)	2.71 (3.09)	2.72 (2.36)	0.004	0.840	−0.032	0.039	0.004	0.825	−0.035	−0.035
Binge drinking frequency before confinement	1.30 (0.842)	1.27 (0.927)	1.31 (0.920)	−0.014	0.801	−0.120	0.092	0.039	0.520	−0.079	0.157
Binge drinking occurrence last week				0.055	0.870	−0.604	0.715	−0.434	0.209	−1.110	0.243
Yes	13 (less 1%)	30 (1%)	26 (1%)								
No	583 (22%)	1372 (50%)	730 (26%)								
Binge drinking frequency last week	0.0688 (0.442)	0.129 (1.68)	0.134 (0.662)	0.173	0.160	−0.068	0.414	0.176	0.157	−0.068	0.419
Virtual binge drinking (if binged last week)				−0.524	0.555	−2.262	1.214	−0.010	0.992	−1.864	1.846
Yes	2 (3%)	7 (10%)	4 (6%)								
No	11 (16%)	23 (33%)	22 (32%)								
Binge drinking intention next 15 days				−0.091	0.677	−0.518	0.336	−0.409	0.075	−0.859	0.0420
Yes	31 (1%)	80 (3%)	58 (2%)								
No	565 (21%)	1322 (48%)	698 (25%)								
Binge drinking frequency next 15 days	1.48 (1.19)	2.63 (6.96)	2.85 (3.46)	0.232	0.149	−0.083	0.548	0.239	0.138	−0.0770	0.556
Online gaming last week	29.2 (36.1)	28.8 (35.6)	33.6 (38.1)	−0.001	0.875	−0.003	0.002	0.003	0.029	0.001	0.006
Online gaming next 15 days	20.5 (29.2)	24.7 (30.9)	29.6 (34.8)	0.004	0.006	0.001	0.008	0.009	<0.001	0.006	0.012
Food compulsion last week	1.27 (0.629)	1.59 (0.843)	1.92 (1.000)	0.633	<0.001	0.478	0.788	1.007	<0.001	0.845	1.168
Food compulsion next 15 days	1.04 (0.189)	1.13 (0.415)	1.27 (0.589)	1.065	<0.001	0.646	1.485	1.607	<0.001	1.184	2.029
Food restriction last week	1.52 (0.934)	1.87 (1.09)	2.15 (1.20)	0.342	<0.001	0.239	0.444	0.556	<0.001	0.446	0.665
Food restriction next 15 days	1.59 (1.01)	1.93 (1.14)	2.28 (1.25)	0.292	<0.001	0.197	0.428	0.529	<0.001	0.387	0.631

Regarding addictive behaviors during lockdown, higher stressed students had more compulsive eating during the last seven days (95% CI, 0.21 to 1.19, $p = 0.005$) and anticipated playing more online games in the next 15 days (95% CI, 0.00 to 0.01, $p = 0.006$) than the low stress group.

Factorial Analysis

Three distinct profiles of students based on perceived stress level were identified in a factorial analysis (see **Figure 1**). Based on this approach, concern about the lockdown, worry about a family member or friend becoming infected with COVID-19, media exposure and being female contributed to the highest perceived stress (see **Figure 2**). This proposed model represented 71% of initial information. This higher stress group was also associated with more anticipated compulsive eating next week, the intention to engage in compulsive eating over the next 15 days and the level of anxiety. Addictive behaviors before lockdown (measured by AUDIT, Fagerström, CAST and IGDT-10) and intention to game online over the next 15 days contributed to mild perceived stress, while a high level of social support contributed to the low perceived stress level.

DISCUSSION

The aim of this study was to assess the perceived stress related to the COVID-19 pandemic and lockdown in a sample of alcohol-drinking university students, assessing addictive behaviors linked with perceived stress before and during lockdown. Our results showed that students were particularly stressed during this period: more than 79% indicated having difficulty

TABLE 4 | Results of a multivariate analysis of factors related to students' perceived stress level.

	Coeff	Std.Err.	*z*	*p*-value	95% confidence interval	
Mild stress						
_cons	−2.59	0.694	−3.73	<0.001	−3.95	−1.23
Intrinsic characteristics						
Gender	0.964	0.136	7.07	<0.001	0.697	1.231
Scholarship	0.019	0.117	0.16	0.872	−0.211	0.249
HADS-A	0.256	0.023	11.28	<0.001	0.212	0.301
HADS-D	0.106	0.026	4.14	<0.001	0.056	0.157
SPS10	−0.532	0.156	−3.42	0.001	−0.838	−0.227
Addictive behaviors before lockdown						
SCOFF	0.124	0.067	1.81	0.071	0.010	0.259
Fagerstrom	−0.060	0.076	−0.80	0.424	−0.209	0.088
AUDIT	0.032	0.015	2.13	0.033	0.003	0.061
IGTD10	0.016	0.025	0.62	0.538	−0.034	0.065
CIUS	0.064	0.016	3.87	<0.001	0.031	0.096
Lockdown-specific scales						
Stressors lockdown	0.290	0.071	4.08	<0.001	0.150	0.428
Stressors COVID19	0.042	0.047	0.88	0.380	−0.051	0.135
Having a loved one infected, hospitalized, or deceased because of COVID-19	0.076	0.086	0.89	0.375	−0.092	0.244
Media exposure	0.026	0.105	0.25	0.801	−0.180	0.233
Addictive behaviors during lockdown						
Compulsion next 15 days	0.515	0.232	2.22	0.026	0.060	0.969
Restriction last week	0.057	0.094	0.61	0.542	−0.127	0.242
Restriction next 15 days	−0.061	0.088	−0.70	0.487	−0.235	0.112
Online game next 15 days	0.005	0.002	2.13	0.033	0.001	0.010
High Stress						
_cons	−7.980	0.859	−9.29	<0.001	−9.664	−6.295
Intrinsic characteristics	1.557	0.192	8.10	<0.001	1.180	1.934
Gender						
Scholarship	0.128	0.152	0.84	0.399	−0.169	0.425
HADS-A	0.486	0.027	17.94	<0.001	0.433	0.540
HADS-D	0.274	0.030	9.03	<0.001	0.214	0.333
SPS10	−0.671	0.191	−3.51	<0.001	−1.045	−0.296
Addictive behaviors before lockdown						
SCOFF	0.200	0.083	2.40	0.016	0.036	0.363
Fagerstrom	−0.139	0.095	−1.46	0.143	−0.324	0.047
AUDIT	0.052	0.018	2.88	0.004	0.017	0.088
IGTD10	−0.002	0.021	−0.06	0.954	−0.063	0.059
CIUS	0.101	0.021	4.84	<0.001	0.060	0.142
Lockdown-specific scales						
Stressors lockdown	0.459	0.095	4.82	<0.001	0.272	0.646
Stressors COVID19	0.023	0.063	0.37	0.709	−0.099	0.145
Having a loved one infected, hospitalized or deceased because of COVID-19	0.082	0.108	0.76	0.45	−0.131	0.295
Media exposure	−0.003	0.134	−0.02	0.984	−0.266	0.261
Addictive behaviors during lockdown						
Compulsion next 15 days	0.700	0.250	2.80	0.005	0.210	10.190
Restriction last week	0.006	0.112	0.05	0.957	−0.214	0.226
Restriction next 15 days	0.002	0.106	0.02	0.983	−0.206	0.211
Online game next 15 days	0.008	0.003	2.75	0.006	0.002	0.014

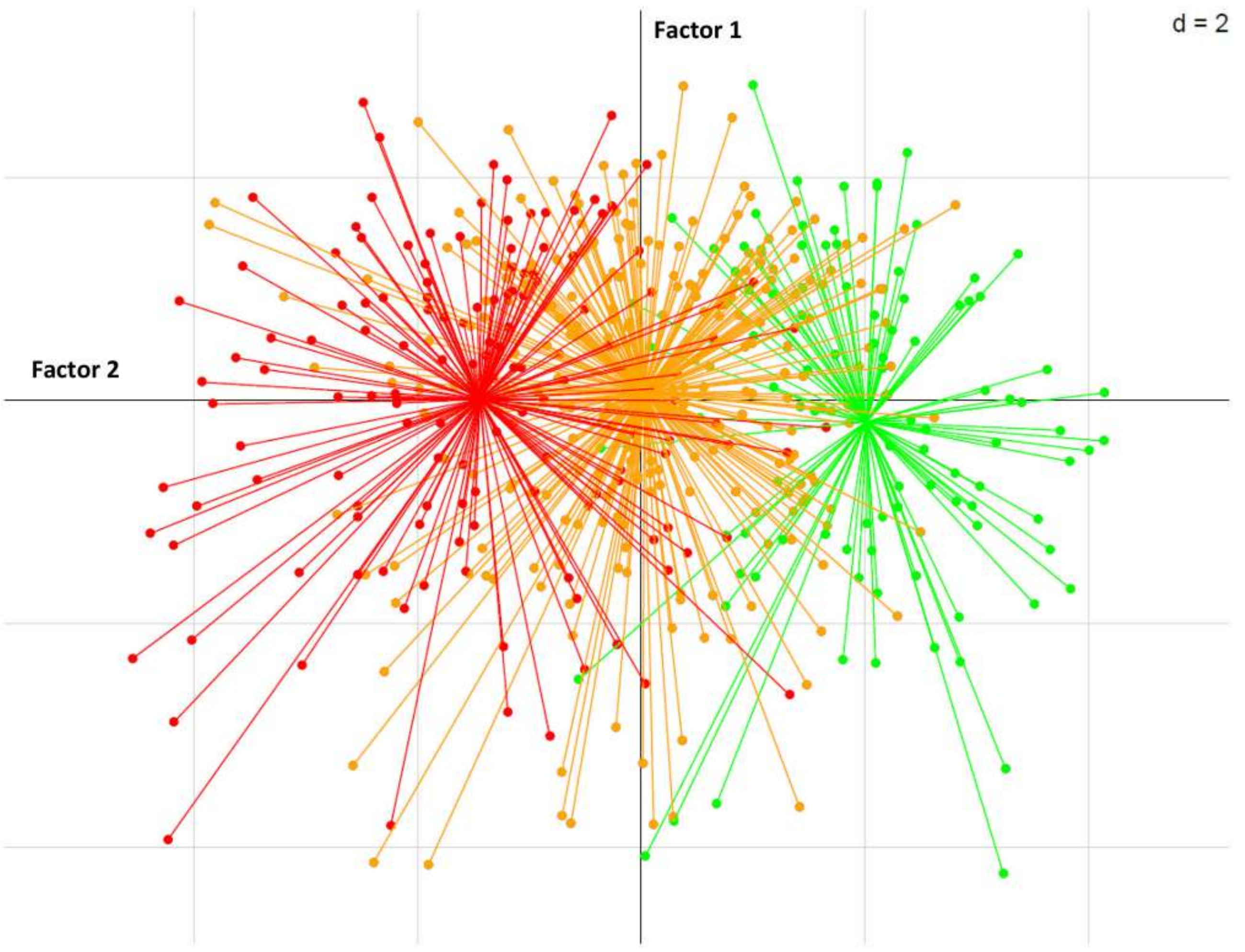

FIGURE 1 | Three distinct profiles of students based on perceived stress level, illustrated by factorial analysis. The red color corresponds to the high-stressed student, the orange to the midly-stressed student and the green to the low-stressed student. The length of the arrows indicates the magnitude of the relationship to the PSS scores, so the longer the arrow, the greater the magnitude.

managing stress. The level of stress was strongly related to four categories of variables: (i) intrinsic characteristics, (ii) addictive behaviors before lockdown, (iii) lockdown-specific conditions, and (iv) addictive behaviors during the lockdown. A factorial analysis distinguished three different group of students by their level of perceived stress based on a number of variables.

The level of perceived stress in this population is higher than what was reported in other studies conducted in the same age group, further emphasizing the impact of the pandemic context on mental health. One previous study conducted between 2009 and 2011 on a population of 1,876 students in France found that 25% of students had a moderate or high level of stress (37). It is striking to note that 75% of our population demonstrated a moderate or high perceived stress level. Our results are consistent with other studies that have collected data over a similar period, but in other countries around the world and on non-student populations. Notably, Kowal et al. (42) observed that being a woman, living in a collectivist culture, being single and living with children were associated with higher levels of stress. Higher stress in women appears to be observed robustly in other work (40).

Women reported a higher level of stress than men, underscoring the fact that they are at increased risk for psychopathology and maladaptive coping behavior (e.g., substance abuse). Women reported frequently more sensitive to stress and negative affect than men (38) but are less likely to use psychoactive substances to cope with stress (43). In addition, women can be more sensitive to reduced social support when social norms change substantially. Previous research has suggested that reducing tension associated with stress is a motivating factor for alcohol use (44, 45), and that this relationship may differ by gender (38). Gender schema theory, which asserts that individuals are socialized to adopt behaviors they perceive as gender congruent (39, 43), suggests that while men are encouraged to engage in alcohol use women are expected to use it less. Under the stressful conditions of

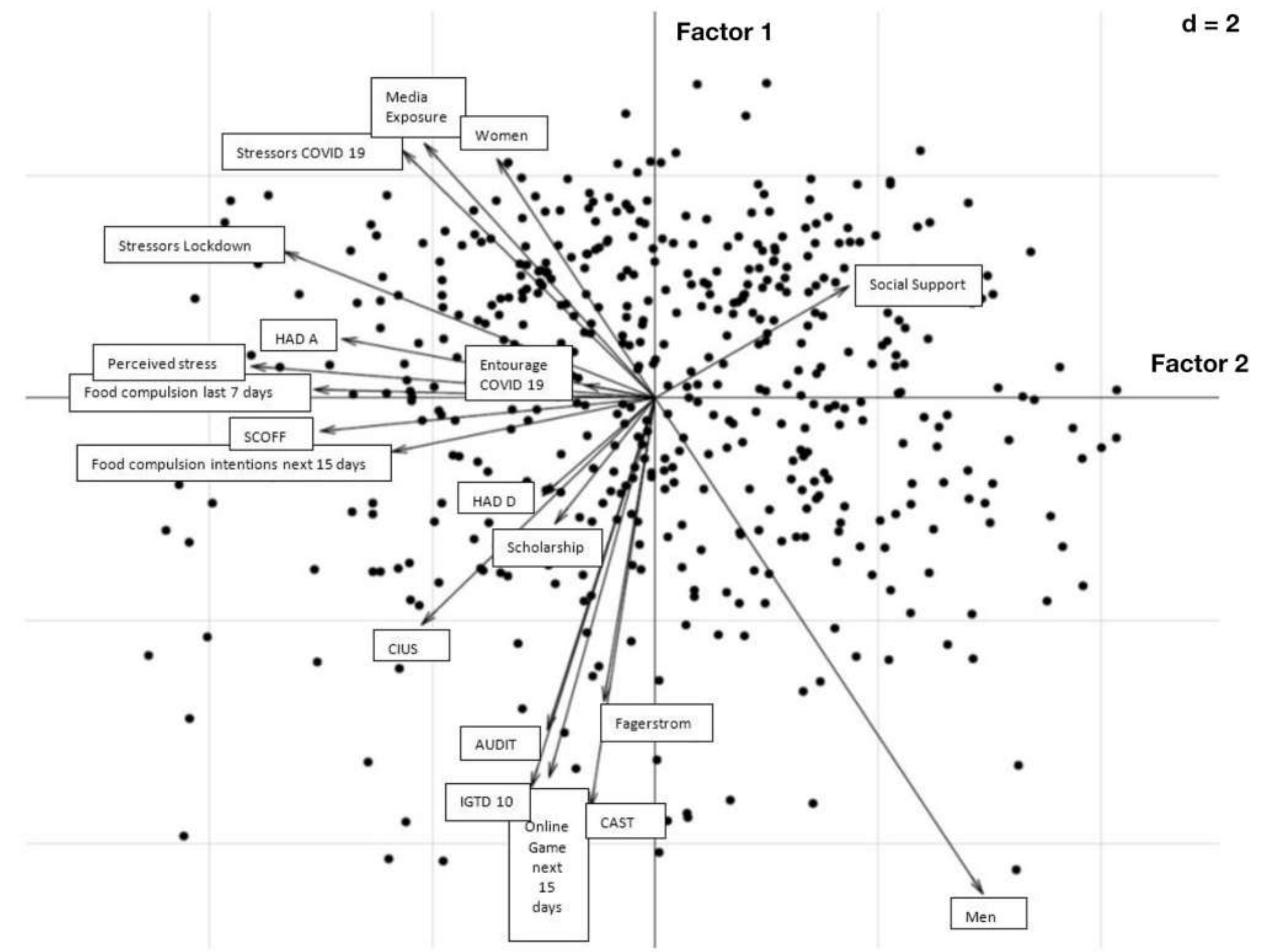

FIGURE 2 | Variables of the perceived stress level induced by the lockdown and addictive behaviors before and during lockdown in the student population, illustrated by factorial analysis. The length of the arrows indicates the magnitude of the relationship to the different scales so the longer the arrow, the greater the magnitude.

the pandemic, women may be able to respond to stress better via a pathological increase in food intake while men respond with increased alcohol consumption (46). This strategy may be augmented as social support is weakened (47). These results must be tempered by the fact that lower alcohol consumption among women under stressful and pandemic conditions is not a certainty. Recently Rodriguez et al. (44) suggested that psychological distress related to the COVID-19 pandemic was consistently related to alcohol use indices, significantly among women for number of heavy drinks. what should attract your attention in the Rodriguez study with respect to ours is that the average age (higher in this population [41.7 years of age (SD = 10.39)] as well as having children are risk factors for this use of alcohol.

Social support appears to be a major factor for resistance to stress. We observed that students with a higher level of social support experience lower stress levels. This is consistent with a recent study showing that the quality of offline social support constitutes a protective factor toward the development of excessive internet and social network involvement (45). Stress is therefore also dependent on the availability of social support and the effectiveness of coping strategies, (48). Hence, social support seems to be a plausible protective factor during lockdown.

During the first week of lockdown stress levels were not related to the level of financial precariousness of the students; whether or not a student had a scholarship for financial need had no effect on perceived stress. This might seem surprising since numerous studies have shown that social rank determines the rate of exposure to stressors (48). However, it is likely that this type of effect on stress could occur with a more prolonged stressful situation, and may be explained by the fact that this study was conducted in the first week of lockdown. A study exploring stress after several weeks of confinement could provide additional information on this.

Stress variables related to pursuing studies during the lockdown, such as worry about not being able to work or not succeeding professionally, were especially linked to the level of perceived stress. These conditions highlight the weight of the pandemic's uncertainties over the course of the academic year and the future of the student.

The level of perceived stress was not related to fears of contracting the disease. Similarly, perceived stress was not related to family or friends infected, hospitalized, or deceased from COVID-19. However, since the survey was conducted at the beginning of the confinement period, we cannot exclude that the number of people affected by COVID-19 was not large enough to sufficiently impact stress levels. The perceived stress of students is therefore more strongly related to the anticipation of consequences than to the actual consequences. Unexpectedly, media exposure to COVID-19-related information was not related to students' perceived stress levels.

In this study, we observed an effect of previous alcohol abuse on the level of perceived stress. These results are coherent with existing literature which has found that young adults with alcohol use disorders have more difficulty with stress management (49). However, there was no effect of tobacco consumption on the level of perceived stress. Additionally, cannabis use was not related to stress for students reporting using alcohol. Concerning addictive behaviors, heavy internet use was related to the perceived stress of students, which is in line with the compensatory internet use theory, which suggests that excessive involvement in online applications is displayed to escape negative emotions and psychopathological symptoms (50). Students consuming alcohol with dietary problems were also more sensitive to stress. Results showed that the level of perceived stress was strongly associated with a higher number of compulsive eating episodes in the previous week, suggesting that problematic eating can constitute a maladaptive coping strategy in a lockdown context. These results are in agreement with our study published on the same set of data, but on all students [see Flaudias et al. (22)]. Thus, one issue to consider is whether and under what conditions confinement associated with high stress can promote compulsive eating.

This study has several limitations. First, it is cross-sectional and does not allow for testing causal effects. Secondly, we explored our research questions with questionnaires created for the occasion and therefore without validation. We cannot exclude that the results could be different depending on the questions asked regarding the issues related to the pandemic. In addition, the participants are self-selected, which may have led to recruitment bias and therefore may not be representative. This choice was made based on self-regulation theories with a particular emphasis on the direct effect of alcohol on regulating capacities. Although this was not the focus of this paper, future research should not to limit oneself to this criterion limiting this selection bias. Nevertheless, the consumption data provided remains consistent with those found in national data (13). Finally, however, it is possible that including the covariates related to past problematic behaviors covered enough of the variance in common with our consumption measurements over the past week to statistically mitigate the effect.

To conclude, this study of student alcohol users shows that several variables linked to COVID-19 do not seem to be directly linked with perceived stress; however, stressors commonly linked to COVID-19 lockdown conditions (e.g., income and employment prospects, access to basic necessities, no access to social activities, etc.) were strongly associated with perceived stress. The increase in compulsive eating that students reported during lockdown suggests that students suffering from eating disorders constitute a high-risk population requiring more psychological support during and after the lockdown period. It is therefore urgent to implement preventive measures for this specific population to reduce the risk of persistent harmful eating habits once the pandemic has been resolved, especially for women, who are severely impacted by high stress.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by ethics Committee of the University of Clermont Auvergne. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

VF, OZ, MN, and GB participated to study concept, design, analysis, interpretation of data, statistical analysis, study supervision, wrote the initial draft of the article, and full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. BP and IC done analysis. P-ML, IC, LR, LS, LB, MN, and GB participated to analysis and interpretation of data. P-ML, IC, LR, LS, LB, CC, JB, SG, JC, LG, and BR reviewed the initial draft and participated in the writing of the final draft. All authors contributed to the article and approved the submitted version.

FUNDING

This paper was supported by an NIH NIAAA grant (R01 AA013750).

ACKNOWLEDGMENTS

All the authors would like to warmly thank Joël Billieux and Pierre Maurage for all their precious advice during the conception of this study, as well as for their feedback on the elements of this article.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.628631/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 09 February 2021
doi: 10.3389/fpsyt.2020.632405

Identifying New/Emerging Psychoactive Substances at the Time of COVID-19; A Web-Based Approach

Valeria Catalani[1]*, *Davide Arillotta*[1], *John Martin Corkery*[1], *Amira Guirguis*[1,2], *Alessandro Vento*[3,4,5] *and Fabrizio Schifano*[1]

[1] Psychopharmacology, Drug Misuse & Novel Psychoactive Substances Research Unit, School of Life & Medical Sciences, University of Hertfordshire, Hatfield, United Kingdom, [2] Swansea University Medical School, Institute of Life Sciences 2, Swansea University, Swansea, United Kingdom, [3] Department of Mental Health, ASL Roma 2, Rome, Italy, [4] Addictions' Observatory (ODDPSS), Rome, Italy, [5] Department of Psychology, Guglielmo Marconi University, Rome, Italy

COVID-19-related disruptions of people and goods' circulation can affect drug markets, especially for new psychoactive substances (NPSs). Drug shortages could cause a change in available NPS, with the introduction of new, unknown, substances. The aims of the current research were to use a web crawler, NPSfinder®, to identify and categorize emerging NPS discussed on a range of drug enthusiasts/psychonauts' websites/fora at the time of the pandemic; social media for these identified NPS were screened as well. The NPSfinder® was used here to automatically scan 24/7 a list of psychonaut websites and NPS online resources. The NPSs identified in the time frame between January and August 2020 were searched in both the European Monitoring Center for Drugs and Drug Addictions (EMCDDA)/United Nations Office on Drugs and Crime (UNODC) databases and on social media (Facebook, Twitter, Instagram, Pinterest, and YouTube) as well, with a content qualitative analysis having been carried out on reddit.com. Of a total of 229 NPSs being discussed at the time of the pandemic, some 18 NPSs were identified for the first time by the NPSfinder®. These included six cathinones, six opioids, two synthetic cannabinoid receptor agonists (SCRAs), two phenylcyclohexylpiperidine (PCP)-like molecules, and two psychedelics. Of these NPSs, 10 were found to be previously unreported to either the UNODC or the EMCDDA. Of these 18 NPSs, opioids and cathinones were the most discussed on social media/reddit, with the highest number of threads associated. Current findings may support the use of both automated web crawlers and social listening approaches to identify emerging NPSs; the pandemic-related imposed restrictions may somehow influence the demand for specific NPS classes.

Keywords: **COVID-19, new psychoactive substances, NPS, NPSfinder®, web crawler, drug misuse**

OPEN ACCESS

Edited by:
Ornella Corazza,
University of Hertfordshire,
United Kingdom

Reviewed by:
Simona Zaami,
Sapienza University of Rome, Italy
Laura Hondebrink,
University Medical Center
Utrecht, Netherlands

Correspondence:
Valeria Catalani
v.catalani@herts.ac.uk

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *23 November 2020*
Accepted: *23 December 2020*
Published: *09 February 2021*

Citation:
Catalani V, Arillotta D, Corkery JM, Guirguis A, Vento A and Schifano F (2021) Identifying New/Emerging Psychoactive Substances at the Time of COVID-19; A Web-Based Approach. Front. Psychiatry 11:632405. doi: 10.3389/fpsyt.2020.632405

INTRODUCTION

The COVID-19 pandemic has been considered as the worst global crisis after the global financial crash of 2007–2008 (1–3). This was caused by massive disruptions in goods' markets and restrictions imposed on individuals' movements (home confinement) followed by the total blocking of air and land travel (January–June 2020) (4). These primary measures generated a substantial economic burden at international, national, and community levels, forcing the general population to face psychological difficulties and behavioral changes (5–8). Of particular concern are people who use drugs (PWUDs) (9, 10). It is well-known how acute or chronic stress can have a pivotal role in the inception of substance abuse and in the worsening of substance use disorders (6, 11).

COVID-19 measures affected the illegal drug markets as well, from production, trafficking, and marketing through to availability and demand. These aspects have been affected in different ways across different countries, with the exception of the retail markets, which have undergone a more homogeneous change. Drug shortages, stockpiling, increase in prices, and reduction in purity were reported across the world (12). This was true especially for the more established drugs like cocaine and heroin, which are produced in specific areas of the world (e.g., South America and Afghanistan) and which rely on open legal commercial routes to be moved around (13). New psychoactive substances (NPSs) (14) encountered a different fate. A diversification of the market was expected between January and June 2020 (12, 15) due to shortages of treatment and classic opiate and opioid drugs (16) pushing users to synthetic available alternatives; lack of precursors for synthetic drugs diverting productions toward new NPS analogs; the economic problems and anxiety caused by the pandemic forcing PWUDs to use cheaper and seek more potent substances; and increased drug e-commerce that followed the restrictions of individual movements (12) facilitating the distribution of NPSs. The expected trend of PWUDs switching to and/or increasingly accessing counterfeit/unknown drugs online represents a serious health threat that should be investigated and monitored.

Monitoring of social media platforms could aid in identifying emerging NPSs during the COVID-19 pandemic. In recent years, social media increased their popularity as interacting platforms, in which users and suppliers of drugs can communicate freely, e.g., about price, purity, pharmacological/toxicological effects, way of administration, dosages of substances, with particular regard to newly introduced/synthesized ones. The analysis of available online information [qualitative analysis (17)] can be an effective tool to understand and identify consumers' needs and decisions and markets supplies and demands' balance. Overall, "social media listening" has been proven to be an effective tool for public health concerns (18).

The aims of the current research were to use a web crawler, NPSfinder®, to identify and categorize emerging NPSs discussed on a range of drug enthusiasts' websites/fora at the time of the COVID-19 pandemic; compare the NPSfinder® results with related listings from the European Monitoring Center for Drugs and Drug Addictions (EMCDDA) and United Nations Office on Drugs and Crime (UNODC) databases (19, 20); screen social media (Facebook, Twitter, Instagram, Pinterest, YouTube) for identified NPSs; and conduct a qualitative analysis (reddit) to better understand the drug market at the time of COVID 19 pandemic.

METHODS

Identification of Molecules

As better specified in Arillotta et al. (21), NPSfinder® is a crawling/navigating, password-protected, proprietary software, which allows registered researchers only to screen and classify the molecules being identified. Indeed, NPSfinder® automatically scans on a 24/7 basis a range of website addresses/uniform resource locator (URLs) for new/novel/emerging NPSs [see also (22, 23)]. When a novel substance is found, this is added to the growing NPSfinder® database. NPSfinder® was used here to facilitate identification of the range of NPSs discussed online from January to August 2020. Although one could argue that in January and February the European Union and the United States did not have any restrictions in place, the restrictions were at that time clearly in place in China (24), a country that has been suggested as being involved in the production/supplying of both synthetic drugs (NPSs) and synthetic drug precursors (4).

The scanned URLs were representative of online psychonauts' websites/fora and other NPS online resources (see **Appendix 1**). NPSfinder® was designed by Damicom, an information technology enterprise based in Rome (Italy), to extract a range of information regarding NPSs including chemical and street names, chemical formulas, three-dimensional images, and anecdotally reported clinical/psychoactive effects. The data extracted were automatically stored in an online, restricted-access/password-controlled database. The predominant language was English, but other languages were also considered: Spanish, German, Russian, Italian, Dutch, French, Swedish, and Turkish. From all the data extracted by the web crawler, the range of unique NPSs being identified was assigned to their NPS class, according to the indications taken from a range of literature papers (25–27).

Comparison Between NPSfinder®, EMCDDA, and UNODC Databases

To assess the possible novelty of NPSfinder® findings, the NPS molecules here identified for the first time by web crawler at the time of the COVID-19 pandemic were compared with entries available from both the EMCDDA's European Database on New Drugs (19) and UNODC Early Warning Advisory on NPS database (20). JMC, a registered user with authorized access to these databases, prepared the listing for the comparison. The comparison was conducted using the International Chemical Identifier Key (InChIKey) (28, 29).

Social Networks' Analysis

In order to better understand the online overall scenario of those NPSs first identified by the web crawler at the time of the COVID-19 pandemic, a range of social networks (e.g., Facebook; YouTube; Twitter; Instagram; Pinterest, reddit) were investigated as well. An observational qualitative analysis, in the time frame September–October 2020, was here performed, and these social networks were chosen because of their popularity, e.g., number of users. A similar approach has already been used by this research group in other studies (18, 21). A content qualitative analysis was conducted on reddit (30), which is a web-based platform that organize topics into fora known as subreddits, where each discussion is considered a thread. Reddit is well-known for its ability in engaging users and reporting good-quality information on a great variety of topics (30–33); these characteristics make this platform as a very popular source for social listening studies (34–37). Reddit fora entries are anonymous and voluntary. The subreddit called "r/Researchchemical" (38) was initially analyzed for the purpose of this article. "r/Researchchemical" is defined as the subreddit for the discussion of synthetic psychoactive research chemicals, also known as NPSs. When the threads were analyzed, the group had 94,000 members. The terms used for the search were the here newly identified substances, their chemical names, and street names. During the search, other subreddits were deemed relevant to the current study and were hence included in the qualitative analysis, e.g., "r/opiods.RCS," "r/stims," "r/noids," and "r/dissociatives" (39–42). Two independent researchers, with different backgrounds in qualitative research, analyzed independently all the relevant threads. The dataset analysis was conducted manually without the use of any software. The subreddits were screened after the analysis of the data provided by NPSfinder® was concluded and the new molecules identified; to allow optimal collection of qualitative data, no time restrictions were used for the reddit qualitative analysis.

TABLE 1 | Descriptive statistics of the 229 NPS identified from January to August 2020.

Total *n* of NPS identified = 229	
NPS class	**%**
Cannabimimetics	42.80
Opioids	11.35
Cathinones	10.9
Tryptamines	7.86
Gabaergics	7.42
NBOMes	6.55
Phenethylamines	3.93
Hallucinogens	3.06
PCP-like	3.06
PIEDS	1.31
Psychostimulants	0.90
Flys	0.44
Prescribed drugs	0.44

The molecules identified were divided by NPS class, and the percentage per class calculated.

RESULTS

The NPSfinder® web crawler has been active since November 2017 and to date reported a total of 4,335 NPSs found on the surface web. For this study, data were collected between January and August 2020. During this time frame, the web crawler identified a total of 229 substances (**Appendix 2**) as being discussed and commented by psychonauts; out of these, and after careful evaluation, 18 were recognized as previously unidentified and new to the NPSfinder®. Proper categorization and descriptive statistics were produced for these 229 molecules (**Table 1**); most popular NPS categories being commented on included synthetic cannabinoid receptor agonists (SCRAs), synthetic opioids, and cathinones.

The 18 newly identified molecules, categorized in line with both Abdulrahim and Bowden-Jones (25) and Schifano et al. (26), included six cathinones, six opioids, two cannabimimetics, two phenylcyclohexylpiperidine-like substances, one hallucinogen, and one tryptamine. In order to understand if these molecules were not only new but unique to NPSfinder®, a comparison with the UNODC and EMCDDA databases was made. As a result, 10 NPSs were identified as previously unknown/unreported (**Table 2**). For three of the six new cathinones (**Table 2**), no information on chemical structure or composition was available, and the molecules appeared here to be totally unknown.

All the 18 molecules identified were identified across a variety of vendor sites (56–59). Only few hits were obtained by the analysis of Facebook, YouTube, Instagram, and Pinterest, whereas on Twitter 7 of these 18 molecules were identified and commented on. Of these, four were identified on the seller's profiles only (MFPVP, MD-PV8, 5F-NPB-22, and nortilidine): two in posts/discussions (A-PCYP, 4F-MDMB-BICA), and only one was mentioned within a trip report (1F-LSD). Three molecules (5F-NBP-22, MFPVP, Etazene) were found on Facebook, Pinterest, and Instagram on the sellers' profiles, and only one (3-Cl-PCP) was found on YouTube (e.g., within a trip report).

Conversely, the outcome of the qualitative analysis conducted on the subreddits for these 18 substances provided here more comprehensive results. Across all subreddits, threads were found for all but two of the 18 molecules (i.e., HEP and 5F-NPB22). The subreddit called "r/Researchchemical" included most threads for all the NPS classes, although opioids seemed to be discussed more often on their dedicated subreddit ("r/opiods.RCS"). Overall, the threads/posts relating to these NPSs were entered by redditors starting in a period that range from 2018 to beginning of 2020; whenever possible, the first data post was here identified and analyzed. Overall, older threads were found to be less informative (e.g., in terms of effects, toxicity, dosage, and ways of administrations) than most recent ones. The threads focusing on trips, effects, and routes of administration seemed to attract the most interest, whereas most popular NPSs included opioids and cathinones, followed by PCP-like molecules and psychedelics.

The total number of threads focusing on opioids was 188, of which 84 were on brorphine and 85 on etazene. The oldest thread related to diphenpipenol and was dated August 2019, whereas most recent threads focused on both brorphine and etazene. Etazene presented with the highest number of posts associated with a thread, followed by brorphine and fluonitazene. Among the opioid threads, the highest number of posts was identified as those discussing/comparing several synthetic opioids, with particular attention to tolerance and dosages (**Table 3**).

The total number of threads identified for cathinones was 101, of which 70 threads were for A-PCYP only. The oldest thread was dated January 2019 for EBK-EBDP, whereas the most

TABLE 2 | List of NPS identified for the first time by NPSfinder® from January to August 2020.

NPS	Chemical family	Chemical name	Description	Previously unidentified NPS	NPSfinder® identification date
3M-4F-αPVP	Catinones	1-(4-fluoro-3-methylphenyl)-2-(pyrrolidin-1-yl)pentan-1-one	It is the 3-methyl derivative of 4F-alpha-PVP. Cathinones, which are structurally like 4F-α-PVP, cross the brain-blood barrier effectively (43). No information has been retrieved on its mechanism of action, but it is likely to affect the monoaminergic system, particularly the dopamine transport, as the 4F-PVP. It is a stimulant.	N	23/07/2020
4H-CMC	Cathinones	N.a.	Derivative of 4-CMC s a stimulant drug of the cathinone class.	Y	06/05/2020
MD-PEP/MD-PV8	Cathinones	1-(benzo[d][1,3]dioxol-5-yl)-2-(pyrrolidin-1-yl)heptan-1-one	MDPEP is a stimulant of the Cathinone class, which has been reported as a novel designer drug (44). MD-PEP is the methylendioxy derivative of α-PEP and the higher homolog of α-pyrrolidinohexiophenone (α-PHP), having an extra carbon on the alkyl side chain. No *in vitro* studies are available to assess the activity on the brain but based on previous work the longer alkyl chain may increase its potency (45).	N	06/05/2020
EBK-EBDP	Cathinones	N.a.	EBK-EBDP is probably a mixture of EBK, a new synthetic derivative of βk-EBDP/ephylone, and ephylone itself. On the website where the molecule was first identified by the NPSfinder®, C20H27FN2O3 was the molecular formula reported. The description was then changed to EBK alone. Other chemical formulas are available online for the same compound. It is sold as a potential strong stimulant with powerful psychotic effects.	Y	06/05/2020
HEP	Cathinones	N.a.	HEP belongs to cathinone and amphetamine chemical classes and it is the new HEX-EN replacement.	Y	06/05/2020
A-PCYP	Cathinones	2-cyclohexyl-1-phenyl-2-(pyrrolidin-1-yl)ethanone	A-PCYP is a stimulant drug of the cathinone class that has been sold online as a designer drug. In a series of α-substituted pyrrolidinyl cathinone derivatives developed in 2015, the α-cyclopentyl derivative was found to have around the same potency *in vitro* as an inhibitor of the dopamine transporter as the α-propyl derivative a-PVP, while the α-cyclohexyl derivative α-PCYP was around twice as strong (46).	Y	06/03/2020
4F-MDMB-BICA	Cannabimimetics	Methyl 2-[[1-(4-fluorobutyl)indole-3-carbonyl]amino]-3,3-dimethyl-butanoate	4F-MDMB-BICA is a synthetic cannabinoid structurally similar to 4F-MDMB-BINACA and 5F-MDMB-PICA. 5F-MDMB-PICA is explicitly a Schedule I substance in the United States; 4F-MDMB-BICA is not a scheduled substance (47).	N	23/07/2020
5F-NPB-22	Cannabimimetics	1-(5-fluoropentyl)-8-quinolinyl ester-1H-indazole-3-carboxylic acid	5-F-NPB-22 is an analog of NPB-22 that differs by adding a fluorine atom to the terminal carbon of the alkyl chain (48).	Y	13/06/2020
ETAZENE	Opioids	(2-[(4-ethoxyphenyl)methyl]-N,N-diethyl-1H-benzimidazole-1-ethanamine)	Etazene was notified as an NPS on 1 June 2020 by Poland (49). The substance belongs to the 2-benzylbenzimidazole group of synthetic opioid analgesics; It is less potent than isonitazene but still almost 70 time more potent than morphine (50, 51).	N	23/07/2020
METODESNITAZENE	Opioids	N,N-diethyl-2-(2-(4-methoxybenzyl)-1H-benzo[d]imidazol-1-yl)ethan-1-amine;	Metodesnitazene is a 2-benzylbenzimidazole. It is structurally related to etonitazene (Schedule I of the 1961 United Nations Single Convention on Narcotic Drugs), with the presence of an ethoxy group instead of the methoxy and the absence of the nitro group at the 5 position. The analgesic activity of the 2-benzylbenzimidazole appears to be related to the substitution at the benzyl moiety with para substitution showing higher activity (52).	N	23/07/2020

(Continued)

TABLE 2 | Continued

NPS	Chemical family	Chemical name	Description	Previously unidentified NPS	NPSfinder® identification date
FLUNITAZENE	Opioids	N,N-diethyl-2-[(4-fluorophenyl)methyl]-5-nitro-1H-benzimidazole-1-ethanamine	It is a novel opioid of the 5-nitro-2-benzylbenzimidazole family that shares the same structure as Clonitazene but with a fluorine atom instead of the chlorine in para to the phenyl ring.	Y	23/05/2020
BRORPHINE	Opioids	1-[1-[1-(4-bromophenyl)ethyl]-4-piperidinyl]-1,3-dihydro-2H-benzimidazol-2-one	Brorphine is a piperidine benzimidazolone (3-piperidin-4-yl-1*H*-benzimidazol-2-one). It shares structural similarities with the internationally controlled narcotic analgesic bezitramide and with the benzimidazole opioids isotonitazene and etazene. However, the latter cannot be considered close derivatives (49).	N	18/03/2020
DIPHENPIPENOL	Opioids	3-[2-[4-(2-methoxyphenyl) piperazin-1-yl]-2-phenylethyl]phenol	Diphenpipenol was invented in the 1970s by Dainippon Pharmaceutical Co (53). It is an opioid analgesic, derivative of 1-substituted-4-(1,2-diphenylethyl)piperazines. It is related to MT-45 and AD-1211, being the most potent compound in the series. The (S) isomer has 105 times the potency of morphine in animal studies (54). This makes it a similar strength to fentanyl and consequently diphenpipenol can be considered a threat to life expected to cause respiratory depression, sedation, itching, nausea and vomiting upon consumption.	Y	20/08/2020
NORTILIDINE	Opioids	ethyl-2-(methylamino)-1-phenylcyclohex-3-ene-1-carboxylate	Nortilidine is the major demethylated active metabolite of tilidine. The racemate has opioid analgesic effects roughly equivalent in potency to that of morphine (55). The drug also acts as a dopamine reuptake inhibitor (26).	N	20/08/2020
3-CL-PCP	PCP-like	1-[1-(3-Chlorophenyl)cyclohexyl]piperidine	3-Chlorophencyclidine (3-CL-PCP) is a dissociative anesthetic drug with hallucinogenic and sedative effects that has been sold as a research chemical. It has comparable potency to phencyclidine but slightly different effects. This is due to its altered binding profile at various targets, particularly being somewhat more potent as an NMDA antagonist while having around the same potency as a dopamine reuptake inhibitor.	Y	23/07/2020
3-F-PCP	PCP-like	1-[1-(3-Fluorophenyl) cyclohexyl]piperidine	3-F-PCP is a dissociative hallucinogen of the aryl cyclohexylamine class related to phencyclidine (PCP) which has been sold online as a designer drug. It is the fluorinated analog of the 3-MeO-PCP, substance listed in UK as Class B of the Misuse of Drugs Act (1971). No *in vitro* studies have been found for this compound but due to the similarity with 3-MeO-PCP it should act acts mainly as an NMDA receptor antagonist interacting with the sigma σ1 receptor and the serotonin transporter as well.	Y	23/07/2020
1F-LSD	Hallucinogens	(6aR,9R)-9-(diethylcarbamoyl)-7-methyl-6a,7,8,9-tetrahydroindolo[4,3-fg]quinoline-4(6H)-carboxylic acid	1-formyl-lysergic acid diethylamide is a chemical analog of ALD-52, which is a formyl group on position 1 instead of an acetyl. No information on potency is available.	Y	23/07/2020
5-CHLORO-DMT	Tryptamines	2-(5-Chloro-1H-indol-3-yl)-N,N-dimethylethan-1-amine	5-chloro-N,N-dimethyltryptamine is a novel, naturally occurring tryptamine found in certain species of deep marine sea sponges, including Smenospongia aurea and Smenospongia echina. It is closely related to 5-bromo-DMT. It was assayed for the *in vitro* serotonin binding receptors. It showed high nanomolar affinity to several serotonin receptors subtype. The highest affinity was observed	N	03/08/2020

TABLE 3 | Most popular reddit threads for each of the NPS classes identified by the NPSfinder® between January and August 2020.

NPS class	Total threads	Most discussed threads	No. of posts
Opioids	118	"Etazene Taper from Methadone Q's"	70
		"Etazene extinct?"	55
		"Brorphine and Metodesnitazene."	47
		"Fluonitazene"	35
		"A few Interesting Opioid Molecules I came up with and the respective Swiss Target Prediction"	63
		"which rc opioid?"	38
Cathinones	101	"Raning about A-PCyP"	68
		"a-PCyP: just say no to snorting it"	33
		"MFPVP/mf-pvp/3m-4f-pvp REPORT"	30
		"MDPEP (as known as MD-PV8) turns out do be a good replacement cathinone in terms of duration & effects similar to MDPV or MDPHP"	22
PCP-like	21	"3-F-PCP and World Domination—Phase Two Underway"	91
		"New Stuff's comin'-–3-F-PCP,"	81
		"3-chloro-pcp! it's really nice!"	50
		"My Initial Impressions of 3-CL-PCP"	32
Psychedelics	10	"1F-LSD 100 mcg (A New Lysergamide)—First Trip Report"	129
		"1F-LSD (150 μg sublingual): Novel lysergamide report"	80
Synthetic cannabinoids	5	"5-Bromo-DMT and 5-Chloro-DMT coming soon I think"	34
		"Warning 4F-MDMB-BICA caused 11 deaths in Hungary"	120
		"4f mdmb bica super potent"	16

The threads can be found in the following subreddits: "r/Researchchemical," "r/opiods.RCS," "r/stims," "r/noids," and "r/dissociatives".

recent focused on MFPVP. Most posts were associated with A-PCYP, commenting on trip reports and effects and routes of administration (**Table 3**). For the two PCP-like molecules, a total of 21 threads were identified with discussions that started in March 2020. The highest number of posts related to 3-F-PCP (**Table 3**). Some 10 threads were associated with the psychedelics 1F-LSD and 5-Cl-DMT; related discussions started in January 2019 for 1F-LSD (**Table 3**). Finally, only five threads were here associated with SCRAs; related discussions started in August 2020, and the latest one in October 2020.

A selection of anecdotal data from the related subreddits referring to the 18 NPSs' availability, desired effects, side effects, routes of administration, onset of action, etc., is reported in **Table 4**.

DISCUSSION

The present article provided a unique insight into the world of the NPSs being discussed online at the time of the COVID-19 pandemic. The results presented here for the activity of the NPSfinder® web crawler showed the importance of the web as an essential source to understand and assess the NPS phenomenon (60). Indeed, previous research from our group (21–23, 61) showed how the overall numbers of synthetic cathinones, opioids, benzodiazepines, and SCRAs identified online since the launch of NPSfinder® (November 2017) were higher than those reported to, and listed by, both the EMCDDA and the UNODC. Some 10/18 of the molecules here identified and commented online at the time of the pandemic were unknown/unreported NPSs (19), and this may highlight the potential of automated web crawlers to accurately describe the evolving drug scenarios.

The 18 molecules identified were distributed across the different NPS classes, roughly in line with international data (4, 62, 63). Conversely, in contrast with recent annual reports indicating an increase in designer/ "exotic" benzodiazepines' number, type, and availability (64, 65), these molecules did not feature here between those first identified by NPSfinder® at the time of the COVID-19 pandemic. One could, however, argue that with the COVID-related disruption of medical/health services (66–68), patients, as it has happened in the United Kingdom, may well have managed to get access to large prescription batches of prescription drugs, hence the decreased need to access the web for designer alternatives. Indeed, an increase in the consumption of prescription benzodiazepines has recently been reported (69). Of the 229 NPSs being discussed online at the time of the pandemic, however, synthetic opioids were featured just after SCRAs and were here one-third (e.g., 6/18) of those first identified by the web crawler at the time of the pandemic (49, 65).

While the data obtained from Twitter, YouTube, Facebook, and other social media were few and could not be used here as a solid base for data interpretation, the parallel qualitative analysis conducted on subreddits seemed to have well-supported the web crawler findings. A massive interest toward synthetic opioids was confirmed by the analysis of reddit entries, and this may have paralleled the shortage of heroin (4, 16, 70–72).

The development of new synthetic opioids could worsen the already worrisome worldwide opioid crisis (73–75). NPS opioids are very powerful analgesics, characterized by severe adverse

TABLE 4 | Information gathered from the qualitative analysis of reddit.com for the 18 molecules identified by NPSfinder®.

NPS	Description	Reddit threads time frame
Opioids		
Brorphine	Novel opioid/research chemical opioid of psychonauts' interest. It is actively discussed on forums with comparisons and trip reports	May 2019–October 2020
	"Looks like a bastard child of the active metabolite of bezitramide, and benzylfentanyl. Bezitramide was pulled off the market due to overdoses. This one makes me nervous, too close to fentanyl to be safe"	
	"It appears the therapeutic index is quite low, from anecdotal reports. Which means that the overdose level is not very much higher than the level needed to get high. I've also been told the high isn't great and is not very euphoric compared to many other opiates. I would stay far away from this stuff, and if you must use RC opioids, stick with the tried and true and relatively safe O-desmethyltramadol."	
Diphenpipenol	Novel opioid discussed by psychonaut with a potency and efficacy that are relatively low respect other novel synthetic opioids	August 2019–June 2020
	"It was total waste of money, completely inactive"	
	"Diphenpipenol review (…) It seems to be basically inactive. I have tried nasal vaping and iv use to no avail. Vaping doesn't work at all, burns product and smoke is extremely harsh on lungs. Burns a lot intranasally as well. Disappointed..."	
Etazene	Recently sold as designer drug and identified in June 2020. It is classified as novel opioid/research chemical opioid. It is a substance of interest to psychonauts.	November 2019–October 2020
	"it is a very strong opioid. It differs slightly in action from classic opioids. It is a molecular speedball. If you take little, you feel everything at once: euphoria, speed and relaxation. If you take more, euphoria is growing, but the opiate action profile is getting stronger, until you finally fall into opioid drowsiness. Compared to isotonitazene and fentanyl, it was hardly seen to cause respiratory depression."	
	"If you don't have an opioid tolerance and aren't an experienced opioid user, this is not one you would want to purchase. The reason it is dosed in nasal sprays is for volumetric dosing: basically you can be sure that each press of the nasal spray is a certain amount, and it can be in micrograms. The difference between fine and overdosed/dead is under 10 mg, which you can't even eyeball."	
Fluonitazene	Very scares information	May–September 2020
	"Some Chinese vendor spat out a new nitazene. Fluonitazene should be stronger than clonitazene, about 20–40x morphine. No idea if it's legit" (39).	
	"I went on a 23 h binge—the legs on this thing is pretty good, but it's also pretty sedating and not particularly euphoric. All in all, I had a good time, but I ran out just before the 24 h mark. I felt really sad afterwards, and depression-slept for 10 h straight, but after waking up this morning, I was glad that I threw most it out"	
Metodesnitazene	Recently sold as designer drug. It is classified as novel opioid/research chemical opioid. Even though there are a few trip reports, it is a psychonaut substance of interest	January–May 2020
	"meto-des-nitazene: Has a dosage like morphine. There are more interesting substances in this group. I do not recommend buying" (42)	
	"It wasn't until today, taking a 200 mg!! ……. that I felt anything………a minor codeine-like high right now. It started with minor warmth in the head, not the typical opioid warmth we know and love but like I had been out in the sun for 10 min. From there it only progressed a little bit, giving me a very minor and not strong high. In conclusion, this drug is absolutely not worth buying or looking into."	
Nortilidine	Recently sold as a designer drug, it is a tilidine active metabolite with potential attractive effects for psychonauts.	April 2018–July 2020
	"It's actually as strong as Morphine so it would be a worthwhile RC (…) I thought tilidine was a German speaking countries only thing. It's also marketed in Belgium Bulgaria and South Africa."	
Cathinones		
3M-4F-αPVP	Better known and mostly discussed on forums as "MFPVP" and widely traceable on the surface web (forums and sellers).	May-September 2020
	"R new flakka replacement….PURE PARANOIA on the comedown, its just awful without benzos, with them, its similar to a good amphetamine experience or Molly-like experience"	
	"MFPVP/4F-3M-PVP is worth a try It's actually surprisingly good, though pretty mild" (40)	
	"I noticed it is the only chem that vaping as an r.o.a doesn't just trigger a weird head pressure and make me annoyed! I didn't try oral, never really do for anything, although not that I say that I am wondering why! It is a very short lasting rush, even when IV'd (which is not really a good idea, especially if it'd new, but probably in general, but...self-destruction is human nature I guess. I find insuffliation to be the best happy medium, vaping does seem to add side effects to almost every chem (Hexen especially), but is likely specific to the individual as most effects appear dependent upon. Njot quite sure of dosage"	

(Continued)

TABLE 4 | Continued

NPS	Description	Reddit threads time frame
4H-CMC	Unknown compound	June 2019
	"Any experience with/knowledge of 4H-CMC?........ the only information they're giving is that 'it's not 4-CMC.' Request for an IUPAC was not met."	
A-PCYP	A very well-known, discussed and apparently appreciated cathinone. Info are available on various websites (e.g., Isomer Design, Wikipedia), on social networks and vendor websites	November 2019–September 2020
EBK-EBDP	Unknown compound	June 2019
	"A blend of two relatively novel compounds needs purification. EBK (BK-EBDP analo) + Eutylone blend. Any ideas how to do this?"	
HEP	No information on the web retrieved.	N.a.
MD-PEP/MD-PV8	Substituted cathinone traceable in some surface web vendor website. Apparently mostly unknown to the psychonauts. According to some users, probably it is "MD-PV8" or a "MD-PHP analog" and it is shipped from China.	May 2019–April 2020
	"MDPEP waste. MD PV8 cytotoxic almost 0 euphoria don't try!)"	
	"It's less potent, less euphoric and more dangerous than most other pyros. There was a guy that died from consuming 800 mg in one night"	
Cannabimimetics		
4F-MDMB-BICA	Described on some vendor websites. Sold as synthetic cannabinoid. User feedback not available on surface web.	August–October 2020
5F-NPB-22	Described on some vendor websites. Sold as synthetic cannabinoid. User feedback not available on surface web.	N.a.
PCP-like		
3-CL-PCP	Psychonauts seems to be interested in it. Few trip reports, being a new chemical. Widely traceable on the surface web on vendor websites and some social media.	July–October 2020
	"3-chloro-pcp! it's really nice! So I tested 3-cl-pcp and it is similar to 3-meo-pcp with the hypomania and stimulation, but also has a really comfy calm euphoria similar I believe if Im remembering correctly to ketamine. Lasts like 6 h with stimulation for longer. but the stimulation is nice this time imo. 25 mg is a very mild dose. 60 mg was really fun! IT IS WAAAAY BETTER THAN 3-FLUORO-PCP!"	
3-F-PCP	Various trip reports so far. PCP related substance, it has intrigued psychonauts since its introduction on the market.	March–October 2020
	"3 fluoro pcp is amazing. Got a sample of this last week with another order from china. And wow (…) It is one of the cleanest, clearest, smoothest euphoria from any disso I have tried (and I've tried em all basically) Its stimulating yet relaxed. Chill yet energizing. Not confusing in the least. Highly recommend trying this chemical whenever you can get your hands on it. ROA was IV in dosages of 5–15 mg"	
	"30–40 mg orally is where it becomes enjoyable (…) Ummm like if they wanted to make a tame version of pcp for hospital anesthesia without totally tripping people out at the same time (…) Lasts about 2–3 h, but leaves you with a really long lasting stimulation which can be either bad or good depending on the situation."	
Psychedelics		
1F-LSD	Little data so far. It seems to be a psychonauts' substance of interests, especially for those who like to enjoy psychedelic trips	January 2019–October 2020
	"It had a distinct visual character—while for me many other lysergamides create aforementioned discrete and distinct contained visuals following animal forms and resembling various kinds of indigenous American art, 1F-LSD had a character of more organic, free flowing visuals, with less color. The headspace was subtle and euphoric, given to earnest but pleasant and merciful introspection, with a lot of holistic reflection on contentedness and the passage of time."	
5-CHLORO-DMT	Not relevant info yet.	February–October 2020
	"There are a couple of vendors which sell these two tryptamines now, but there hasn't been any trip report about 5-Chloro-DMT released yet and there are only two reports about 5-Bromo-DMT"	

The subreddits analyzed were "r/Researchchemical," "r/opiods.RCS," "r/stims," "r/noids," and "r/dissociatives". (Note: Current anecdotal data refer to a range of redditors' entries which may be contribute to illustrate the level of the debate relating to the index NPS; no editing has been carried out).

effects such as abuse liability and respiratory depression (21). Although none of the opioids first identified by NPSfinder® at the time of the pandemic was a structural analog of fentanyl (76, 77), all potentially present with a similar threat to public health (63) and are reported to be far more potent than morphine (50, 54, 55). New synthetic opioids were derivatives of different chemical families, such as 2-benzylbenzimidazole and 1-substituted-4-(1,2-diphenylethyl)piperazines. Diphenpipenol, for example, presents with a similar strength to fentanyl, although was anecdotally reported here as "inactive" and "a total waste of money." It is possible that, although advertised as diphenpipenol, the actual compound made available for purchase was one of its structural isomers with a much weaker opioid activity (78). The recent emergence of this group of opioids may suggest a step back from fentanyl, arguably as a result of control measures introduced in the United States and China in 2019 (51).

The synthetic cathinones' group was followed here in terms of popularity on reddit. Differently from the synthetic opioids, this result is slightly unexpected. In line with the increase reported in the number of newly identified cathinones for 2019 (63), three of the six cathinones identified as first discussed at the time of the pandemic were previously unknown. Furthermore, we recorded here an intense increased vendors' activity to possibly counteract, with cathinones, the threatened/expected shortage of cocaine (13). However, the possible presence on the market of these new compounds is a reason of concern, because of their well-known severe side effects (e.g., paranoia, cognitive impairment, hallucinations, violence, and suicidal thoughts) (79, 80) that could worsen existing depression and trigger low mood induced by COVID-19 (6).

Psychedelic and PCP-like molecules, despite being lower in number compared to the other chemical classes identified, were also discussed at the time of the pandemic. One could argue that these categories of drugs, indeed very popular within the psychonauts' niche scenario (81, 82), were self-administered in a private context, helping to evade the stress, discomfort, and uncertainties associated with COVID-19.

Limitations

It must be emphasized here that the NPSfinder® crawling activity and the further manual analysis was conducted here only on the surface web. Further studies from our group will focus on the deep web and darknet, as there may be more information in the hidden web (83). Moreover, the present NPSfinder® findings related mostly to psychonaut and vendor websites and may not represent the entirety of those NPSs debated/discussed/mentioned online. Furthermore, one could argue that of the 18 new NPSs identified here, only 10 were not in EMCDDA and UNODC databases at the time of the analysis, and hence only 10 were new. Conversely, as in previous articles (21–23), we thought that it was useful to provide the reader with comparison of current with existing data at the time of the analysis provided by reliable NPS databases such as the EMCDDA and UNODC. Although eight NPSs were already identified by these databases, they were discussed online by the psychonauts at the time of the pandemic, and hence they were grouped together with the "new" ones. Of course, because of a range of methodological differences, it may happen that not all the substances reported by the UNODC and the EMCDDA are identified by the NPSfinder, and *vice versa* (22). However, the evaluation of the NPSfinder performances was beyond the scope of the current article.

Regarding the qualitative analysis, one could argue that people posting on the subreddits may not be representative of the wide community of PWUDs or high-risk groups (e.g., homeless, individuals from deprived areas, adolescents/youth, etc.). Another limitation related here to the sole use of English as the language chosen for the reddit analysis; this may have been associated with levels of loss in data collection. Languages such as Chinese, Japanese, and Arabic were not here included in the NPSfinder® searches, but this will occur in future works. Qualitative methods are at times generally questioned for reliability and objectivity. Finally, the analysis of data originating from the subreddits was conducted manually without the use of any *ad hoc* software, and this may have introduced levels of bias. To overcome this issue, two professionals separately analyzed here the data.

CONCLUSIONS

The analysis of the web presented here has a potential to identify a range of new and previously unidentified/unreported NPSs, with the chance of providing information on current drug trends. The ability of monitoring the net had been proven useful in detecting possible changes in the online drug markets that can reflect the real-world situation during such unprecedented times.

The 18 new NPSs identified in this study, and the related threads analyzed here, showed an appetite for synthetic drugs during a period of negative economic trend imposed by the COVID-19 pandemic. Results from the qualitative analysis on reddit confirmed how opioids represented the most discussed class of NPSs and the one that should keep getting more attention from international health and regulatory bodies. We noticed that while some of these opioids made their first appearance in redditors' discussions before COVID-19, related posts and experiences increased during the first semester of 2020. One could argue that present findings may be consistent with the observation that, in times of stress and crisis, PWUDs prefer drugs that can be used/experienced in solitude to escape the anxiety, boredom, uncertainty, and discomfort generated by the COVID-19 pandemic (84). Uncertainty and fear caused by this unprecedented crisis could push vulnerable people toward dangerous/risky behavior and increased drug consumption. Hence, entry into the drug markets of new and perhaps very potent NPSs is a clear reason of concern.

It is of interest that some of the emerging NPS molecules here described received the attention of redditors even a few months before the start of the pandemic; hence, further studies should combine the use of both web crawlers and social listening data to optimally identify drug scenarios' modifications. These studies, based on a thorough qualitative analysis of both psychonauts' fora and social media, should better assess not only the molecules mentioned by NPS enthusiasts, but also the users' understanding of the pharmacological characteristics of these same molecules.

Finally, the current findings indeed support and highlight the potential and added value of automated web crawlers such as the NPSfinder® in scanning the web and retrieve data in an easy and time-effective way. At present, when a second wave of COVID-19 is generating further lockdown measures, it will remain to be seen if online drug sales and/or increased popularity of some NPSs will persist and influence future drug consumption patterns (63).

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

VC and FS conceived the idea of the manuscript and coordinated the whole project. VC and DA carried out the process of both data collection and systematization. VC performed the literature searching, the analysis of data, and drafted the manuscript. JC provided data from the EMCDDA and UNODC databases for the purposes of this research. AV supervised the word done with NPSfinder®. FS, AG, and JC contributed to the literature overview and the drafting of the paper. All authors contributed to the articles and approved the submitted version.

ACKNOWLEDGMENTS

The authors are grateful to Damicom srl, a small enterprise from Rome (Italy), whose professionals have developed, under the supervision of AV and FS, the NPSfinder® web crawler and so generously have allowed here the testing of its potential.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.632405/full#supplementary-material

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Conflict of Interest: The authors declare that the NPSfinder® web-crawler was provided by Damicon srl.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

REVIEW
published: 18 February 2021
doi: 10.3389/fpsyt.2021.623649

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COVID-19 Social Restrictions: An Opportunity to Re-visit the Concept of Harm Reduction in the Treatment of Alcohol Dependence. A Position Paper

Christos Kouimtsidis[1], Bernadette Pauly[2], Tessa Parkes[3], Tim Stockwell[4] and Alexander Mario Baldacchino[5]*

[1] Imperial College London and Surrey and Borders Partnership NHS Foundation Trust, London, United Kingdom, [2] Canadian Institute for Substance Use Research, University of Victoria School of Nursing, Victoria, BC, Canada, [3] Faculty of Social Sciences, University of Stirling, Stirling, United Kingdom, [4] University of Victoria, Canadian Institute for Substance Use Research, Victoria, BC, Canada, [5] Population and Behavioural Science Division, Medical School, St Andrews University, St Andrews, United Kingdom

OPEN ACCESS

Edited by:
Ornella Corazza, University of Hertfordshire, United Kingdom

Reviewed by:
Biljana Gjoneska, Macedonian Academy of Sciences and Arts, Macedonia
Domenico De Berardis, Azienda Usl Teramo, Italy

***Correspondence:**
Christos Kouimtsidis
drckouimtsidis@hotmail.com

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *30 October 2020*
Accepted: *01 February 2021*
Published: *18 February 2021*

Citation:
Kouimtsidis C, Pauly B, Parkes T, Stockwell T and Baldacchino AM (2021) COVID-19 Social Restrictions: An Opportunity to Re-visit the Concept of Harm Reduction in the Treatment of Alcohol Dependence. A Position Paper. Front. Psychiatry 12:623649. doi: 10.3389/fpsyt.2021.623649

The COVID-19 pandemic is presenting significant challenges for health and social care systems globally. The implementation of unprecedented public health measures, alongside the augmentation of the treatment capacity for those severely affected by COVID-19, are compromising and limiting the delivery of essential care to people with severe substance use problems and, in some cases, widening extreme social inequities such as poverty and homelessness. This global pandemic is severely challenging current working practices. However, these challenges can provide a unique opportunity for a flexible and innovative learning approach, bringing certain interventions into the spotlight. Harm reduction responses are well-established evidenced approaches in the management of opioid dependence but not so well-known or implemented in relation to alcohol use disorders. In this position paper, we explore the potential for expanding harm reduction approaches during the COVID-19 crisis and beyond as part of substance use treatment services. We will examine alcohol use and related vulnerabilities during COVID-19, the impact of COVID-19 on substance use services, and the potential philosophical shift in orientation to harm reduction and outline a range of alcohol harm reduction approaches. We discuss relevant aspects of the Structured Preparation for Alcohol Detoxification (SPADe) treatment model, and Managed Alcohol Programs (MAPs), as part of a continuum of harm reduction and abstinence orientated treatment for alcohol use disorders. In conclusion, while COVID-19 has dramatically reduced and limited services, the pandemic has propelled the importance of alcohol harm reduction and created new opportunities for implementation of harm reduction philosophy and approaches, including programs that incorporate the provision of alcohol as medicine as part of the substance use treatment continuum.

Keywords: harm reduction, structured preparation for alcohol detoxification, managed alcohol programs, alcohol, COVID-19

INTRODUCTION

On March 11, 2020 the World Health Organization declared a global pandemic due to the novel coronavirus (1). The call rippled globally resulting in the implementation of public health measures including travel restrictions, stay-at-home orders, frequent handwashing, physical distancing, and self-isolation (2). COVID-19 has dramatic implications for those with alcohol use disorders (AUD) due to changes in the severity and pattern of drinking, changes in access to services with restrictions and closures, as well as significant shifts in the mode of delivery of substance use services (3, 4). The pandemic demands attention to the continuum of substance use services, including alcohol harm reduction, and the specific needs of those impacted by intersecting crises of alcohol use disorders, poverty and homelessness (5, 6).

Harm reduction to prevent the transmission of blood borne diseases, prevent overdoses, and provide an alternative to an unsafe illicit drug supply, is underpinned by the goal of reducing harm associated with illicit drug use (7, 8). Alcohol harm reduction, like other harm reduction approaches, aims to reduce the harms of alcohol without necessarily requiring a reduction in, or stopping, drinking (9). Strategies to reduce harm from alcohol often focus on general population strategies, such as low risk drinking guidelines and population-based policies related to pricing and other forms of regulation, to reduce overall population harm. While critically important to population health, this approach is not sufficient to reduce individual harms for some groups, and may even have unintended consequences that increase harms (8). While there is robust evidence for interventions to reduce harms of illicit drug use, much less attention has been paid to reducing the many harms associated with alcohol use, specifically heavy episodic drinking, chronic use, and illicit and non-beverage alcohol use. Alcohol harm reduction for individuals this includes pharmaceutical alternatives to reduce cravings, potential use of cannabis as a substitution for alcohol, social interventions such as Housing First programs where substance use including alcohol use is tolerated, safer drinking education, and programs that provide alcohol. During the COVID-19 pandemic, the importance of alcohol harm reduction as an adjunct to other approaches has become increasingly prominent due to changes in service provision.

In this position paper, our objectives are to: (i) explore the shifts in relation to harms associated with AUD during COVID-19; (ii) illustrate both adverse and optimal changes in substance use and addiction services during the pandemic, and; (iii) underscore the philosophical shifts and opportunities for enhancing harm reduction strategies for those with AUD during the pandemic and beyond. We draw on international literature, wherever available, with specific examples from the UK and Canada. We did not undertake a systematic search of the literature but team members collated specific COVID-19 and AUD publications throughout the pandemic, most specifically utilizing the Society for the Study of Addiction COVID-19 research/briefings/evidence web-based resource (10). Our aim is to highlight harm reduction as an important approach and set of strategies for reducing alcohol related harms as part of health care systems and alongside treatment services during COVID 19 and beyond.

ALCOHOL RELATED HARMS AND VULNERABILITY

In 2016, the use of alcohol was estimated to result in 2.8 million deaths (5.3% of all deaths) worldwide and 132.6 million disability-adjusted life years (DALYs) (11). Alcohol related mortality exceeds that caused by other communicable and non-communicable diseases, such as tuberculosis, HIV/AIDS and diabetes. Harms from alcohol and other drugs can be classified into those which are: (i) "acute," comprising injuries, poisonings and/or acute illnesses partly caused by an episode of heavy use; (ii) "chronic," comprising a range of chronic and relapsing conditions including liver disease, cancers, strokes and gastrointestinal diseases which are caused by the overall volume of alcohol consumed over time (12), and; (iii) "social," which may involve problems in the spheres of housing, finances, relationships, the law, and workplace (12). Contextually, harms are increased along the socio-economic gradient, with increased alcohol-related harms experienced by those with low socio-economic status (13–16).

AUDs are experienced by 3–4% of the population globally (17). DSM-V includes dependence under the category of AUD and is defined as a clustering of signs of increased tolerance, the experience of withdrawal, continued use despite the experience of problems, and a degree of impaired control over consumption (18). Alcohol dependence carries heavy health and social costs which are increased when associated with poverty, homelessness, and/or housing instability (19–21). An international review found 10 studies concerning severe AUD experienced by men who are homeless but little data was available for homeless women (22). Among homeless men in economically developed countries, the prevalence of severe AUDs has been estimated to be almost 40% (22). Homelessness is associated with higher rates of depression, suicide, chronic pain, and poor mental health, alongside inadequate housing, food and other insecurities, as a consequence of severe poverty (23–26). The combination of severe AUDs and homelessness is often a response to, and a consequence of, multiple intersecting structural, systemic, and individual factors, in which alcohol can be a means of coping (27–29).

The relationship between stress and alcohol use is bilateral. Stress has been recognized as a predisposing risk factor for the development of AUD, and chronic alcohol use can exaggerate the experience of stress and compromise the ability of the individual to cope with stress (30). In the early stages of the pandemic, two opposite scenarios were introduced based on a review of the impact of previous epidemics by Rehm et al. (31). The first scenario predicted an increase of consumption, in particular in men, due to increased stress, and the second scenario predicted a reduction of consumption due to a reduction of access to alcohol, due to the social distancing measures (31). In fact, policymakers in many countries deemed alcohol sale to be "essential" and loosened alcohol restrictions e.g., allowing internet orders and home delivery. It seems that two main factors [vulnerability to stress and increased access to alcohol), had a synergic impact that further exaggerated pre-exisiting vulnerabilities of people with AUD (4). There is emerging evidence that alcohol use increased during the early phase of the pandemic, in both the general population (32, 33) and the population with pre-exisiting AUD (34)]. It has been also documented that limited access to alcohol led to increased frequency of abrupt discontinuation, and a temporary uptick in presentations to hospital for management of alcohol withdrawal symptoms experienced by dependent and heavy drinkers (4). This change in consumption, in conjunction with limited access to generic health and specialist services, plus the impact of the pandemic on social care and social stability, suggest the need to review the potential usefulness of alcohol harm reduction strategies during the COVID-19 period.

CHANGES TO SERVICE PROVISION DURING COVID 19 FOR PEOPLE WITH AUD

COVID-19 has affected every healthcare system in the world, even in countries that have not had high numbers of COVID-19 case numbers. According to Sutherland et al. [(35), p8], *"different healthcare systems have seen varying patterns of changes in healthcare activity – depending on prevalence, the stage of the pandemic and local policy."* Preparations to help health and social care services cope with anticipated increased demand from patients with severe cases of COVID-19, and the requirement to reduce the risk of infection/transmission, led to tremendous global changes in health service provision for non-COVID-19 related conditions, and also to public expectations of what would be provided by healthcare services (4). For example, Sutherland et al. (35) investigated changes in New South Wales, Australia using healthcare data drawn from multiple sources. Their study found that, between March and June 2020, compared with the same period in 2019, primary care face-to-face consultations decreased by 22.1%, breast screening activity by 51.5%, ambulance incidents by 7.2%, emergency department visits by 13.9%, public hospital inpatient episodes by 14.3%, and public hospital planned surgical activity by 32.6%. They concluded that there were substantial declines in a wide range of healthcare activities across the NSW health system over this period and, while activity was recovering by September 2020, they had still not returned to "normal." There was widespread deferment of scheduled appointments and procedures to attempt to accommodate the actual or predicted COVID-19 cases.

Across the world, staff were redeployed to unfamiliar environments away from services deemed non-essential to the COVID-19 response (36). This also involved the need for retraining and repurposing of staff resources. In England, for example, new staff such as trainees in the early stages of their career (foundation and core trainees), retired colleagues, or staff from other hospital departments, were deployed to increase capacity within emergency departments. These staff might not have been aware of existing protocols for cross departmental coordination, coordination with primary care, or secondary care specialist services such as drug and alcohol services. Restrictions of provision of substance use hospital liaison services was also experienced. This was due in part to generic measures employed to protect staff (rotation of work force or over the phone advice), as well as re-deployment of acute hospital staff, such as phlebotomists, clinical and administrative staff. This led to major reductions in/lack of access to services such as provision of liver function tests and regular hepatology outpatient appointments (37). Another important factor during the initial period of the COVID-19 response was fear on behalf of the public regarding the risk of infection if they approached health services impacting on seeking help for non-COVID-19 conditions, and a reluctance to place additional burden on health care services (35). For people with AUD, this could exacerbate pre-existing fragmentation in service provision and contribute to the long term deterioration of health and unnecessary therapeutic pessimism (4). Services were also reconfigured to accommodate the need for physical distancing, for example by moving services on to virtual platforms (35). The above mentioned barriers are increased for people impacted by severe AUD, poverty and/or homelessness, who may lack access to primary care.

Changes to Specialist Substance Use/Addiction Services

As documented during a temporary alcohol prohibition in India (38), temporary spikes in treatment seeking for alcohol withdrawal may occur initially but these rapidly decline, as has also been documented during other major alcohol restrictions (39). There is a complex interplay over time between alcohol supply and alcohol harm. During COVID 19, requirements for social distancing introduced by most countries have led to major changes to substance use specialist service provision. The most common changes adopted across a range of countries were (i) stopping provision of treatment *via* structured group work, (ii) stopping community detoxification, and (iii) reduction of face to face consultation to the minimum and, in some cases, reduced access to withdrawal management and rehabilitation services (36, 40). These changes have disproportionally affected substance use service provision for individuals with AUDs (39, 41). In some countries, addiction/substance use services were deemed to be essential services and thus protected from having staff resource redeployed (36). It is important to note that, while there were extensive clinical guidelines and advice being issued early in the pandemic to provide continuity of service and contingency planning (36), it was hard for service providers to adapt quickly while also continuing to provide services (6, 42–44). There is also the risk that the most vulnerable sub group of people with AUD, such as those experiencing homelessness and unemployment, would not necessarily have the technology to be able to access virtual services offered by phone or computer (5, 6). There are examples of attempts to address those barriers, for example in Scotland where phones were distributed to this group to address digital barriers (45). This population also lost other community supports such as access to food banks, due to reduced capacity and requirements for social distancing (6) and for some loss of income from begging/panning and recycling.

Mental Health Impact and Access to Mental Health Services

The mental health impact of various elements of the pandemic on the general population and on people with pre-exisiting mental health conditions was acknowledged early on by the scientific community (46–50). Similar impacts were therefore expected for vulnerable people with substance use problems such as AUD (36). According to DeJong et al. (36) who conducted a qualitative study with people in substance use treatment including for alcohol problems in the Netherlands, COVID-19 feelings of anger, guilt, gloom, fear, panic, restlessness, and stress were reported by participants, along with social isolation, lack of structure and boredom. The additional stress of a pandemic can create additional vulnerabilities in relation to physical and psychological health (51), and also increase risk of relapse (52). Increased levels of stress due to fear of infection, illness and death, as well as financial stressors, can increase levels of stress experienced by an already vulnerable population with AUD that is additionally compromised due to chronicity of drinking (36).

Social Care and Community Services

Prior to COVID-19, individuals with both severe AUD and homelessness faced significant barriers to accessing temporary accommodation and, in some cases, had to go without shelter as a consequence of alcohol use (53). Pre-existing structural vulnerability and alcohol related harms for this population were escalated with the announcement of the global pandemic in March 2020. Individuals may also have had difficulties accessing beverage alcohol due to restricted hours, restrictions on the use of cash, and implementation of isolation measures and restrictive policies that limited guests or public access (6). Additionally, socioeconomic factors may affect purchasing ability, such as loss of income from begging, pan handling, and closure of bottle or recycling depots (41). These factors may shift patterns of drinking in ways that increase harms, or lead to other unanticipated consequences, such as alcohol withdrawal, alcohol poisoning and/or substitution of illicit drugs for alcohol. Due to costs and availability, use of non-beverage alcohol such as hand sanitizer and rubbing alcohol can increase among those who are homeless posing significant harms (54). Also, this group may experience more serious COVID-19 symptoms due to the higher risk of pneumonia and compromised immune function associated with high levels of alcohol consumption (55). Further, the requirements of physical distancing and self-isolation may contribute to even greater social isolation, marginalization, and loss of social networks.

STRATEGIC CHANGE IN TREATMENT PHILOSOPHY TOWARD HARM REDUCTION

A harm reduction approach, beyond the provision of safety from unwanted withdrawals, that can be combined with other treatment components across a range of settings, such as emergency departments, primary care and specialist community services, became necessary during the pandemic. Phone and digital consultations were widely used during this period to support clients in opioid substitution treatment, alongside other measures and modifications compatible with social distancing. For individuals with AUDs, however, where substitution was not an option, digital or phone consultations, might not be sufficient, whilst other components of the treatment pathway, such as detoxification and group work, are interrupted. To maximize their effectiveness these consultations should be planned and structured with the aim of maintaining a therapeutic component (56).

A harm reduction approach, informed by the changes required during the COVID-19 pandemic, as applied in harm reduction for opioid treatment (57), is therefore needed. Managing risks around COVID-19 could mean self-isolation and reduction of income which, in turn, might put the ability of the person to maintain stable levels and patterns of drinking at risk. This may increase risk of severe withdrawal complications (e.g., seizures) (4, 58). Harm reduction advice to maintain stable levels of drinking, while facilitating engagement with AUD services, could be expanded in conjunction with AUD services, given the lack of access to community detoxification, acute hospital admission, or reduced access to inpatient specialist detoxification services. However, expansion of alcohol supply has to always be carefully balanced against the high level of demonstrable harm to health attributed to alcohol, with rates of associated morbidity, mortality and economic costs far higher than for other substances (59).

The harm reduction approach is compatible with an overall pre-habilitation approach to the management of AUD. Pre-habilitation advocates the identification and proactive management of; (i) any factors anticipated to compromise the successful outcome of an intervention, and; (ii) the potential side effects associated with the intervention itself. It is a pro-active rather than a reactive approach aimed at ensuring more sustainable outcomes (60). Harm reduction, using alcohol as an agent of treatment, could achieve both aims (54). The concept of pre-habilitation is not new. The ability to predict, or anticipate, certain harm, or assess certain risks, is associated with the human ability of learning from experience, modifying behavioral responses, and developing long-term and sustainable response strategies. To that effect, planning in advance, in anticipation of risks, can be considered to be an essential strategy and quality, associated with individual survival and progress.

POTENTIAL HARM REDUCTION STRATEGIES WITHIN A HARM REDUCTION FRAMEWORK FOR PEOPLE WITH AUD

Alcohol harm reduction for individual clients refers to a range of strategies and approaches that specifically seek to reduce the harms of alcohol without necessarily requiring a reduction in, or stopping, drinking. Specific alcohol harm reduction strategies include: (1) use of pharmaceutical alternatives to reduce cravings; (2) use of cannabis as a substitution for alcohol; (3) social interventions such as Housing First programs where substance use and alcohol use is tolerated; (4) safer drinking education; (5) substitution programs that provide alcohol. Although individuals experiencing severe AUD and homelessness often express a preference for harm reduction goals, there is limited discussion and availability of specific alcohol harm reduction strategies (61–63). We will provide a brief overview of the first four strategies and provide more detail on substitution programs that provide alcohol, such as SPADE and MAP, as forms of alcohol harm reduction that could be enhanced in substance use services. We will comment on the need for the strategy during COVID 19 and any particular challenges and adaptations that the COVID-19 pandemic might necessitate to those strategies.

Pharmaceutical Alternatives

Pharmaceutical alternatives include use of medication such as Naltrexone or Acamposate to manage craving and withdrawal symptoms, and may be used alone or in combination with other approaches such as motivational interviewing. Different medications are approved for use in different countries (58). Limited access to health services due to the pandemic (as discussed in section Social Care and Community Services above) might have reduced capacity for baseline and ongoing monitoring such as liver function tests, necessitating adaptation of the clinical protocols to pandemic mode.

Cannabis Substitution

Cannabis use has also been suggested as a substitute for alcohol. Where abstinence is neither feasible or preferable, cannabis has been used within a harm reduction framework to reduce use of other substances and help meet goals of reducing harm (64–66). In particular, cannabis substitution has been proposed as a potential harm reduction strategy for those with alcohol dependence (67). Cannabis substitution for alcohol problems meets, or partially meets, the seven criteria for evaluating the use of substitution medicines developed by Chick and Nutt (68). The need for further evidence through clinical trials has been recommended (68). While cannabis use is not without harm, it is argued that the scale of harms is substantially lower than for alcohol (68, 69). It has the potential to stave off cravings and reduce withdrawal, as well as having a potential beneficial effect for pain, PTSD, anxiety, and sleep (69). However, cannabis can potentiate the effects of alcohol and more evidence is needed as to its use and effectiveness with people with AUD. During COVID-19, especially in the context of legalization of cannabis, or in a medical context, such a strategy could be considered harm reduction where other interventions are not accessible or unacceptable, and with appropriate guidelines for safe use.

Housing First

Tolerance of substance use in Housing First programs has been associated with improved costs and better outcomes for those able to manage their own alcohol use (70–73). This strategy is even more crucial during the period of the COVID-19 pandemic as housing is a front line defense against COVID-19. There are indications that the financial and social impact associated with the measures taken to manage the pandemic has increased unemployment, loss of income, and in some cases homelessness (74).

Safer Drinking Education

In some cases, safer drinking education has been incorporated as an intervention in Housing First programs to reduce harms. Safer drinking education includes provision of information and education by peers that focuses on reduces the risks of drinking (75). This approach could be used in a wide range of community settings including outreach, shelters and drop-ins. Specifically, two of the authors led the development of safer drinking tips during COVID 19.

Substitution Programs That Provide Beverage Alcohol

The principles of a harm reduction approach that helps people who use opioids to stay alive and, safe, and which provides easy access into other components of treatment, has relevance for people with AUD. While there is no substitution substance for alcohol, managed access to beverage alcohol has been provided by Managed Alcohol Programs (MAP)s in Canada, often to replace use of non-beverage alcohol, which may both be more intrinsically harmful, and easier to consume in harmful quantities due to higher alcohol concentrations and lower prices. Structured Preparation for Alcohol Detoxification (SPADe) and MAP are now examined in more depth as harm reduction approaches that provide alcohol as medication within a harm reduction framework which, during the COVID-19 period, can reduce the risk and severity of abrupt and unplanned withdrawal, as well as harms related to use of non-beverage alcohol.

Structured Preparation for Alcohol Detoxification (SPADe)

The emphasis of SPADe is on stable drinking and avoidance of major fluctuations in the amount and pattern of drinking as the first step toward preparation for abstinence, as well as a final aim for controlled drinking. The SPADe approach, although not described as "harm reduction" *per se*, has similar components to a harm reduction approach, given that it promotes the use of alcohol as a medication, with frequent and regular dosing to prevent rather than treat withdrawal symptoms. Within SPADe, the main aim is the stabilization of both the amount and pattern of drinking. This type of controlled drinking is referred to as "partial" for two main reasons: (a) it is an intermediate treatment stage rather than the final treatment aim, which remains abstinence and; (b) the amount and pattern of drinking during this process is not always within healthy limits (76).

This proactive elimination of symptoms is considered fundamental from a biological perspective as it protects against brain acute dysregulation which, in turn, might sensitize the brain, leading to an exaggeration of the negative impact associated with the disturbance of the brain's homeostatic system. From a psychological perspective, it empowers the individual through regaining some control of decision making, thus reducing the impulsivity associated with the experience or avoidance of experiencing cravings and withdrawal symptoms. Furthermore, it provides a relatively stable environment for the individual and the close social environment to start implementing lifestyle changes leading to increased self-efficacy which is considered to be the final mediating factor in social learning theory and cognitive and behavioral treatment models (77, 78).

The amount of drinking, following stabilization of the patterns described above, could be reduced gradually following the principle of small sustainable changes. The aim is to avoid any dramatic change to the amount of drinking that might not only be unsustainable but also lead to precipitation of withdrawal symptoms which, on rare occasions, might potentially be life threatening. Once stability is achieved then gradual reduction can be safely initiated. Roughly half of the individuals would be able to stop using alcohol without the use of detoxification medication (79). This model of detoxification is called "guided self-detox" and refers to the process of using alcohol "as if it was medication" and as a safe detoxification tool. During the period of COVID-19 pandemic, with the associated limitations in specialist service provision, the stabilization of drinking and the guided self-detox wherever possible, rather than detoxification seems to be a safer and more realistic treatment aim.

Within the SPADe original approach, guided self-detox can be achieved more easily if other lifestyle changes are taking place at the same time, and family and important others (if present) are aware and supportive of the plan. These are the other two crucial components of SPADe. Early and gradual implementation of changes within the individual's lifestyle are necessary to provide: (i) a routine in everyday life that would protect from early relapse; (ii) fill in the void that alcohol detoxification would leave behind; (iii) could be used as distraction strategies against cravings; (iv) would enhance personal responsibility; (v) would de-mystify alcohol and challenge the omnipotence of cravings or withdrawal symptoms, and finally; (vi) would protect from the acute stress experienced in the early days of abstinence. According to SPADe, these lifestyle changes should be initiated and tested while alcohol is stabilized and to be augmented, as well as evaluated, after the detoxification. The involvement of family members and the immediate social support system helps by providing education, modifying unrealistic expectations, and supporting a more gradual adaptation to the new family dynamics (following the removal of alcohol). It helps with managing anxiety and the difficult feelings/emotions associated with broken trust and promotes a partnership approach. The fundamental reason for this involvement is that recovery is easier and more sustainable within a respectful, stress-free, and supportive environment. These lifestyle changes and possible family involvement should be discussed in depth with the individual as they might be particularly challenging due to social restrictions associated with COVID-19.

Managed Alcohol Programs (MAPs)

MAPs go beyond tolerance of alcohol onsite in housing or other accommodation. MAPs are a strategy to assist people to manage their alcohol use with the aim of reducing harms of consumption, including consumption of non-beverage alcohol (80). In Canada, we witnessed the growth and implementation of many new MAPs with the onset of COVID 19. The need for MAPs during COVID-19 was a strategy to assist with physical distancing and self-isolation by reducing the need for participants to source alcohol daily, as well as reducing risks of withdrawal and avoiding use of non-beverage alcohol and substitution of illicit drugs associated with high rates of overdose deaths. In British Columbia, specific operational guidance was released to assist with the development of a range of models (81).

MAPs originated as a response to the complex needs of people who do not respond to abstinence programs and are experiencing homelessness or housing instability (82). A maximum number of doses are provided to participants daily. MAPs intend to replace non-beverage alcohol, heavy drinking episodes, and intoxication, with a steady source of alcohol, and thereby reduce acute alcohol-related harms (82). To the extent that MAPs contribute to reductions in total alcohol consumption among people with AUDs who are not willing or able to abstain, they may also contribute to lower risks of serious alcohol-related diseases, though these will still be high compared to general population (83). MAPs offer regulated access to beverage alcohol, alongside meals, healthcare, accommodation and a range of social supports. There are a wide range of models, from community programs led by people with lived experience, to programs in shelters, transitional and supportive housing, and hospitals. Despite the range in models, the goals of MAPS are to reduce harms and provide an option for those who have not been successfully supported by other approaches and do not wish to stop drinking. MAPS seek to provide an alternative to street-based survival drinking and/or use of non-beverage alcohol. An important element of MAPs, consistent with a harm reduction framework, is the involvement of people with lived experience in design, development, and delivery of programs (53, 54, 84, 85).

Podymow and colleagues first documented the impacts of MAPs in 2006, based on a program in Ottawa, and found benefits related to reduced hospital and policing costs, improved hygiene and nutrition, and increased medication compliance (82). The Canadian Managed Alcohol Study (CMAPS) began in 2011 and is the largest study to date of MAP implementation and outcomes (www.cmaps.ca). Initial studies of MAPs found evidence of reduced alcohol-related harms, reduced use of non-beverage alcohol, improved quality of life and safety, increased housing stability, and reduced demands and costs for the health and criminal justice systems (86–88). Management issues related to eligibility criteria, and tailoring programs to individual needs, were identified. In a comparison of 175 MAP participants and 189 controls in five cities, Stockwell et al. found that long-term MAP residents (>2 months) drank significantly fewer drinks per day than controls over the previous 30 days (83). In this same analysis, long-term MAP residents reported significantly fewer acute alcohol-related harms in the domains of health, safety, social, legal, and withdrawal symptoms. The same participants reported that, when unable to afford alcohol, they would often use positive coping strategies e.g., waiting for money (46%), make supplies last longer (53%), seek treatment (37%) or go without alcohol (39%), and be less likely to use strategies with negative or harmful consequences, such as use illicit drugs (usually cannabis) (28%) and/or non-beverage alcohol (30%) (75). Compared to controls, the long-term MAP residents were significantly less likely to use illicit substances, steal, or go without alcohol, and they were more likely to seek treatment. In the first longitudinal analysis of 59 MAP participants and 116 controls, Stockwell et al. (89), found that MAP participants drank less hazardously than controls and experienced fewer alcohol related harms at 0–6 months than controls (89). Additionally, qualitative findings from MAP participants suggested that being in a MAP disrupts survival drinking and cycling through multiple settings (which is particularly important to reduce movement in the context of COVID-19), as well as enhancing feelings of safety, belonging, sense of place or home, and hope for the future (90). This evidence indicates that acute and social harms (e.g., injuries, poisoning) can be reduced for this population by engagement in a MAP. In order to reduce chronic harms, and elevated risk of alcohol-related diseases created by a program of continuous daily alcohol administration, attention to program policies and administration is critical (83, 89).

In summary, MAPs have been shown to enhance housing stability, reduce acute and social alcohol-related harms, improve safety, and create opportunities for reconnection with families, communities, and healing. However, there has been limited research on programs that incorporate sex and gender considerations, or the needs of ethnically diverse populations as the majority of the existing programs primarily serve men. A recent study conducted in Scotland that aimed to explore the potential of MAPS concluded that the model held much promise for implementation across Scotland and potentially in the UK more widely, and recommended that they should be taken forward into pilot implementation (63). MAPs fill an important gap for those who require additional support to manage alcohol use in order to maintain stability and, during COVID-19, adhere to stay at home and physical distancing measures.

DISCUSSION

Services for people with AUD have largely focused on treatment approaches that have a goal of abstinence. Arguments for the appropriateness of harm reduction strategies for the most vulnerable subgroup of people with AUD, namely people who are homeless, is not new (7, 91). Implementation of public health measures to reduce the spread of COVID-19 have increased alcohol consumption in some countries (32), especially those that have relaxed policies on alcohol availability and pricing. This has added to pressures on service provision for people with AUD and highlighted the need for new approaches during a pandemic (92, 93). Reductions in, and substantial limitations of, provision of services to this group has created an opportunity for a further shift in philosophy toward harm reduction in substance use services, as well as implementation of services that focus on substitution, tolerance, and safer or managed use of alcohol. Medications that help to manage alcohol craving or withdrawal are often used when the goals are for abstinence, while cannabis substitution may provide a less harmful substance to replace alcohol. In addition, safer drinking education (e.g., about lower risk beverages, contexts and drinking patterns) is a harm reduction strategy that has been incorporated into Housing First initiatives but could be provided in other community settings. In this paper, we have discussed the strategic need and evidence for the enhancement of treatment services through the explicit incorporation of alcohol harm reduction approaches both during the COVID-19 period and beyond.

While there is a growing evidence base for alcohol harm reduction beyond population level policies that seek to reduce overall harms, we recognize that the incorporation of alcohol harm reduction approaches described here require philosophical shifts as well as policy shifts. Our view is that such shifts, and the associated change of attitudes toward one of the most vulnerable and marginalized groups in society, would contribute toward the reduction of discrimination and systemic neglect of their needs. To be clear, we are not proposing that all services be oriented to harm reduction but, rather, that harm reduction be a recognized and accepted approach within mainstream substance use services in order to expand access to a broader range of services based on client choice and goals. It is the underlying values base of harm reduction in which the explicit intention is to reduce harm that has created controversy as it conflicts with long established and often dominant norms of abstinence as the ultimate goal of substance use services for people with AUD. Paradoxically there are individuals often impacted by structural inequities and vulnerability who are left out or even potentially impacted by unintended consequences of such policies (13).

In this position paper, we have specifically examined approaches that provide alcohol within a harm reduction framework, namely SPADe and MAPs. While both provide alcohol, and share goals related to reducing harm through provision of a safe and regular source of alcohol to address harms of binging and smoothing out of drinking patterns, there are differences between the two approaches. The ultimate aim of SPADe is abstinence, while MAPs aim to reduce harms as a primary goal with or without necessarily resulting in eventual abstinence. Both take a pragmatic and incremental approach to provision of alcohol which is aligned with harm reduction principles more generally (8). Our view is that there is much that can be learned from both approaches in meeting the needs of clients with severe AUD. For example, MAPs might incorporate elements of SPADe for clients who express an interest in reducing alcohol consumption and/or goals of abstinence. Alternatively, SPADe programs may identify clients who would be better suited to MAPs. As such, the existence of such programs provides an expanded range of services for those with severe AUD who are often overlooked or underserved by current treatment systems.

CONCLUSION

Alcohol harm reduction that spans tolerance of ongoing drinking and provision of alcohol, as well as substitution, have become more important during COVID-19. However, such approaches have a history preceding COVID-19 and a place in the broader landscape of harm reduction that is often dominated by illicit drugs. While COVID-19 has dramatically reduced and limited services, the pandemic has propelled the importance of alcohol harm reduction and created new opportunities for implementation of harm reduction philosophy and approaches, including programs that incorporate the provision of alcohol as medicine as part of the substance use treatment continuum.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

ACKNOWLEDGMENTS

The authors would like to acknowledge Wendy Masterton for her help with preparing the references for this paper.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 18 February 2021
doi: 10.3389/fpsyt.2021.620442

The Effects of the Fear of Missing Out on People's Social Networking Sites Use During the COVID-19 Pandemic: The Mediating Role of Online Relational Closeness and Individuals' Online Communication Attitude

Francesca Gioia[1], *Giulia Fioravanti*[2], *Silvia Casale*[2] *and Valentina Boursier*[1]*

[1] *Department of Humanities, University of Naples Federico II, Naples, Italy,* [2] *Department of Health Sciences, School of Psychology, University of Florence, Florence, Italy*

Forced isolation induced by COVID-19 pandemic dramatically impacted individuals' well-being, reducing the opportunities for social encounters, consequently resulting in a greater use of social media in order to maintain social relationships. Although the range of friend-related activities appeared to be severely constrained during quarantine, the Fear of Missing Out (FoMO) needs to be carefully examined, especially in relation to problematic social networking site use (PSNSU). Indeed, FoMO might enhance individuals' need to stay connected and communicate with other people, leading to PSNSU, in order to face the fear of being invisible in the world of social media in circumstances of physical isolation. The present study sought to evaluate the predictive role of FoMO on PSNSU during the COVID-19 pandemic, testing the mediating effect of online relational closeness and online communication attitude. A total of 487 Italian adults (59.3% women), aged between 18 and 70 years (mean age = 29.85 years; *SD* = 9.76), responded to an online survey during the period of COVID-19 pandemic lockdown in Italy. The survey included self-report measures assessing perceived FoMO, online communication attitude, relational closeness with online friends, and PSNSU. Participants declared they spent significantly more time social networking during the pandemic, particularly women. The total model accounted for a significant amount of variance in participants' PSNSU [$R^2 = 0.54$; $F_{(9, 447)} = 58.285$, $p < 0.001$). Despite the other people's social rewarding experiences had been drastically reduced by the lockdown, findings showed a direct effect of FoMO on PSNSU. Moreover, FoMO had an effect on online communication attitude and online relational closeness, although only online communication attitude predicted, in turn, PSNSU. Conversely, relational closeness on social networking sites did not predict PSNSU. The present study suggests that, during COVID-19 lockdown, FoMO levels may have strengthened attitudes toward online communication, which, in turn, may have put some individuals at risk of PSNSU.

Keywords: COVID-19, fear of missing out, online communication attitude, problematic social networking sites use, relational closeness

OPEN ACCESS

Edited by:
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University of Studies G. d'Annunzio Chieti and Pescara, Italy

****Correspondence:***
Valentina Boursier
valentina.boursier@unina.it

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *22 October 2020*
Accepted: *28 January 2021*
Published: *18 February 2021*

Citation:
Gioia F, Fioravanti G, Casale S and Boursier V (2021) The Effects of the Fear of Missing Out on People's Social Networking Sites Use During the COVID-19 Pandemic: The Mediating Role of Online Relational Closeness and Individuals' Online Communication Attitude. Front. Psychiatry 12:620442. doi: 10.3389/fpsyt.2021.620442

INTRODUCTION

The impact of the COVID-19 pandemic on people's lives represents a critical issue that deserves empirical examination for mental health science (1). Indeed, the experience of isolation and separateness due to the forced physical-distancing has impacted on people's relationships and well-being, resulting in negative psychological outcomes (2–4), sometimes leading to fatal events (5–7).

In this context, the relevance that fears had on individual behavior and functioning represents an important matter of the debate. Accordingly, an integrated model of understanding fear experiences during the COVID-19 pandemic has been recently proposed, together with a multidimensional assessment for COVID-19-related fears (8, 9). Moreover, the experience of fear specifically related to interpersonal features (i.e., the fear of missing out and fear of not mattering to other people), resulting from individuals' psychological needs not met due to the pandemic, has been discussed as a crucial point for public health (10). Generally, stressful and uncertain situations increase anxiety and emphasize the individuals' need to receive social support by sharing similar experiences with others (11). Indeed, as previously stated, the loss of one's usual routine and reduced social contacts may cause frustration and a sense of isolation, which can generate high levels of distress (12–14). A 2-month follow-up study among Italian people during the Covid-19 lockdown showed an increase in stress and depression in the course of the lockdown (15). Relevant to the current study, this recent research has also shown that fewer coping strategies were associated with increased depression at follow-up. This suggests that how individuals dealt with their experience of isolation, including their need to communicate, belong to, and be part of a community, may well represent key issues during the COVID-19 pandemic.

Within this context, the use of social networking sites (SNSs) fulfilled the essential function of connection (16) by helping individuals to grow their social capital, and supporting relational closeness to the others *via* online interactions (17–20). The positive effects of SNSs have been clearly demonstrated, as they may promote positive functioning and foster positive emotional states (21, 22). Indeed, SNSs have been proposed as tools for alleviating anxiety during the COVID-19 pandemic (16), by allowing individuals to feel that they are not alone but part of a community (23). Smartphone apps and social technologies have had the potential to enhance individuals' experience of connectedness, despite the disclosed risks of infodemic and technological exhaustion (24–26). Accordingly, the positive central role of a recreational and needful use of videogames and SNSs in times of physical and social distancing, has been evidenced even though carefully addressed (27, 28), also suggesting that an excessive use of SNSs might temporarily act as a coping strategy (29, 30). However, some authors have recently argued that this coping mechanism might potentially lead to a longer-lasting threat (i.e., Problematic Social Networking Sites Use; PSNSU) in keeping with findings from a few recent studies (31, 32).

Fear of Missing Out and Social Networking Site Use

The Fear of Missing Out (FoMO) is defined as "a pervasive apprehension that others might be having rewarding experiences from which one is absent, FoMO is characterized by the desire to stay continually connected with what others are doing. For those who fear missing out, participation in social media may be especially attractive" (31, p. 1841). Indeed, the online environment constitutes an ideal context to fulfill the need to be connected with the others and to be socially informed despite the distance, satisfying individuals' need for relatedness (10). For this reason, some studies [e.g., (33)] have focused their attention on the association between FoMO and Internet addiction. However, Internet addiction has been criticized as being an inadequate umbrella term that overlooks important differences between various online activities (34, 35) which, conversely, warrant specific and differentiated attention (36–38). Specifically, PSNSU has been defined as "being overly concerned about social networking sites (SNSs), to be driven by a strong motivation to log on to or use SNSs, and to devote so much time and effort to SNSs that it impairs other social activities, studies/job, interpersonal relationships, and/or psychological health and well-being" [(39), p. 4054]. Previous research has found a positive association between FoMO and social media misuse (40–43). Moreover, findings on gender-related differences suggested that women tend to score higher on FoMO than men (44, 45).

As the desire—or the need—to be continually connected with others is easily satisfied by using SNSs, it has been suggested that FoMO might be a risk factor for PSNSU. FoMO is a direct predictor of PSNSU use or a mediator in the relationships between psychopathological symptoms and negative outcomes arising from SNS use (46, 47). FoMO was also found to predict metacognitions associated with social media use, which, in turn, predict unregulated social media use (48). Thus, individuals may try to regulate their FoMO through massive use of social media because they believe that this tool is useful for regulating their fear of being excluded.

As pandemic does not constitute a usual life-circumstance, and social restrictions due to the COVID-19 epidemic have reduced the opportunities for social encounters, FoMO needs to be carefully questioned. Casale and Flett (10) have recently discussed the utility of the FoMO construct during the current pandemic, suggesting that this construct might become less relevant and salient because of the currently prevailing conditions. It might be the case that aspects of the psychological reality that this construct is intended to represent are either missing or have been drastically reduced. The FoMO construct includes, by definition, the possibility for significant others to have fun or to enjoy rewarding experiences, planning get-togethers, and meet up with friends. However, social isolation restricts the range of what friends are actually doing because their behavior is severely constrained. One might argue that if FoMO levels decrease in times of pandemic, unhealthy behaviors and negative outcomes related to high levels of FoMO (i.e., PSNUS) should show a decrease as well (10). Consequently, there is a need to investigate if the well-established positive association between FoMO levels and PSNUS remains stable during the pandemic or, instead, if it might be the case that PSNSU is driven by different psychological risk factors depending on the circumstances. Recent findings have reported that the psychological burden of the COVID-19 pandemic includes increased social media use in order to maintain social relationships (49). Individuals who are afraid of being invisible in the world of social media (8) and who are in situations of physical isolation will more likely need to find ways to stay connected with other people. Hence, these conditions might enhance massive or problematic SNSs use. Below we will describe the specific mechanisms that might explain how FoMO might impact on PSNSU in time of physical distancing.

Online Communication Attitude and Relational Closeness Across Social Networking Sites

Computer-mediated communication (CMC) has been described as a digitally-mediated pattern of communication (50–52). For younger generations, CMC is essential to the initiation, development, and maintenance of interpersonal relationships (53). Within this context, the Online Communication Attitude (OCA) has been conceptualized as a cluster of cognitive and affective orientations, that is a trait-like attitude and relatively enduring organization of beliefs that leads individuals to respond in some preferential manner toward online communication, thus influencing online behaviors and relational outcomes (54, 55). More specifically, attitudes toward *online self-disclosure* (OSD) and *online social connection* (OSC) have been stated as two core features of individuals' OCA, affecting media-use patterns in the interpersonal relationship (54, 56). According to Ledbetter (54), those with a high attitude toward OSD feel more comfortable and less embarrassed when sharing personal information across social media and are less shy when communicating online, whereas those with high attitude toward OSC share the belief that loss of online communication would reduce contact with others and dramatically change their social life. It seems that attitudinal variables strongly predict the motives for socialization and interpersonal relationships development/maintenance *via* SNSs (57). In this regard, previous research has posited that the more people are prone to communicate *via* online social platforms (i.e., keeping social contacts and self-disclosing online), the more this attitude will influence their engagement in SNSs for interpersonal relationships and, in turn, relational closeness to friends across SNSs (54, 55).

In this regard, Vangelisti and Caughlin (58) highlighted the importance of psychological closeness to others within the context of personal disclosure. Later, according to Aron et al. (59), Ledbetter et al. (55) conceptualized *relational closeness* as "a subjective experience of intimacy, emotional affinity, and psychological bonding with another person" (p. 34), which plays a critical role in online relationships contributing to individuals' experiences of intimacy and emotional closeness. Moreover, assuming that self-disclosure and social connection are basic motivations that promote online interpersonal communication (54), it has been demonstrated that these attitudes toward online communication may directly influence relational closeness to the others *via* online relationships (55).

Therefore, relational closeness has been posited as an important interpersonal outcome, associated with online communication, supporting the dominance of close ties in the provision of social support *via* social media (60, 61). Similarly, comments from relationally close individuals are more supportive if compared to a relationally non-close reply (62, 63) and may influence adolescents' identity development, including sociability and self-esteem (64). In this regard, psychological outcomes should be considered depending on the healthy or unhealthy use of online communication and relationships. Accordingly, Baym and Ledbetter (65) already posited a strict association between the quality of relationship with SNS friends and the frequency of SNS contacts, as well as scientific research has increasingly explored the strong relationship between Internet use/misuse and interpersonal facets of Internet applications [e.g., (42, 66–71)].

In fact, the use of SNSs provides for social connections, information, and emotional content-sharing, as well as for experiences of online self-disclosure, intimacy, and emotional closeness. However, contradictory results concerning the use of new communication technologies highlighted positive (54, 72, 73) rather than deleterious (74–76) effects on the quality of interpersonal relationships. Specifically, despite online communication may fulfill critical needs of social interactions, self-disclosure, and identity exploration in young people (77), this attitude has been associated with compulsive Internet use and a specific preference for online social interactions (56). Moreover, even though responding to the need of facing negative emotions and searching for social support (31, 78, 79), the preference for computer-mediated interactions may trigger risky psychosocial and relational outcomes (80–82). Particularly, attitude toward OSC has emerged as a significant positive predictor of social media use (83) and relational closeness across SNSs (55), likely a healthy, communicatively competent motivation for using online communication. Conversely, OSD has been associated with negative psychosocial and relational outcomes, probably due to the individual's desire for over-controlling or falsifying personal self-presentation (55, 56, 80, 81). Accordingly, a recent study from the Authors (blinded reference for peer review), confirmed the association between OSD and negative relational outcomes suggesting that young adults who were prone to self-disclose online largely tend to prefer online social interactions. Moreover, these recent findings also reinforced previous few evidence on the predicting role that online communication attitudes may have on relational closeness with online friends (55).

Finally, gender-related differences have been indicated in individuals use of social media, thus showing that females disclose more than their male peers principally using social media for relational purposes (84–87). However, recently higher scores in men's self-disclosure and relational closeness with online friends (Authors, submitted, blinded reference) suggested a reconsideration of gender-related differences in online communication attitudes and social media use, addressing for further investigation.

Interestingly, the potential effect of FoMO on PSNSU through online self-disclosure and online social connection has not yet been the focus of scientific attention. On the one hand, previous studies supported a positive association between FoMO levels and problematic social media use. On the other hand, previous findings show that attitudes toward online communication directly predict relational closeness toward online friends and that the higher the attitude toward online self-disclosure and online social connection, the higher the compulsive use of social media. It is psychologically plausible that those who fear to be excluded might develop stronger attitudes toward online self-disclosure and online social connection in a time of physical and social distancing, in order to meet their need to be socially connected. That is, we speculated that in time of social restrictions, attitudes toward the online environment are enhanced because the forced lockdown might have merely transferred social interactions to the online environment and this, in turn, might put a person at risk to develop PSNSU.

The Present Study

Accordingly, we hypothesized that individuals who are afraid of being excluded or invisible to the others, in situations of physical isolation would more likely need to find ways to be close and connected, *to become visible* self-disclosing in the only possible context of interaction they could use during the pandemic lockdown. Therefore, the current study aimed to explore the predicting role of FoMO on PSNSU during the COVID-19 social restrictions, testing the mediating effect of the online communication attitude and online relational closeness on this relationship. In detail, we expected to find an association between FoMO levels and PSNSU in accordance with previous studies [e.g., (33, 41, 43, 46)]. Moreover, we expected that FoMO would influence the tendency toward online social connections and promote the need for interpersonal contacts and relational closeness to the others *via* online social interactions, which would lead in turn to PSNSU (**Figure 1**). Finally, since there are gender-related differences in individuals' attitude toward online communication and FoMO levels, we explored gender differences in this relationship.

Thus, the following hypotheses were proposed and tested:

H1: There will be self-reported higher use of SNS during the pandemic compared to previous levels;

H2: FoMO will positively affect PSNSU through online communication and relational closeness on social networking sites. We expected this mediation to be partial rather than full, as other mechanisms through which FoMO influences PSNSU (e.g., metacognitions) are also likely to operate.

METHODS

Participants and Procedure

A total of 487 Italian adults responded to an online survey. The sample comprised 198 men (40.7%) and 289 women (59.3%) aged between 18 and 70 years, with a mean age of 29.85 years (SD = 9.76). Participants were recruited during the COVID-19 pandemic lockdown phase in Italy (specifically from April 1st to 30th 2020) *via* advertisements in Italian university Web communities and other online groups (*via* social media platforms), which asked for dissemination among their members. Therefore, a snowball sampling method was adopted as a recruitment strategy. The call for participation in the online study contained a website link for participants to click on in order to fill out the questionnaire. Participants were informed of the research aims, its scope, and the measures to be used in generating the data. Participation was voluntary. Confidentiality and anonymity were guaranteed. The participants could withdraw from the study at any time. No course credits or payment was given. There were no specific inclusion criteria, except that of being of legal age which, according to Italian law, is 18 years of age. The study was approved by the Research Ethics Committee of the University of Naples Federico II and was conducted according to the ethical guidelines for psychological research established by the Italian Psychological Association (AIP).

Measures

Sociodemographic Information and Social Media Use Patterns

Information was collected about gender, age, ethnic origin, being student, marital status, geographical provenance, whether the participant was living alone during the quarantine, the most used social networking sites, and hours per day spent social

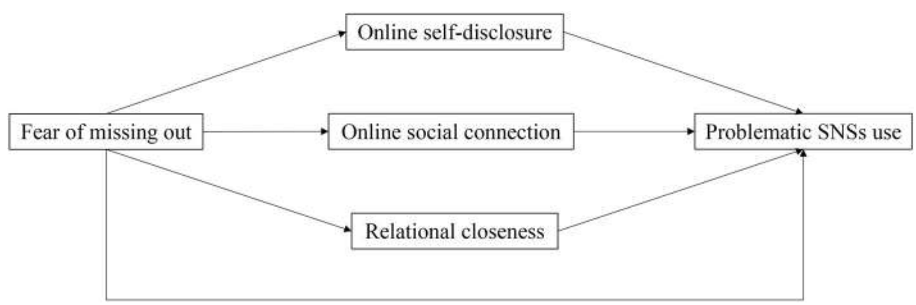

FIGURE 1 | Hypothesized parallel mediation model.

networking before and during forced isolation due to COVID-19. A score was calculated that reflected the difference between the number of hours participants declared they spent on SNSs during and before the COVID-19 lockdown.

Fear of Missing Out Scale

The Italian version of the FoMO scale [(48); original English version by (88)] was used to evaluate the fears, worries, and anxiety people might have in relation to being out of touch with events, experiences, and conversations among their social circles (e.g., "*I fear my friends have more rewarding experiences than me*"). FoMO is a 10-item scale rated on a 5-point Likert scale ranging from 1 (*not at all true of me*) to 5 (*extremely true of me*). Higher scores indicate a higher Fear of Missing Out. The Cronbach alpha in the current study was $\alpha = 0.83$.

Online Communication Attitude Scale

The online self-disclosure (OSD) and online social connection (OSC) subscales of the Italian version of the OCA scale [(54); Authors, submitted, blinded reference] were used. The online self-disclosure attitude subscale contains seven items (e.g., "*I feel like I can be more open when I am communicating online*"), and the online social connection subscale contains six items (e.g., "*I would communicate less with my friends if I couldn't talk with them online*"). Participants responded on a 7-point Likert-type scale with response options ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's α values for the online self-disclosure and online social connection subscales were 0.91 and 0.82, respectively.

Relational Closeness

A preliminary Italian version of Vangelisti and Caughlin's (58) seven-item measure was used to assess relational closeness with online friends (e.g., "*How often do you talk about personal things with your online friends*?" and "*How close are you to your online friends?*"). Participants responded on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*very much*). The measure demonstrated strong internal reliability ($\alpha = 0.91$).

This preliminary Italian version of the relational closeness measure was obtained using a back-translation method in which one translator translated the tests from the source language (English) to the target language (Italian). A second translator, without having seen the original test, translated the new versions of the tests back to the source language. The original and the back-translated versions of the tests were then compared, and judgments were made about their equivalence. Although not yet validated, this measure has been used in a previous study on Italian sample of adolescents and adults, showing a good internal consistency ($\alpha = 0.92$) and a strong correlation with OCA and preference for online social interactions (POSI) [(89) unpublished thesis dissertation; Authors, submitted, blinded reference].

Generalized Problematic Internet Use Scale 2

The 15-item Italian version of GPIUS2 [(90) original English version by (91)] assesses the degree to which someone experiences the cognitions, behaviors, and outcomes arising because of the unique communicative context of the Internet on a scale ranging from 1 (*strongly disagree*) to 8 (*strongly agree*). Participants' scores on the 15 items can be added up to create an overall GPIU score. As in various previous studies (92, 93), since the GPIUS2 items are referred to the use of the Internet without differentiating between different activities carried out online, for the purposes of the present study the word "Internet" has been replaced by "social networking sites" (e.g., "*I have used SNS to feel better when I was down*"). In the current study, Cronbach's α was 0.90.

The online survey was administered to a pilot sample of 10 undergraduate volunteers (four men and six women), in order to explore possible difficulties with the items and the online survey.

Statistical Analyses

Descriptive statistics were performed using the Statistical Package for Social Sciences SPSS (Version 23 for Windows) and it was used to assess the means, standard deviation of the variables, and confidence interval of means (CI: 95%). Independent *t*-tests were used to assess gender differences, and the magnitude of the differences was evaluated with effect sizes (Cohen's *d*). Pearson's correlations between the study variables were performed. A parallel mediation analysis was conducted by using Model 4 of Hayes's (94) Process Macro for SPSS to explore the mediating effect of online communication attitude and relational closeness between the fear of missing out and the problematic SNSs use. The bootstrapping method was used to produce 95% bias-corrected confidence intervals (CI) for the magnitude of these effects based on 1,000 resamples of the data. Based on previous studies (46, 47) we expected the magnitude for the direct effect between FoMO and PSNSU to be medium in effect size. With $\alpha = 0.05$ and power $= 0.80$, a sample size to detect a correlation of 0.30 is $N = 115$ (one-tailed). For the indirect (mediated) effects, we considered empirically-based estimates of sample-sizes needed to detect a mediated effect, presented in Fritz and McKinnon [(95), **Table 3**]. Assuming direct path coefficients of $\beta = 0.26$ and using a bias-corrected bootstrapping method, the estimated sample size to detect a mediated effect with $\alpha = 0.05$ and power $= 0.80$ is estimated to be $N = 148$. Thus, we deem our collected sample to be sufficient to detect the predicted effects.

RESULTS

Descriptive Statistics and Bivariate Correlations

Among the participants, 100% were Caucasian, 37.6% were single and only 4.3% were living alone during the quarantine. Concerning the geographical provenance, 61.9% were from Southern Italy, 23.8% were from Northern Italy, 12.9% were from Central Italy, and 1.4% were from Italian islands. The most used social media were WhatsApp (96.9%), Facebook (85%), Instagram (76.6%), Facebook Messenger (53.6%), and Twitter (16.2%). Before the forced isolation due to COVID-19, 35.3% of the participants reported that they spent 1–2 h/day on SNSs, and only 12.1% spent more than 4 h/day. During the quarantine, the percentage corresponding to 1–2 h/day significantly decreased to 15.4%, and 36.4% of the participants declared that they spent more than 4 h/day social networking [$\chi^2_{(25)} = 449.16$; $p < 0.001$; phi = 0.96].

Descriptive statistics and gender differences are reported in **Table 1**. No gender-related statistically significant differences have been found except in h/day spent on SNSs during the COVID-19 pandemic, with women obtaining higher mean scores than men with a moderate effect size.

Bivariate correlations between all variables are shown in **Table 2**. Overall, statistically significant positive correlations were found among Fear of Missing Out, online communication attitudes (i.e., online self-disclosure and online social connection), relational closeness, and problematic social networking sites use, as expected. Moreover, the higher the Fear of Missing Out levels, the higher the hours per day on SNSs during COVID-19 pandemic and problematic social networking sites use.

Parallel Mediation Analysis

In order to test the direct and indirect effect of Fear of Missing Out on problematic social networking sites use *via* the online communication attitude and relational closeness, a parallel mediational analysis was conducted. As shown in **Table 3**, after controlling for participants' gender (females coded as 0, males coded as 1; $\beta = 0.036$; $p = 0.64$, ns), age ($\beta = 0.001$; $p = 0.87$, ns), marital status (single coded as 0, in a relationship coded as 1; $\beta = -0.106$; $p = 0.18$, ns), living alone during the quarantine (no coded as 0, yes coded as 1; $\beta = 0.124$; $p = 0.53$, ns), and the difference between h/day spent on SNSs during and before the COVID-19 pandemic ($\beta = 0.104$; $p < 0.05$), the Fear of Missing Out had a significant direct effect on online self-disclosure ($t = 8.208$; $p < 0.001$), online social connection ($t = 7.9$; $p < 0.001$), and relational closeness ($t = 4.188$; $p < 0.001$). Moreover, self-disclosure and social connection had a significant direct effect on problematic SNSs use ($t = 9.39$; $p < 0.001$ and $t = 7.842$; $p < 0.001$, respectively), whereas relational closeness did not show a significant effect ($t = 0.391$; $p = 0.70$). Finally, the positive and significant direct effect of fear of missing out on problematic social networking ($t = 5.943$; $p < 0.001$) increased in magnitude when mediators were included in the model ($t = 11.13$; $p < 0.001$). Analysis of the bias-corrected confidence intervals of the

TABLE 1 | Means, standard deviations (SD), *t*-test, effects sizes (Cohen's *d*) for both genders, and confidence intervals (CI).

	Total sample	Males	Females			
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**t**	***d***	**95% CI**
Hour/day spent on SNSs before the COVID-19 pandemic	2.92 (1.321)	2.82 (1.394)	2.99 (1.267)	1.395	0.13	−0.069;0.409
Hour/day spent on SNSs during the COVID-19 pandemic	3.95 (1.467)	3.65 (1.472)	4.15 (1.432)	3.721***	0.34	0.235;0.760
Fear of missing out	2.346 (0.743)	2.28 (0.756)	2.387 (0.734)	1.509	0.14	−0.033;0.248
OCA self-disclosure	2.443 (1.33)	2.565 (1.403)	2.366 (1.278)	−1.559·	0.14	−0.45;0.052
OCA social connection	3.641 (1.366)	3.653 (1.413)	3.634 (1.338)	−0.140	0.01	−0.277;0.24
Relational closeness	4.404 (1.271)	4.347 (1.252)	4.439 (1.284)	0.758·	0.07	−0.148;0.333
Problematic SNS use	2.535 (1.107)	2.566 (1.153)	2.515 (1.078)	−0.480	0.04	−0.26;0.158

OCA, Online Communication Attitude.
****$p < 0.001$.*

TABLE 2 | Bivariate correlations between all variables estimated with 1,000 bootstrap sample.

	1	2	3	4	5	6	7	8	9	10
1. Gender	–									
2. Age	0.02	–								
3. Marital status	−0.23***	0.20***	–							
4. Living alone during COVID-19	−0.09*	−0.18***	0.11*	–						
5. Hours/day on SNSs during COVID-19 pandemic	−0.17***	−0.23***	−0.10*	0.05	–					
6. Fear of missing out	−0.07	−0.39***	−0.17***	0.07	0.22***	–				
7. OCA self-disclosure	0.07	−0.21***	−0.18***	−0.07	0.22***	0.41***	–			
8. OCA social connection	0.01	−0.30***	−0.09	0.01	0.24***	0.42***	0.49***	–		
9. relational closeness	−0.04	−0.17***	−0.10*	0.11*	0.21***	0.25***	0.14**	0.25***	–	
10. Problematic SNS use	0.02	−0.27***	−0.18***	<0.00	0.39***	0.52***	0.61***	0.59***	0.21***	–

OCA, Online Communication Attitude.
**$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.*

TABLE 3 | Direct and indirect effect of the fear of missing out on problematic SNS use via online communication attitudes and relational closeness.

			BCa 95% CI	
	Coeff.	**SE**	**Lower**	**Upper**
Path estimates				
Gender (male)	0.036	0.077	−0.115	0.187
Age	0.001	0.004	−0.008	0.009
Marital status (in relationship)	−0.106	0.079	−0.262	0.049
Living alone during the quarantine	0.124	0.196	−0.261	0.508
Difference between h/day on SNSs during and before the COVID-19	0.104**	0.034	0.037	0.172
FoMO→Online self-disclosure	0.682***	0.083	0.519	0.845
FoMO→Online social connection	0.671***	0.085	0.504	0.838
FoMO→Relational closeness	0.356***	0.085	0.189	0.523
Online self-disclosure→PSNSU	0.301***	0.032	0.238	0.365
Online social connection→PSNSU	0.249***	0.032	0.186	0.311
Relational closeness→PSNSU	0.012n.s.	0.03	−0.047	0.07
Total effect: FoMO→PSNSU	0.723***	0.065	0.595	0.850
FoMO→PSNSU	0.346***	0.058	0.232	0.460
			BCa 95% CI	
	Effect	**SE**	**Lower**	**Upper**
Indirect effects				
Total	0.377	0.047	0.291	0.473
M1	0.206	0.038	0.138	0.284
M2	0.167	0.029	0.114	0.228
M3	0.004	0.011	−0.016	0.028

FoMO, Fear of Missing Out; PSNSU, Problematic Social Networking Sites Use; M1, Online self-disclosure; M2, Online social connection; M3, Relational closeness.
$^{**}p < 0.01$; $^{***}p < 0.001$. n.s., non-significant.

indirect effect of Fear of Missing Out on problematic SNSs use in the bootstrapped samples further revealed that the indirect effects *via* self-disclosure and social connection were significant. The total model accounted for a significant amount of variance in participants' problematic social networking [$R^2 = 0.54$; $F_{(9,447)} = 58.285$, $p < 0.001$].

DISCUSSION

The present study aimed to explore the direct and indirect effect of FoMO on problematic SNS use *via* individuals' online communication attitude and relational closeness in a sample of Italian adults during the COVID-19 lockdown phase. It has been hypothesized that the use of SNSs would have been grown in this specific circumstance in order to preserve social connections and that FoMO would have been acted as a predictor of PSNSU. Moreover, we hypothesized that this predictive role would have been mediated by the attitude toward online self-disclosure and social connection and by the effect of the relational closeness to others *via* social interactions. Our results only partially confirmed these hypotheses. As expected, participants declared they spent more time on SNSs during the pandemic, particularly women, thus supporting previous results showing an increase in the hours per day spent using social media during the pandemic (31). Furthermore, our findings are aligned with all the previous results concerning the association between FoMO and PSNSU [e.g., (41, 46)] as FoMO directly predicted PSNSU. However, our results also built upon these previous studies as they highlight that the association remains stable in a period when one of the aspects of the psychological reality that this construct represents (i.e., others' socially rewarding experiences) has been drastically reduced because of the lockdown. The fear of being excluded from what's going on "outside" might have been transferred to what's going on "at home," in the experience of online social encounters among friends that constituted the only chance to socialize that people had during the pandemic isolation. Moreover, the need for "ego validation" through comparison, which usually underlies individuals' use of social media and their fear of being excluded, might have been high, despite the social restrictions that limited people's behaviors inside their homes. Indeed, comparison, emotional sharing and social encounters have probably been addressed toward what friends were doing at home. Furthermore, we hypothesized that online communication attitudes (i.e., attitudes toward online social connectiveness and self-disclosure as well as the need of relational closeness *via* online interactions) would have been influenced by the experience of FoMO from the online environment, in times of offline social restrictions, consequently promoting a problematic use of SNSs. Our findings confirmed our hypothesis highlighting the influence that OCA—and particularly online self-disclosure—has in predicting the problematic use of SNSs under these circumstances. The predictive role of online communication attitudes with respect to problematic Internet use had already been highlighted by a previous study (56), but it has not been previously investigated in the context of social media use. Therefore, the current study builds upon previous results by showing that individuals' attitudes to online self-disclosure and social connection is involved in the link between FoMO and PSNSU. Conversely, and unexpectedly, relational closeness across SNSs did not predict individuals' use of SNS. We hypothesized that, during the COVID-19-induced social restrictions, individuals' use of social media would have been increased also because of the need to feel close to friends *via* online social connections, experiencing emotional closeness to the others and searching for support from close ties (62, 63) during these difficult circumstances. However, the present findings showed the pivotal role of attitudinal variables toward online communication, which seem to strongly predict individuals' development/maintenance of interpersonal relationships *via* SNSs (57), whereas we did not find a support for the role of relational closeness. Moreover, people's increase in SNS misuse seems to be a reaction to FoMO strengthened by individuals' trait-like attitudes toward online social connections and self-disclosure, more than by individuals' need to experience closeness to the others.

We can assume that the COVID-19 restrictions strengthened individual's use of social media and that those experiencing FoMO tried to regulate their fears by means a massive/problematic SNS use, improved by their preexisting attitudes toward online communication which might be reinforced, on their own, by this specific circumstance of social-distancing. These findings need to be addressed, as they seem to suggest that online communication trait-like attitudes might be a potential risk factor for social media misuse/abuse if linked to a real experience of social isolation and/or a fear of being deprived of the possibility of relatedness with others and of being involved in their experiences. However, further exploration on the association between FoMO and OCA are needed.

Moreover, although SNS use temporarily acted as a useful coping strategy with which to face social isolation (26, 29, 30), their massive use in this specific circumstance could have long-lasting effects on people with high levels of separation anxiety and fears of being excluded, and on those individuals who are more prone to using online communication strategies for connection and self-disclosure. Thus, longitudinal designs are greatly needed to analyze the pandemic's effects on social media use in different populations in greater depth, and the differences and similarities between different cultural contexts should be explored together with age and gender differences. The current study has some limitations that need to be addressed. First, the cross-sectional design limited the ability to formally test the causative effects. Second, the well-known risk of desirability biases due to the use of self-reported measures is also prevailing. Moreover, while considering the risks and the opportunities due to the online data collection (96), this study was conducted during the period of COVID-19 pandemic and specifically focused on individuals' behavior during the lockdown, thus online administration was the only possible and useful data collection among the population. Finally, since the current study refers to individuals' behavior across SNS during the COVID-19 epidemic, we cannot assume that their social media use would have been the same in different conditions. Therefore, our findings cannot be generalized. However, further research should investigate in-depth the influence that individuals' attitudes toward social connectiveness, self-disclosure and relational closeness across SNSs, could have on their use of social media in more regular circumstances. Indeed, within this context online relational closeness neither acted as a predictor nor as a mediator of problematic SNS use, although this feature is still little studied. Further research could explore the role that experiencing intimacy and emotional closeness across SNSs might have on a non-problematic use of social media, taking into account cultural, gender and age differences. Despite these limitations, the current findings have some theoretical and clinical implications. They built upon previous results regarding the effect of FoMO levels on PSNUS by showing that the usefulness of SNSs to regulate this specific fear remains stable during the experience of isolation and separation. Accordingly, this association between FoMO and PSNSU deserves clinical interest, especially considering the unexplored role of OCA in this relationship. Indeed, further exploration is needed on the role of online communication as a trait-like attitude potentially influencing individuals' unregulated use of social media. This study suggests deepening the risks related to the connection between the experience of FoMO and online self-disclosure and social connection. The fear to be excluded/invisible and the consistent urgency to become visible within the media environment should be carefully questioned also relating to identity developmental issues, as they both might widely affect online social encounters and promote dangerous individuals' hyper-self-disclosure or false self-presentation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Committee of Psychological Research - Department of Humanities University of Naples Federico II. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

VB designed the study and contributed to writing a first draft of the manuscript. FG contributed to data collection, statistical analysis, and contributed to writing the first draft of the manuscript. GF contributed to developing methodology and statistical analysis. SC revised the whole work critically for important intellectual content. All authors read and approved the final version of the work.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

OPINION
published: 18 February 2021
doi: 10.3389/fpsyt.2021.634254

Alcohol and Tobacco Use During the COVID-19 Pandemic. A Call for Local Actions for Global Impact

Rodrigo Ramalho[1]*, Frances Adiukwu[2], Drita Gashi Bytyçi[3], Samer El Hayek[4], Jairo M. Gonzalez-Diaz[5], Amine Larnaout[6], Laura Orsolini[7], Victor Pereira-Sanchez[8], Mariana Pinto da Costa[9,10,11], Ramdas Ransing[12], Mohammadreza Shalbafan[13], Zulvia Syarif[14] and Paolo Grandinetti[15]

[1] Department of Social and Community Health, School of Population Health, University of Auckland, Auckland, New Zealand, [2] Department of Neuropsychiatry, University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria, [3] Community Based Mental Health Center and House for Integration Prizren, Hospital and University Clinical Service of Kosovo, Prizren, Kosovo, [4] Department of Psychiatry, American University of Beirut, Beirut, Lebanon, [5] CERSAME, School of Medicine and Health Sciences, Universidad del Rosario - Clínica Nuestra Señora de la Paz, Bogotá, Colombia, [6] Department of Psychiatry, Faculty of Medicine of Tunis, Razi Hospital, Tunis El Manar University, Tunis, Tunisia, [7] Unit of Clinical Psychiatry, Department of Neurosciences/DIMSC, Polytechnic University of Marche, Ancona, Italy, [8] Department of Child and Adolescent Psychiatry, NYU Grossman School of Medicine, New York, NY, United States, [9] Unit for Social and Community Psychiatry, Queen Mary University of London, London, United Kingdom, [10] Institute of Biomedical Sciences Abel Salazar, University of Porto, Porto, Portugal, [11] Hospital de Magalhães Lemos, Porto, Portugal, [12] Department of Psychiatry, BKL Walalwalkar Rural Medical College, Kasarwadi, India, [13] Mental Health Research Center, Department of Psychiatry, School of Medicine, Iran University of Medical Sciences, Tehran, Iran, [14] Department of Psychiatry, Tarakan General Hospital, Jakarta, Indonesia, [15] Addictions Services (SerD), Department of Territorial Assistance, ASL Teramo, Teramo, Italy

Keywords: COVID-19, pandemic, public health, alcohol, tobacco, alcohol policy, tobacco control

OPEN ACCESS

Edited by:
Ornella Corazza, University of Hertfordshire, United Kingdom

Reviewed by:
Marianna Mazza, Catholic University of the Sacred Heart, Italy
Gabriel Rubio, University Hospital October 12, Spain
Hollis C. Karoly, Colorado State University, United States

****Correspondence:***
Rodrigo Ramalho
r.ramalho@auckland.ac.nz

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *27 November 2020*
Accepted: *19 January 2021*
Published: *18 February 2021*

Citation:
Ramalho R, Adiukwu F, Gashi Bytyçi D, El Hayek S, Gonzalez-Diaz JM, Larnaout A, Orsolini L, Pereira-Sanchez V, Pinto da Costa M, Ransing R, Shalbafan M, Syarif Z and Grandinetti P (2021) Alcohol and Tobacco Use During the COVID-19 Pandemic. A Call for Local Actions for Global Impact. Front. Psychiatry 12:634254. doi: 10.3389/fpsyt.2021.634254

Faced with the COVID-19 pandemic, the world was forced to adopt strong public health measures, such as travel restrictions, physical distancing, and self-isolation. Prolonged periods of self-isolation, like the one imposed by the ongoing pandemic, may have serious repercussions on people's mental health (1, 2). For example, these restrictive measures could potentially lead to an increase in the incidence of risky behaviors, like smoking or excessive alcohol use and medical conditions due to increasing smoking and alcohol use, as well as an increased risk of domestic violence (3–9). Furthermore, harmful patterns of substance use, including hazardous patterns of drinking and smoking, represent a risk during lockdowns due to the prolonged periods of self-isolation necessary to control the transmission of the virus (1, 10, 11). Unfortunately, despite ongoing research efforts, there is still sparse information about the impact of the COVID-19 pandemic on substance use patterns.

We conducted a search on August 8th, 2020 for peer-reviewed publications in English using three databases: PubMed, ProQuest, and Web of Science. We searched for publications that had the following keywords in their titles: "alcohol" or "drinking" or "smoking" or "nicotine" or "cigarette" or "cigarettes" or "cigar" or "cigars" and "COVID-19" or "pandemic" or "SARS-CoV-2," a search that led to ∼300 publications. We found two publications regarding potential changes in tobacco use patterns due to the pandemic in the general population. One, a study describing a survey conducted in the United States of America (USA), where almost half of the respondents reported no changes in their smoking patterns, and about a quarter reported having reduced their cigarette smoking (12). There was also a study reporting an increase in tobacco quit attempts during COVID-19 in Italy, India, South Africa, the United Kingdom (UK), and the USA (13), with similar findings being reported in Turkey (14).

Regarding alcohol use, we found a publication reporting an increase in alcohol sales during the early stages of the pandemic in the UK (15). We also found a report of a higher rate of harmful alcohol consumption in the province of Hubei, China (16), a report of a higher rate of alcohol use associated with COVID-19 related psychological distress in the USA (17), and one of increased alcohol use following the closure of a university campus in Ohio, USA (18). We also found two studies reporting an increase in alcohol withdrawal syndrome in India, following lockdown measures (19, 20). In a survey conducted in Germany, 35% of respondents reported consuming more alcohol during lockdown (vs. ∼38% who reported no changes) (21); and one in Poland found that 14% of the respondents used more alcohol during the COVID-19 pandemic (vs. 16% who reported drinking less) (22).

To complement this search, the authors also looked for country-specific information regarding restrictions on alcohol and tobacco sales, if there were any, and changes in patterns of alcohol and tobacco use in their respective countries. To conduct this search, the first and last authors invited fellow mental health professionals, members of a team connected through the World Psychiatric Association (WPA) (23), to share information related to their country. The resulting team comprised members from a diverse range of countries. These countries included lower-middle-income (India, Nigeria, Indonesia, and Tunisia), upper-middle-income (Colombia, Lebanon, Iran) and high-income countries (Italy, USA), plus one non-United Nations' country, Kosovo. Official reports and literature review of emerging knowledge about COVID-19 and its impact on these issues were the preferred data source. However, the scarcity of information retrieved from those sources made it necessary for the team also to resort to local media outlets, polls, and anecdotal evidence portrayed in the media.

Restrictions on alcohol sales as a response to the pandemic vary among countries represented in our team, within a continuum that goes from total alcohol ban to no restrictions besides those caused by physical distancing. In India, for example, there was a nationwide alcohol ban during initial stages of lockdown (24), which seemed to have led to an increased incidence of cases of alcohol withdrawal syndrome during that time (19, 20). In later stages, some states, like Delhi, implemented a "special corona fee" on all categories of liquor, a fee currently withdrawn (25). Iran had banned the marketing and consumption of alcoholic beverages decades before the pandemic (26). However, rumors about alcohol consumption as a protective factor against the virus were reported to have led to more than 700 deaths due to methanol intoxication in that country, a common adverse event that follows drinking homemade contaminated alcoholic beverages (27–29). In Tunisia, a few local governors closed liquor stores in their regions (30).

In most countries, however, even during stricter lockdown periods, alcohol sales have been allowed in liquor stores, supermarkets, and retailers. In Nigeria, alcoholic beverages are considered essential commodities, with liquor stores exempted from the lockdown (31), despite the closing down of bars and clubs. Similarly, in the USA, liquor stores were considered essential businesses and they remained open during the times of stricter lockdown (except for the state of Pennsylvania). A survey published in early April showed that drinking had increased in some populations in the USA, including people with previous hazardous drinking patterns (32); also, there are reports of an overall increase in alcohol sales nationwide (33). In Colombia, an online survey reported alcohol to be the second most consumed substance during the COVID-19 related quarantine, after cannabis (34). In Italy, and apparently facing a rise in alcohol consumption, health officials published a report debunking some misinformation about alcohol use as a protective factor against the virus (35). On the other hand, there seems to be a reduction in alcohol sales and consumption in Indonesia (36).

There have been no restrictions on tobacco sales in any of the contributing authors' countries. However, in Colombia, cigar shops can only remain open as long as they also distribute food and basic necessities. In India and the USA, accessibility to tobacco via retailers has varied across states. In the USA, there were reports of tobacco sale increases (13, 37). An increase in tobacco use at home was reported in Italy and India (13). Still, a survey conducted by Yach (13) reported a rise in tobacco quit attempts in the USA, India, and Italy. In Colombia, a recent survey reported that 8% of the respondents have experimented with tobacco for the first time during the pandemic (34). In Indonesia (38), tobacco use has decreased during the lockdown, while a report in March suggests the same happening in Tunisia (39).

Our findings concur with the suggestions made by other authors that, during the COVID-19 pandemic, tobacco and alcohol use patterns have been influenced by societal and cultural processes, as well as by local alcohol control policies (40, 41). We found various factors potentially playing a role in a country's trend of alcohol and tobacco use during the current pandemic besides public health and trading policies, such as public health campaigns and misinformation, socioeconomic conditions, cultural background, and the prevalence of substance use disorder or psychological distress.

The pandemic has led the world to recognize the need for global action in order to support people's health and well-being. It is necessary for all countries to develop measures that will support the entire population during this time of crisis, including people with a substance use disorder. These measures should incorporate effective demand, supply, and harm reduction strategies to reduce risky substance use and substance-related harm. In regard to alcohol and tobacco, potential ways forward include revising local alcohol and tobacco licensing systems and reducing hours of sale, reducing availability via carry out and delivery services, promoting help seeking and reducing stigma around it, providing sustained public health promotion campaigns, and fostering diversion initiatives that could be conducted while observing physical distancing. It is of the utmost importance for any strategy to be evidence informed, locally relevant, culturally appropriate, and equitable. In other words, it is relevant and necessary local actions that would lead to global impact, and the time for action is now.

AUTHOR CONTRIBUTIONS

RRam and PG developed the concept of this manuscript and discussed it with FA, DG, SE, JG-D, AL, LO, VP-S, MPC, RRan, MS, and ZS. FA, DG, SE, JG-D, AL, LO, VP-S, RRan, MS, ZS, and PG provided country-specific information. RRam and PG wrote the initial draft and FA, DG, SE, JG-D, AL, LO, VP-S, MPC, RRan, MS, and ZS edited and approved the final version for submission. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 23 February 2021
doi: 10.3389/fpsyt.2021.634583

The Influence of Trait Compulsivity and Impulsivity on Addictive and Compulsive Behaviors During COVID-19

Lucy Albertella[1]*, *Kristian Rotaru*[1,2], *Erynn Christensen*[1], *Amelia Lowe*[1], *Mary-Ellen Brierley*[1], *Karyn Richardson*[1], *Samuel R. Chamberlain*[3], *Rico S. C. Lee*[1], *Edouard Kayayan*[1], *Jon E. Grant*[4], *Sam Schluter-Hughes*[1], *Campbell Ince*[1], *Leonardo F. Fontenelle*[1,5,6], *Rebecca Segrave*[1†] and *Murat Yücel*[1†]

[1] BrainPark, Turner Institute for Brain and Mental Health, Monash University, Clayton, VIC, Australia, [2] Monash Business School, Monash University, Caulfield, VIC, Australia, [3] Department of Psychiatry, University of Southampton, Southampton, United Kingdom, [4] Department of Psychiatry and Behavioral Neuroscience, University of Chicago, Chicago, IL, United States, [5] Obsessive, Compulsive, and Anxiety Spectrum Research Program, Institute of Psychiatry, Federal University of Rio de Janeiro (UFRJ), D'Or Institute for Research and Education (IDOR), Rio de Janeiro, Brazil, [6] D'Or Institute for Research and Education, Rio de Janeiro, Brazil

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United States

***Correspondence:**
Lucy Albertella
lucy.albertella@monash.edu

†These authors share senior authorship

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 28 November 2020
Accepted: 29 January 2021
Published: 23 February 2021

Citation:
Albertella L, Rotaru K, Christensen E, Lowe A, Brierley M-E, Richardson K, Chamberlain SR, Lee RSC, Kayayan E, Grant JE, Schluter-Hughes S, Ince C, Fontenelle LF, Segrave R and Yücel M (2021) The Influence of Trait Compulsivity and Impulsivity on Addictive and Compulsive Behaviors During COVID-19. Front. Psychiatry 12:634583. doi: 10.3389/fpsyt.2021.634583

Background: The COVID-19 pandemic has resulted in high levels of psychological distress worldwide, with experts expressing concern that this could result in corresponding increases in addictive behaviors as individuals seek to cope with their distress. Further, some individuals may be at greater risk than others for developing problematic addictive behaviors during times of high stress, such as individuals with high trait impulsivity and compulsivity. Despite the potential of such knowledge to inform early detection of risk, no study to date has examined the influence of trait impulsivity and compulsivity on addictive behaviors during COVID-19. Toward this aim, the current study examined the association between impulsive and compulsive traits and problematic addictive and compulsive behaviors during the first COVID-19 lockdown in Australia.

Methods: Eight hundred seventy-eight adults completed a cross-sectional online survey during the first lockdown, between late May to June 2020. Participants completed scales for addictive and compulsive behaviors for the period prior to and during lockdown for problematic eating, pornography, internet use, gambling, drinking, and obsessive-compulsive behaviors. Negative binomial regressions examined the associations between impulsivity, compulsivity, and their interaction with problematic behaviors during lockdown, controlling for age, gender, sample, psychological distress, exposure to COVID-related stressors, and pre-COVID problems.

Results: Greater trait compulsivity was associated with more problematic obsessive-compulsive behaviors ($p < 0.001$) and less problematic drinking ($p = 0.038$) during lockdown. Further, trait compulsivity interacted with trait impulsivity in relation to problematic eating behaviors ($p = 0.014$) such that greater trait compulsivity was associated with more problems among individuals with low impulsivity only ($p = 0.030$). Finally, psychological distress and/or exposure to COVID-related stressors were associated with greater problems across all addictive and compulsive behaviors, as was severity of pre-COVID problems.

Discussion: Trait compulsivity was associated with addictive and compulsive behaviors in different ways. Further, the finding that stress-related variables (psychological distress and COVID-related stressors) were associated with greater problems across all lockdown behaviors supports the idea that stress may facilitate, or otherwise be associated with, problematic behaviors. These findings highlight the need for interventions that enhance resilience to stress, which in turn may reduce risk for addictive and compulsive disorders.

Keywords: compulsivity, impulsivity, addiction, OCD, COVID-19

INTRODUCTION

Stress is a well-known risk factor across addictive and compulsive behaviors (1, 2). This knowledge has led to the general expectation that such behaviors will increase during the COVID-19 pandemic (3–6), considered a stressful time worldwide due to health and financial concerns, lockdown-related social isolation, and life disruption. While studies suggest that some addictive and compulsive behaviors may have increased during COVID-19, including problematic internet use (7), drinking (8), and obsessive-compulsive behaviors (9), this has not been the case across the board. Particularly, reports of gambling-related harm suggest a decrease during lockdown (10, 11), and there have been mixed findings for obsessive-compulsive behaviors [e.g., (12)]. An emerging body of research suggests that lockdown-related changes in addictive and compulsive behaviors may be predicted by, or otherwise related to, behavior-specific factors, such as motives [e.g., (13)] and pre-existing severity (6, 10, 14). However, individual characteristics also play a role [e.g., (15)]. This pattern of findings is not unique to COVID-19; there is a wealth of past research showing that while stressful life events generally increase risk for addictive and compulsive behaviors (16–19), the extent to which they do is influenced by individual differences (20–22). As such, COVID-19 provides an invaluable context within which to better understand (and thereby address) individual-level risk factors for psychopathology.

It is generally accepted that, at least under non-pandemic circumstances, trait impulsivity is associated with risk *across* the spectrum of addictive and compulsive disorders (23–31). Briefly, impulsivity refers to the tendency to act without thinking, especially when the consequences of such action are inappropriate to the situation (32, 33). There is a large body of evidence showing that greater trait impulsivity is associated with more problematic addictive and compulsive behaviors, including for alcohol use, gambling, internet use, binge eating, pornography, as well as obsessive-compulsive behaviors (24, 30, 34–40). Another risk factor for addictive and compulsive behaviors is compulsivity, that is, the tendency to engage in repetitive, habitual behaviors that are difficult to control or interfere with current goals (27, 41–46). Indeed, higher levels of trait compulsivity have been found to be associated with addictive and compulsive behaviors, including problematic alcohol use, internet use, binge eating, gambling, and obsessive-compulsive behaviors (35, 37, 46, 47). Further, research suggests that impulsivity and compulsivity may interact such that individuals with high levels on both compulsive and impulsive traits are at greatest risk of problematic impulsive-compulsive behaviors (23, 29, 35). For instance, individuals characterized by high impulsivity and high compulsivity have been shown to have more severe obsessive-compulsive symptoms (29) and problematic eating (48). Similarly, this interaction is seen at the cognitive level, with higher levels of both impulsive and compulsive cognitive traits being associated with more problematic alcohol use and obsessive-compulsive behaviors (35).

Arguably, this risk profile (high impulsivity, high compulsivity) might contribute to more problematic addictive and compulsive behaviors during lockdown. For instance, while individuals with high impulsivity and low compulsivity might engage in impulsive behaviors during lockdown, they would not engage in the same impulsive behavior routinely. On the other hand, individuals with high compulsivity and low impulsivity might engage in certain behaviors routinely during lockdown but might be able to inhibit these newly adopted routine behaviors should they become maladaptive. However, when these traits are combined, an individual might engage in routine coping behaviors (due to compulsive tendencies) and have difficulty inhibiting these behaviors if they become maladaptive (due to the impaired response inhibition that characterizes impulsivity). Thus, individuals with high compulsivity and high impulsivity may be at greater risk of developing persistent, maladaptive coping behaviors during the current pandemic. This risk may further increase with time, as impulsive behaviors become coping strategies (through reinforcement) and routine behaviors become habits. Intervening early in the course of impulsive-compulsive behaviors, before behaviors become entrenched, is critical to curtailing progression to addictive and compulsive disorders (44).

Early detection of risk for impulsive-compulsive disorders may be especially important during the current pandemic as problematic behaviors may become entrenched more quickly under times of high stress. Specifically, stress may facilitate progression toward problematic compulsive behaviors by promoting a shift toward habit learning and/or otherwise supporting the maladaptive expression of learned behaviors (44, 49–54). Through facilitating these mechanisms, stress may effectively shorten the window of time that a behavioral pattern is malleable. Thus, early detection of risk during COVID-19 (a stressful period for many) is critical to enabling timely access to interventions, before addictive and compulsive behaviors become harder to modify. The current study therefore aimed to examine the potential of trait compulsivity and impulsivity as risk markers for problematic addictive and compulsive behaviors during the first lockdown of COVID-19. Specifically, this study examined the associations between trait compulsivity, impulsivity, and their interaction on problematic internet use, drinking, eating, pornography use, gambling, and obsessive-compulsive behaviors during COVID-19. Obsessive-compulsive behaviors were examined alongside addictive behaviors in line with transdiagnostic models of compulsive behaviors (42, 44, 55), as well as the recent conceptualization of OCD as a behavioral addiction (56). In line with the idea that impulsive and compulsive traits may pre-dispose individuals to developing problematic behaviors, especially during times of high stress, we hypothesized that impulsivity and compulsivity would interact in relation to problematic behaviors during lockdown. Specifically, we hypothesized that individuals with high compulsivity *and* high impulsivity would report the greatest increases in addictive and compulsive behaviors during lockdown.

METHOD

Participants

Participants included in the study were 992 adults (18 years and above). The current analyses exclude participants who did not complete all the general study measures (trait impulsivity and compulsivity, COVID events, and psychological distress), which were 114 in total. Thus, the resulting study sample includes 878 participants. Participants were recruited through two methods: (1) general advertisements on Facebook, twitter, and other social media platforms, and reimbursement was entry into a draw to win one of 50 $100 JB HiFi vouchers, and (2) Prolific online participant recruitment platform targeting individuals residing in Australia, and reimbursement was £7.50 per hour. The current study includes 214 community participants and 664 prolific participants.

All study procedures were carried out in accordance with the Declaration of Helsinki. The Monash University Human Research Ethics Committee ethically reviewed and approved the study.

Measures

Demographic information such as age and gender was collected, and participants completed the following questionnaires:

Short UPPS-P Impulsivity Scale [S-UPPS-P; (57)]: This is a 20-item scale that measures impulsivity traits with five subscales: Negative Urgency, the tendency toward impulsive action when experiencing strong negative emotions (e.g., "When I am upset, I often act without thinking"); Positive Urgency, the tendency toward impulsive action when experiencing strong positive emotions; Lack of Perseverance; Lack of Premeditation; and Sensation Seeking. For each item, participants selected whether the extent to which they agreed or disagreed with statements describing ways in which people act and think (generally, i.e., no timeframe was specified). Response options were "strongly disagree," "disagree somewhat," "agree somewhat," or "strongly agree," scored as 1–4, respectively (or 4–1 for reverse items). The present study used total S-UPPS-P score as the measure of interest.

The Cambridge-Chicago Compulsivity Trait Scale [CHI-T; (47)]. This is a 15-item scale covering broad aspects of compulsivity including the need for completion or perfection, being stuck in a habit, reward-seeking, desire for high standards, and avoidance of situations that are hard to control. For each item, participants selected whether the statement applied to them (generally, i.e., no timeframe was specified) by selecting "strongly disagree," "disagree," "agree," or "strongly agree," scored as 0–3, respectively. The measure of interest was the total score.

COVID-related events: An 8-item checklist of COVID-related events was used to gauge exposure to stressors from the start of the pandemic. These eight items were taken from a measure of potentially stressful COVID-related events [COROTRAS; (58, 59)]. Specifically, these items asked about worsening of financial situation; reduced time in paid employment; being diagnosed with COVID-19; having a family member or significant other diagnosed with COVID-19; having experienced a cough or fever during the pandemic; being kept away from home (in another state or country) because of COVID-19; having family member or significant other share space with a suspected or confirmed case of COVID-19 or being in a position where they are exposed to lots of people; and having to work or be exposed against your wishes to any activity associated with a high risk of contracting COVID-19. The measure was in the form of a checklist (with a score of 1 given for each event experienced) the total score was used in the present study (i.e., total number of events experienced).

K10 (60): This is a 10-item scale designed to measure past month psychological distress. Each item is rated on a 5-point scale as follows: None of the time (1); A little of the time (2); Some of the time (3); Most of the time (4); or All of the time (5). The measure of interest was the total score. We adjusted for psychological distress given research showing that it is associated with increases in addictive behaviors during COVID-19 (61) as well as its elevation during COVID-19 (62, 63). The total score was used in the present study.

Problematic Behavior Scales

Modified Yale Food Addiction Scale 2.0 [mYFAS2.0; (64)]: This scale is a 13-item scale designed to measure addiction-like eating behaviors in accordance with the DSM5 diagnostic criteria for addictive disorders, with additional items asking about distress and interference as a result of the eating behaviors. All participants completed the mYFAS 2.0. The scale was modified to cover a month timeframe and response options were modified as follows: Never (1); 1–3 times/month (2); 1–3 times/week; (3); 4+ times/week (4). Further, each scale item was asked in relation to both (a) the month prior to the onset of the first COVID-19 restrictions and (b) the past month, during COVID-19 restrictions. The current study used total scores for each timeframe (pre-COVID and lockdown) as the measures of interest.

Young's Internet Addiction Test, Short Version [IAT; (65)]: This is a 12-item version of Young's IAT developed to measure Problematic Usage of the Internet. Only participants who reported excessive use of the internet in the past 3 months were asked to complete the IAT. Each scale item was asked in relation to both (a) the month prior to the onset of the first COVID-19 restrictions and (b) the past month, during COVID-19 restrictions. Item response options were as follows: Never (0); Rarely (1); Sometimes; (2); Often (3); and Very often (4). The current study used total scores for each timeframe (pre-COVID and lockdown) as the measures of interest.

Short Version of the Problematic Pornography Consumption Scale [PPCS-6; (40)]: This is a 6-item scale designed to measure problematic pornography use. Only participants who reported watching pornography in the past 3 months were asked to complete the PPCS-6. Each scale item was asked in relation to both (a) the month prior to the onset of the first COVID-19 restrictions and (b) the past month, during COVID-19 restrictions. Item response options were as follows: Never (1); Sometimes; (2); Often (3); and Very often (4). The current study used total scores for each timeframe (pre-COVID and lockdown) as the measures of interest.

Problem Gambling Severity Index [PGSI; derived from the 31-item Canadian Problem Gambling Index, (66)]. This is a 9-item measure of gambling harm severity. Only participants who reported gambling in the past 3 months were asked to complete the PGSI. Each scale item was asked in relation to both (a) the month prior to the onset of the first COVID-19 restrictions and (b) the past month, during COVID-19 restrictions. Item response options were as follows: Never (0); Sometimes; (1); Almost always (2); and Always (3). The current study used total scores for each timeframe (pre-COVID and lockdown) as the measures of interest.

Alcohol Use Disorders Identification Test [AUDIT; (67)]. The AUDIT is a 10-item self-report measure that assesses hazardous/risky alcohol consumption. Only participants who reported drinking in the past 3 months were asked to complete the AUDIT. Each scale item was asked in relation to both (a) the month prior to the onset of the first COVID-19 restrictions and (b) the past month, during COVID-19 restrictions. Response options were modified to suit the 1-month timeframe needed for the current study. For questions 1, response options were: Never (0); Once a month (1); 2–4 times/month (2); 2–3 times/week (3); 4+ times/week. For questions 3–8, response options were: Never (0); Monthly (1); Weekly (2); Daily or almost daily (3). For questions 9 and 10, participants were asked to answer yes (2) or no (0) in relation to the timeframe in question. The current study used total scores for each timeframe (pre-COVID and lockdown) as the measures of interest.

Obsessive-Compulsive Inventory Revised [OCI-R; (68)]. This is an 18-item scale enquiring about OC-related experiences. All participants were asked to complete the OCI-R. Each scale item was asked in relation to both (a) the month prior to the onset of the first COVID-19 restrictions and (b) the past month, during COVID-19 restrictions. For each scale item the individual rated how distressed or bothered they had been by this over the specified timeframe, with response options as follows: Not at all (0), A little (1), Moderately (2), A lot (3), or Extremely (4). The current study used total scores for each timeframe (pre-COVID and lockdown) as the measures of interest.

TABLE 1 | (A) Sample descriptives ($N = 878$) and (B) Pre-COVID and lockdown problematic behavior scale scores.

(A)		**Overall sample**	
Gender	% female	53%	
Age	M	32.0	
	SD	12.50	
Impulsivity	M	42.7	
	SD	7.40	
Compulsivity	M	26.8	
	SD	5.48	
Distress	Md/M	20/21.8	
	Range/SD	10–50/78.8	
COVID stressors	Md/M	2/1.6	
	Range/SD	0–5/1.7	
(B)		**Pre-COVID**	**Lockdown**
Eating ($n = 878$)	Md/M	15/17.0	15/17.4
	Range/SD	13–36/5.5	13–38/6.1
Pornography ($n = 438$)	Md/M	8/9.0	8/9.2
	Range/SD	6–19/3.0	6–20/3.2
Gambling ($n = 150$)	Md/M	1/2.9	0/2.3
	Range/SD	0–19/4.7	0–14/3.7
Internet ($n = 375$)	Md/M	15/16.2	18/19.5
	Range/SD	0–42/8.0	0–48/9.2
Alcohol ($n = 599$)	Md/M	4/4.6	3/4.5
	Range/SD	0–18/3.8	0–18/3.8
OCS ($n = 878$)	Md/M	1/4.4	3/6.0
	Range/SD	0–27/6.6	0–32/7.7

NB. Impulsivity, trait impulsivity (measured using the S-UPPS-P); Compulsivity, trait compulsivity (measured using the CHI-T); Distress, psychological distress (measured using the K10); Eating, problematic eating (measured using the mYFAS 2.0, modified for 1-month timeframe); Pornography, problematic pornography use (measured using the PPCS); Gambling, problematic gambling (measured using the PGSI, modified for 1-month timeframe); Internet, problematic internet use (measured using the IAT); Alcohol, Problematic alcohol use (measured using the AUDIT, modified for 1-month timeframe); OCS, obsessive-compulsive symptoms (measured using the OCI-R).

Statistical Analyses

The data were examined for outliers (based on Z scores >3.29), which were then winsorized. Descriptive statistics compared pre-COVID to lockdown problematic behaviors using Wilcoxon Signed Ranks Test (**Table 1**), and examined correlations across compulsivity, impulsivity, and all problematic behaviors during lockdown (**Table 2**). Six negative binomial regressions examined whether trait impulsivity (S-UPPS-P score), trait compulsivity (CHIT score), and their interaction were associated with each of the following problematic behaviors during lockdown; eating, internet use, pornography use, drinking, gambling, and obsessive-compulsive behaviors. Compulsivity scores and impulsivity scores were mean-centered according to the respective outcome group, and interaction terms calculated accordingly. All regression models adjusted for corresponding pre-COVID problematic behavior score, age, gender, sample, COVID-related events, and psychological distress (K10).

TABLE 2 | Spearman's correlation across impulsivity, compulsivity, and problematic behaviors during lockdown.

		1 Imp	2 Comp	3 Eating	4 Pornography	5 Gambling	6 Internet	7 Alcohol	8 OCS
1	rs	1.000							
	p	–							
	N	878							
2	rs	**0.181**	1.000						
	p	**<0.001**	–						
	N	**878**	878						
3	rs	**0.195**	**0.221**	1.000					
	p	**<0.001**	**<0.001**	–					
	N	**878**	**878**	878					
4	rs	**0.238**	**0.245**	**0.253**	1.000				
	p	**<0.001**	**<0.001**	**<0.001**	–				
	N	**438**	**438**	**438**	438				
5	rs	**0.329**	**0.216**	**0.370**	**0.406**	1.000			
	p	**<0.001**	**0.008**	**<0.001**	**<0.001**	–			
	N	**150**	**150**	**150**	**93**	150			
6	rs	**0.208**	**0.201**	**0.305**	**0.349**	**0.340**	1.000		
	p	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.006**	–		
	N	**375**	**375**	**375**	**210**	**65**	375		
7	rs	**0.173**	0.022	**0.127**	**0.112**	**0.311**	0.075	1.000	
	p	**<0.001**	0.583	**0.002**	**0.043**	**0.001**	0.233	–	
	N	**599**	599	**599**	**329**	**117**	251	599	
8	rs	**0.205**	**0.471**	**0.414**	**0.356**	**0.348**	**0.475**	**0.093**	1.000
	p	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.022**	–
	N	**878**	**878**	**878**	**438**	**150**	**375**	**599**	878

NB. Imp, trait impulsivity (measured using the S-UPPS-P); Comp, trait compulsivity (measured using the CHI-T); Eating, problematic eating (measured using the mYFAS 2.0, modified for 1-month timeframe); Pornography, problematic pornography use (measured using the PPCS); Gambling, problematic gambling (measured using the PGSI, 1-month timeframe); Internet, problematic internet use (measured using the IAT); Alcohol, Problematic alcohol use (measured using the AUDIT, modified for 1-month timeframe); OCS, obsessive-compulsive symptoms (measured using the OCI-R). Bolded font signifies $p < 0.05$.

Significant and trend-level interactions were followed up by dividing the sample into high and low trait impulsivity groups (by median split, according to corresponding outcome group) and running a negative binomial regression with trait compulsivity as the predictor, lockdown score of behavior in question as the dependent variable, and adjusting for the pre-COVID scale score.

Further, to provide an illustration of significant interactions, we graphed change scores (calculated as lockdown minus pre-COVID score) by high and low impulsivity and compulsivity groups (median split). This is shown in the **Supplementary Figure 1**. Finally, to support interpretation of study findings, pre-COVID behaviors were analyzed to examine their relationship with trait impulsivity and compulsivity. These analyses are also presented in the **Supplementary Materials**.

RESULTS

Participants were 878 adults (466 females; age $M = 32.0$ years, $SD = 12.5$, range 18–84). Prolific participants were younger than community participants [mean diff. = 2.5, $t_{(876)} = 2.5$, $p = 0.012$]. The community sample had relatively more females (71 vs. 47%) than the prolific sample, $X^2 = 36.6$, $p < 0.001$. The community sample also reported higher lockdown obsessive-compulsive symptoms scores than the prolific sample, $Z = -2.5$, $p = 0.012$. No other differences were found between the two samples.

As shown in **Table 1**, problematic internet use, $Z = 12.0$, $p < 0.001$, $d_{Cohen} = 0.98$, pornography use, $Z = 3.5$, $p < 0.001$, $d_{Cohen} = 0.24$, eating, $Z = 5.5$, $p < 0.001$, $d_{Cohen} = 0.27$, and obsessive-compulsive symptoms, $Z = 15.0$, $p < 0.001$, $d_{Cohen} = 0.77$, increased from pre-COVID to lockdown. In contrast, problematic gambling score decreased from pre-COVID to lockdown, $Z = -2.6$, $p = 0.011$, $d_{Cohen} = 0.30$. No differences were found for problematic drinking. As shown in **Table 2**, trait compulsivity and impulsivity were significantly correlated with all lockdown behaviors, except for problematic drinking, which did not show a significant correlation with trait compulsivity.

Problematic Eating During Lockdown

Results of the regression on lockdown problematic eating are shown in **Table 3**. Female gender was associated with increased problematic eating during lockdown ($Wald\ X^2 = 9.7$, $p = 0.002$), as was greater psychological distress ($Wald\ X^2 = 27.0$, $p < 0.001$), and higher pre-COVID problematic eating score ($Wald\ X^2 = 1{,}343.4$, $p < 0.001$). The interaction between trait

TABLE 3 | Regression results.

	B	SE	LCI	UCI	Wald X^2	p
Sample	0.008	0.0113	−0.014	0.030	0.462	0.497
Gender	**0.030**	**0.0097**	**0.011**	**0.049**	**9.358**	**0.002**
Age	7.84E-5	0.0004	−0.001	0.001	0.032	0.858
COVID stressors	0.005	0.0044	−0.004	0.013	1.065	0.302
Psych. Distress	**0.004**	**0.0008**	**0.002**	**0.005**	**26.985**	**<0.001**
Comp	3.60E-4	0.0009	−0.001	0.002	0.144	0.704
Imp	−0.001	0.0007	−0.002	0.001	0.974	0.324
Imp × Comp	**−2.47E-4**	**0.0001**	**4.44E-4**	**−5.04E-5**	**6.061**	**0.014**
Pre-COVID score	**0.044**	**0.0012**	**0.042**	**0.046**	**1343.364**	**<0.001**

DV: problematic eating behaviors during lockdown (N = 878). Bolded font signifies p < 0.05.

TABLE 4 | Regression results.

	B	SE	LCI	UCI	Wald X^2	p
Sample	−0.030	0.0227	−0.075	0.014	1.788	0.181
Gender	**−0.065**	**0.0164**	**−0.097**	**−0.032**	**15.523**	**<0.001**
Age	**−0.001**	**0.0006**	**−0.003**	**−2.08E-4**	**5.203**	**0.023**
COVID stressors	**0.015**	**0.0064**	**0.002**	**0.028**	**5.404**	**0.020**
Psych. Distress	0.002	0.0010	−0.001	0.004	2.091	0.148
Comp	3.91E-4	0.0013	−0.002	0.003	0.088	0.766
Imp	0.001	0.0010	−0.001	0.003	1.419	0.234
Imp × Comp	−2.36E-4	0.0001	−4.97E-4	2.45E-5	3.153	0.076
Pre-COVID score	**0.087**	**0.0033**	**0.080**	**0.093**	**674.297**	**<0.001**

DV: problematic pornography use during lockdown (N = 438). Bolded font signifies p < 0.05.

TABLE 5 | Regression results.

	B	SE	LCI	UCI	Wald X^2	p
Sample	0.184	0.3859	−0.573	0.940	0.226	0.634
Gender	−0.188	0.2606	−0.699	0.323	0.519	0.471
Age	**−0.040**	**0.0108**	**−0.061**	**−0.018**	**13.342**	**<0.001**
COVID stressors	0.092	0.0835	−0.072	0.255	1.208	0.272
Psych. Distress	**0.027**	**0.0111**	**0.005**	**0.049**	**6.021**	**0.014**
Comp	−0.030	0.0252	−0.079	0.019	1.412	0.235
Imp	−0.006	0.0199	−0.044	0.033	0.078	0.781
Imp x Comp	0.001	0.0029	−0.005	0.006	0.035	0.852
Pre-COVID score	**0.223**	**0.0297**	**0.165**	**0.282**	**56.445**	**<0.001**

DV: problematic gambling behaviors during lockdown (N = 150). Bolded font signifies p < 0.05.

TABLE 6 | Regression results.

	B	SE	LCI	UCI	Wald X^2	p
Sample	**−0.149**	**0.0466**	**−0.241**	**−0.058**	**10.254**	**0.001**
Gender	−0.006	0.0332	−0.071	0.059	0.037	0.848
Age	**−0.005**	**0.0018**	**−0.009**	**−0.002**	**8.907**	**0.003**
COVID stressors	0.002	0.0181	−0.033	0.038	0.017	0.897
Psych. Distress	**0.009**	**0.0026**	**0.004**	**0.014**	**11.057**	**0.001**
Comp	−0.002	0.0027	−0.008	0.003	0.705	0.401
Imp	−0.002	0.0031	−0.008	0.004	0.586	0.444
Imp × Comp	−1.70E-4	0.0004	−0.001	0.001	0.221	0.639
Pre-COVID score	**0.047**	**0.0033**	**0.040**	**0.053**	**204.309**	**<0.001**

DV: problematic internet use during lockdown (N = 375). Bolded font signifies p < 0.05.

compulsivity and impulsivity was also significant (*Wald* $X^2 = 6.3$, $p = 0.014$). Follow-up of this interaction found that while the association between compulsivity scores and lockdown eating was significant for the low impulsivity group (*Wald* $X^2 = 4.7$, $p = 0.030$, $n = 423$), it was not significant in the high impulsivity group (*Wald* $X^2 = 0.61$, $p = 0.434$, n = 455). **Supplementary Figure 1** shows change scores (calculated as lockdown minus pre-COVID score) by high and low impulsivity and compulsivity groups (median split), to aid interpretation of the above interaction.

Problematic Pornography Use During Lockdown

Results of the regression on lockdown problematic pornography use are shown in **Table 4**. Female gender was associated with lower lockdown problematic pornography use (*Wald* $X^2 = 15.5$, $p < 0.001$). Younger age (*Wald* $X^2 = 5.2$, $p = 0.023$), a higher number of COVID events (*Wald* $X^2 = 5.4$, $p = 0.020$), and greater pre-COVID problematic pornography use (*Wald* $X^2 = 674.3$, $p < 0.001$) were associated with higher lockdown problematic pornography use. Finally, there was a trend-level interaction (*Wald* $X^2 = 3.2$, $p = 0.076$), which follow-up analyses revealed was driven by a trend-level association between compulsivity and lockdown pornography use in the low impulsivity group (*Wald* $X^2 = 3.2$, $p = 0.072$, $n = 224$) which was not seen in the high impulsivity group (*Wald* $X^2 = 0.48$, $p = 0.488$, $n = 214$).

Problematic Gambling During Lockdown

Results of the regression on lockdown problematic gambling scores are shown in **Table 5**. Younger age (*Wald* $X^2 = 13.3$, $p < 0.001$), greater psychological distress (*Wald* $X^2 = 6.0$, $p = 0.014$), and greater pre-COVID problematic gambling (*Wald* $X^2 = 56.4$, $p < 0.001$) were associated with more problematic gambling during lockdown.

Problematic Internet Use During Lockdown

Results of the regression on lockdown problematic internet use are shown in **Table 6**. Younger age (*Wald* $X^2 = 8.9$, $p = 0.003$), community sample status (*Wald* $X^2 = 10.3$, $p = 0.001$), greater K10 (*Wald* $X^2 = 11.1$, $p = 0.001$), and greater pre-COVID problematic internet use (*Wald* $X^2 = 204.3$, $p < 0.001$), were associated with more problematic internet use during lockdown.

Problematic Drinking During Lockdown

Results of the regression on lockdown problematic drinking scores are shown in **Table 7**. Older age (*Wald* $X^2 = 6.6$, $p = 0.010$), greater COVID-related events (*Wald* $X^2 = 9.3$, $p =$

TABLE 7 | Regression results.

	B	SE	LCI	UCI	Wald X^2	p
Sample	−0.013	0.0551	−0.121	0.095	0.055	0.814
Gender	−0.020	0.0470	−0.112	0.072	0.177	0.674
Age	**0.005**	**0.0018**	**0.001**	**0.008**	**6.600**	**0.010**
COVID stressors	**0.059**	**0.0194**	**0.021**	**0.097**	**9.348**	**0.002**
Psych. Distress	0.002	0.0032	−0.004	0.008	0.412	0.521
Comp	**−0.009**	**0.0043**	**−0.018**	**−4.88E-4**	**4.294**	**0.038**
Imp	−0.001	0.0037	−0.008	0.007	0.021	0.884
Imp × Comp	0.001	0.0006	−2.71E-4	0.002	2.315	0.128
Pre-COVID score	**0.132**	**0.0074**	**0.117**	**0.146**	**316.089**	**<0.001**

DV: problematic alcohol use during lockdown (N = 599). Bolded font signifies p < 0.05.

TABLE 8 | Regression results.

	B	SE	LCI	UCI	Wald X^2	p
Sample	−0.096	0.0791	−0.251	0.059	1.472	0.225
Gender	0.028	0.0679	−0.105	0.162	0.176	0.675
Age	**−0.006**	**0.0028**	**−0.011**	**−4.85E-4**	**4.562**	**0.033**
COVID stressors	**0.083**	**0.0273**	**0.029**	**0.137**	**9.208**	**0.002**
Psych. Distress	**0.028**	**0.0045**	**0.019**	**0.037**	**38.643**	**<0.001**
Comp	**0.044**	**0.0071**	**0.030**	**0.058**	**38.803**	**<0.001**
Imp	0.002	0.0053	−0.008	0.013	0.186	0.667
Imp × Comp	−0.001	0.0009	−0.003	0.001	1.532	0.216
Pre-COVID score	**0.106**	**0.0059**	**0.094**	**0.118**	**319.865**	**<0.001**

DV: problematic obsessive-compulsive behaviors during lockdown (N = 878). Bolded font signifies p < 0.05.

0.002), lower trait compulsivity (*Wald* $X^2 = 4.3$, $p = 0.038$), and greater pre-COVID drinking problems (*Wald* $X^2 = 316.1$, $p < 0.001$) were associated with more problematic drinking during lockdown.

Problematic Obsessive-Compulsive Behaviors During Lockdown

Results of the regression on problematic obsessive-compulsive behaviors during lockdown are shown in **Table 8**. Younger age (*Wald* $X^2 = 4.5$, $p = 0.033$), greater COVID-related events (*Wald* X^2 =9.2, $p = 0.002$), greater psychological distress (*Wald* $X^2 = 38.6$, $p < 0.001$), greater trait compulsivity (*Wald* $X^2 = 38.8$, $p < 0.001$), and greater pre-COVD obsessive-compulsive behaviors (*Wald* $X^2 = 319.9$, $p < 0.001$) were associated with more problematic obsessive-compulsive behaviors during lockdown.

Supplementary Analyses on Pre-COVID Problematic Behaviors

Higher trait impulsivity and/or compulsivity, or their interaction were significantly associated with all pre-COVID problematic behaviors. Please see **Supplementary Materials** for details.

DISCUSSION

The current study examined whether two transdiagnostic risk factors, trait impulsivity and compulsivity, and their interaction, were associated with problematic addictive and compulsive behaviors during lockdown. First, the current study found that participants reported increased problematic behaviors during lockdown, compared to pre-COVID levels, except for alcohol use and gambling. In fact, participants reported reduced gambling during lockdown. However, with the exception of reported changes (from pre-COVID to lockdown) in obsessive-compulsive symptoms and internet use, which were large in effect size, reported changes in problematic behaviors were small in effect size. Second, trait impulsivity and compulsivity were significantly correlated with all lockdown problematic behaviors (except compulsivity with alcohol use). These correlations were small to medium in effect size and generally in line with past research in non-clinical populations (35, 36, 38). However, these relationships changed considerably once examined within regression models, which controlled for pre-COVID levels of problematic behaviors. These analyses found that greater trait compulsivity was associated with greater lockdown obsessive-compulsive behaviors, as well as lower levels of lockdown problematic drinking. Further, trait compulsivity interacted with impulsivity in relation to problematic eating and (at trend level) pornography use. Follow-up of these interactions found that greater trait compulsivity was associated with greater problematic eating and (at trend-level) pornography use during lockdown among individuals with *low* trait impulsivity only. It must be noted however that the effect sizes of these interactions are very small, as may be seen from **Tables 3**, **4** (interaction term *B*s). Psychological distress and/or exposure to COVID-related stressors were associated with greater problems across all addictive and compulsive lockdown behaviors as were pre-COVID levels of the behavior in question.

The finding that greater trait compulsivity was associated with more problematic obsessive-compulsive behaviors during lockdown, after adjusting for psychological distress, COVID-related stressors, and pre-COVID obsessive-compulsive behaviors highlights its role as a key risk marker for OCD. While the nature of its role in driving risk has yet to be identified, the current findings suggest that these traits, or what they reflect, interact with environmental factors to promote the expression of compulsive symptoms. Critically, while greater compulsivity was associated with obsessive-compulsive behaviors during lockdown, it was not associated with *pre-COVID* obsessive-compulsive behaviors (expect through interaction with impulsivity; see **Supplementary Table 6** for details). Notably, trait compulsivity is associated with family history of obsessive-compulsive and addictive behaviors (46). Thus, these traits may reflect a genetic predisposition toward compulsivity that is influenced by environmental factors (69). As the nature of COVID-19 stressors directly support OCD symptomatology (e.g., contamination concerns), this pre-disposition (which is reflected in trait compulsivity) might then be expected to be associated with greater obsessive-compulsive symptoms during lockdown, more so than with other compulsive and addictive behaviors during lockdown. Finally, this finding adds to the growing literature supporting the CHI-T scale as a measure that is sensitive to OCD-related risk in the general population (28, 46, 47), and may be especially useful to detect at-risk individuals who might benefit from early intervention during the pandemic to minimize progression and entrenchment of problematic behaviors.

Higher trait compulsivity was also associated with more problematic eating behaviors during lockdown, albeit among individuals with low impulsivity only. Among individuals with high impulsivity, trait compulsivity was not associated with problematic lockdown eating behaviors. This pattern of findings may reflect the high impulsivity group having higher levels of pre-existing problematic eating (see **Supplementary Table 1**), which was itself associated with greater problematic eating during lockdown. In contrast, the lower levels of baseline eating problems among individuals with low impulsivity may have allowed for other influences on lockdown behavior to be revealed, such as trait compulsivity. This pattern of findings was also seen at trend-level for problematic pornography use and may be interpreted similarly. Finally, greater trait compulsivity was associated with lower problematic alcohol use during lockdown. This finding may be best understood in the context of lockdown-related closures of public venues where drinking was common prior to COVID-19. For individuals who drank at these venues regularly, these places provided a wide range of cues (people, situation, etc.) and routines that supported drinking. Individuals high on trait compulsivity are habit- and routine-oriented (47, 70), and strongly influenced by cues (46). Thus, with the closure of public drinking venues, compulsive individuals who drank there lost the cues and routines that previously promoted their drinking. According to this account, without such routines and cues to promote drinking, compulsive individuals may drink less during lockdown than previously, at least, until new drinking habits and routines set in.

The finding that higher psychological distress was associated with greater problematic behaviors during lockdown is in line with emerging findings across addictive and compulsive behaviors (8, 10, 61, 71), as well as a large body of literature suggesting that stress facilitates habit-driven behavior and/or otherwise promotes the maladaptive expression of learned behaviors (44, 49–53). Problematic obsessive-compulsive behaviors were associated with both COVID-related events and psychological distress, in line with a recent study using a COVID events checklist (from which the current items were taken) in relation to obsessive-compulsive and related disorders (59). These findings may be explained in various ways. For instance, for people with obsessive-compulsive tendencies, COVID-related events might be more salient, which may in turn increase reporting of them. Supporting this interpretation, pre-COVID obsessive-compulsive behaviors were the only pre-COVID problematic behavior (of all addictive and compulsive behaviors) associated with exposure to COVID-19 events (see **Supplementary Table 6**). Further, as several COVID-related events involve potential harm to others and/or contamination, exposure to these events may further promote compulsive behaviors through triggering obsession-related concerns.

In line with other COVID-19 studies, greater pre-COVID levels of problematic behaviors predicted greater problematic behaviors during lockdown across all problematic behaviors. This provides important context for interpreting the current findings in relation to trait impulsivity and compulsivity and their role in driving risk during the current pandemic. That is, while their relationship with addictive and compulsive behaviors is evident from past research (24, 25, 46), as well as current findings (see **Supplementary Tables**), they may have limited influence on behavior during the current pandemic at this early stage, at least, over and above stress-related influences and pre-COVID levels of the behavior in question. It is likely that the influence of trait impulsivity and compulsivity will become clearer over time, as patterns of behavior become established and differences emerge in relation to how people adapt their behaviors as problems arise. In any case, the current findings highlight the need to better understand the different roles that individual risk factors might play during life as usual vs. during COVID-19, and how these traits might interact with environmental factors to influence disorder-specific expressions.

The current study has several limitations, such as its cross-sectional design, which limits the ability to draw conclusions about the direction of the findings. For instance, while we interpreted the association between compulsivity and problematic eating as indicating that compulsivity increases risk for problematic eating (in those with low impulsivity), an alternative explanation might be that engaging in excessive, unhealthy eating may result in cognitive impairments that in turn drive inflexible, compulsive behaviors (72, 73). Longitudinal research is needed to better understand the direction of the relationship between the trait impulsivity and compulsivity and how they are related to problematic behaviors over the course of this pandemic. Other limitations include the self-reporting of problematic behaviors, including comparisons of behaviors at different timepoints, which is subject to bias and random error. However, previous studies have found self-reported addictive and obsessive-compulsive behavior measures to be generally valid and reliable (74, 75). Also, the current study did not control for important confounding variables such as current mental health diagnosis, trauma, psychiatric medication, illicit drug use, or IQ. Such variables have been shown to be associated with addictive and compulsive behaviors (76–80) as well as impulsivity and/or compulsivity (81–83). Future studies are needed to confirm the present findings taking these confounding variables into account. Finally, participants in this study were recruited through social media and may therefore not be representative of individuals in the general population.

A clear implication of the current findings is the need for interventions that increase resilience to stress to protect against its effects on addictive and compulsive behaviors. Such interventions may include promoting adaptive coping skills and/or healthy lifestyle patterns. For instance, engaging in exercise has been shown to reduce stress levels acutely (84) and regular exercise has been shown to increase resilience to stress generally (85) and has been linked to greater resilience during COVID-19 (63, 86, 87). Further, maintaining a healthy diet (88) and having strong social support (89) have also been linked to increased resilience to stress generally, as well as during COVID-19 (61, 87, 90). Through enhancing resilience to stress, lifestyle interventions and the use of adaptive coping strategies may in turn reduce the risk for addictive and compulsive behaviors during the COVID-19 pandemic.

In conclusion, the current study found that the influence of trait impulsivity and compulsivity on addictive and compulsive behaviors during lockdown differed according to the behavior in question. These behavior-specific findings suggest that traits may interact with situational factors to influence whether pre-existing behaviors continue, increase, or decrease during major life disruptions. In contrast, stress-related variables, i.e., psychological distress and/or exposure to COVID-related stressors, were associated with greater problems across all addictive and compulsive behaviors. The current study adds to the growing literature supporting the need for interventions that enhance resilience to stress during the current pandemic, which in turn could reduce risk for addictive and compulsive disorders.

CONTRIBUTION TO THE FIELD

The COVID-19 pandemic has resulted in high levels of psychological distress worldwide, with experts expressing concern that this could result in corresponding increases in addictive behaviors as individuals seek to cope with their distress. People with high levels of impulsive and compulsive traits may be especially prone to developing problematic coping behaviors during COVID-19. Not only do these traits heighten risk generally, but their influence on risk may be accelerated during times of stress. Thus, early detection of risk is critical as the timeframe for early intervention may be shortened by stress. The current study thus examined the potential of impulsive and compulsive traits to serve as risk markers for addictive and compulsive behaviors during COVID-19. The findings suggest that while impulsive-compulsive traits were associated with all problematic pre-COVID behaviors examined, their influence was limited to a few problematic behaviors during COVID-19. In contrast, stress-related variables were associated with all problematic behaviors during COVID-19, as was severity of pre-COVID problems. These findings suggest that the influence of impulsive and compulsive traits on addictive behaviors during COVID-19 might be largely indirect, mediated through pre-COVID problems. Further, these findings also highlight the impact of stress-related factors across addictive and compulsive behaviors and the need for interventions aimed at enhancing resilience to stress, which in turn may reduce risk for addictive and compulsive disorders.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Monash Human Research Ethics Committee. The patients/participants provided their consent to participate in this study.

AUTHOR CONTRIBUTIONS

LA wrote first draft of this manuscript. LA, MY, KRo, and RS designed the major components of the study. LA, KRo, EC, M-EB, AL, and KRi contributed critically to data collection for this study. All authors contributed to revising subsequent versions of the paper. All authors contributed to the selection of study measures.

FUNDING

MY has received funding from Monash University, the National Health and Medical Research Council (NHMRC; including Fellowship #APP1117188), the Australian Research Council (ARC), Australian Defense Science and Technology (DST), and the Department of Industry, Innovation and Science (DIIS). He has also received philanthropic donations from the David Winston Turner Endowment Fund, Wilson Foundation, as well as payment from law firms in relation to court and/or expert witness reports. SC consults for Promentis; and receives a stipend from Elsevier for editorial work. SC's role in this study was funded by a Wellcome Trust Clinical Fellowship (110049/Z/15/Z). RL was funded by a National Health and Medical Research Council project grant (APP1162031). JG has received research grants from Biohaven, Promentis, and Otsuka Pharmaceuticals. JG receives yearly compensation from Springer Publishing for acting as Editor-in-Chief of the Journal of Gambling Studies and has received royalties from Oxford University Press, American Psychiatric Publishing, Inc., Norton Press, and McGraw Hill.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.634583/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 25 February 2021
doi: 10.3389/fpsyt.2021.620661

COVID-19 Related Distress in Gambling Disorder

Luana Salerno[1]* *and Stefano Pallanti*[1,2]

[1] INS, Istituto di Neuroscienze, Florence, Italy, [2] Department of Psychiatry and Behavioral Sciences, Albert Einstein College of Medicine, New York, NY, United States

The COVID-19 pandemic has exerted a dramatic impact on everyday life globally. In this context, it has been reported that the lockdown and social distancing may have exerted an impact even on gambling behavior, not only by increasing gambling behavior in those affected by this disorder but even contributing to the occurrence of new cases. To explore such a possibility, we designed a cross-sectional web survey addressing a general population sample that lasted 3 weeks (March 23–April 20). Participants completed a survey including a demographic information section, a question regarding the presence of pathological gambling in the past and several questionnaires. These included the Perceived Stress Scale (PSS), the Kellner's Symptom Questionnaire (SQ), and the version of The Yale Brown Obsessive Compulsive Scale adapted for Pathological Gambling (PG-YBOCS) that investigated the presence of gambling behaviors in the last week. The final sample was composed by 254 subjects (112 males, 44.1%; 142 females, 55.9%). According to PG-YBOCS total score, pathological gambling has been found in 23.6% ($n = 60$) of the sample (53 males, 88.3%; 7 females, 11.7%), which is a high frequency compared to that reported by the existing literature. Among gamblers, 20.9% ($n = 53$) reported both past and current problem gambling (they have been defined as "chronic gamblers"), whereas 2.8% ($n = 7$) did not report to use gambling platforms in the past but only in the last week (defined as "new gamblers"). Data analysis showed a statistically significant difference between gamblers and people who do not gamble in age but not in education, and higher level of perceived stress, distress, and hostility in both chronic and new gamblers compared to those who did not report gambling behavior. A consistent proportion of business owners and unemployed individuals reported problem gambling during the lockdown period.

Keywords: COVID, gambling, stress, social isolation, hostility, occupation

OPEN ACCESS

Edited by:
Ornella Corazza,
University of Hertfordshire,
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Reviewed by:
Amandine Luquiens,
Université Paris-Saclay, France
Daria Piacentino,
National Institutes of Health (NIH),
United States

Correspondence:
Luana Salerno
salerno.luana@gmail.com

Specialty section:
This article was submitted to
Addictive Disorders,
a section of the journal
Frontiers in Psychiatry

Received: *23 October 2020*
Accepted: *29 January 2021*
Published: *25 February 2021*

Citation:
Salerno L and Pallanti S (2021)
COVID-19 Related Distress in
Gambling Disorder.
Front. Psychiatry 12:620661.
doi: 10.3389/fpsyt.2021.620661

INTRODUCTION

The DSM-5 has recognized Gambling Disorder (GD) as a Substance-Related and Addictive Disorder because of the increasing evidence supporting the presence of similarities between pathological gambling and substance addiction (1, 2). GD is conceptualized as a persistent and recurrent problem gambling behavior characterized by increased tolerance and inability to stop such a behavior, which causes significant impairment and distress (3).

According to epidemiological data, the prevalence of GD ranges between 1.2 and 7.1% in the general population (4), and it seems to be higher among young people, ranging between 6 and 9% (5). A more recent systematic review reported that 0.1–5.8% of individuals meet diagnostic criteria for problem gambling across five continents during the year before the survey, whereas 0.7–6.5% meet criteria for problem gambling during their lifetime (6). A recent study performed in Italy showed low-risk gambling behavior in less than 15%, a moderate-risk in 4% and problem gambling in 1.6% (7). The use of internet seems to play a role in the rise of problem gambling, as recent evidence reported that replacing 10% of offline with online gambling increases the likelihood of being a problem gambler by 8.8–12.6%, with an increase of 27.24 million euros per year of additional expenditures (8).

The COVID-19 pandemic has exerted a dramatic impact on everyday life globally. Several studies performed in different countries around the world have reported psychological and mental health problems due to the changes caused by the COVID-19, including stress, anxiety, and depressive symptoms (9–11). According to recent data, the lockdown and social distancing may have exerted an impact even on gambling behavior (12), not only by increasing gambling behavior in those affected by this disorder but even contributing to the occurrence of new cases (13). Italy was one of the first European countries to be affected by the COVID-19 crisis, and government regulations imposed many restrictions. The latter have concerned not only individuals, who have been told to remain in their houses, but even many businesses with dramatic consequences on many persons who have not been able to work because they were unable to do their job from home (i.e., smart working). Indeed, among the limitations imposed by Italian government, it should also be mentioned the closing of retail shops different from food shops and those providing essential services (such as health ones), the suspension of the sports events and the closure of gambling and bingo halls as well as betting shops.

In consideration of data from a general population survey reported by Hakansson (14) demonstrating that a non-negligible percentage of respondents reported an increase of gambling behavior during the COVID-19 pandemic, we aimed to investigate if there was a similar increase in Italian population during the lockdown period, and if there were some differences in demographic as well psychological variables (e.g., perceived stress, distress, anxiety, depression, well-being) between those who had gambling problems and those who did not. For this aim, we designed a cross-sectional web survey addressing a general population sample that lasted 3 weeks (March 23–April 20).

METHODS

Design and Participants

This is a cross-sectional web survey addressing a general population sample. We recruited participants using ads on facebook groups and information pages regarding the Italian situation relating to COVID-19, psychology, physical and mental health on other social media channels (i.e., twitter, telegram, instagram). The participants were also invited to in turn forward the invitation onto their own facebook/other social media friends. They were all over 18 years of age and where able to open the survey only after receiving the study information; on the first page, they were asked to give their consent to study participation. The study was carried out during a period of 3 weeks (from March 23 to April 20). The survey did not include any information that could directly or indirectly identify an individual. Researchers could not detect the IP-addresses. No compensation to take part to the study was provided. As the study involved human subjects, it was conducted in accordance with the Declaration of Helsinki.

Measures

Basic socio-demographic variables included age, gender and occupation. After an explanation on what was considered as "gambling" (i.e., gambling for money through online platforms including betting sites, casinos, poker games, lotteries, bingo etc., and through the corresponding on-land based counterparts, even including slot machines and instant lotteries), respondents had to report if they have used gambling online and on-land platforms in the past 3 years or if they had started using them since the lockdown beginning. On this basis, they have been classified as "chronic gamblers" if they reported a past use of gambling platforms, with a need to gamble with increasing amount of money, restlessness or irritability when trying to cut down or stop gambling, had repeated unsuccessful efforts to control, cut back on or stop gambling in the last 3 years, "new gamblers" if they reported a beginning during the lockdown period, and "no gamblers" if they have reported they never used these platforms.

The severity of pathological gambling within the past week has been assessed by the Pathological Gambling Adaptation of Yale-Brown Obsessive Compulsive Scale (PG-YBOCS) (15). The first five questions assess urges and thoughts associated with gambling, whereas the last five questions assess the behavioral component of the disorder. The sum score of each subscale ranges from 0 to 20. Each subscale can be analyzed separately as well as together as a total score. The total score can be interpreted as follows: 0–7 sub-clinical, 8–15 mild, 16–23 moderate, 24–31 severe, and 32–40 extreme gambling symptoms. Originally the questionnaire was used as a semi-structured interview, however, in the present study the PG-YBOCS was administered as an online self-rating questionnaire, which is expected to be unproblematic as both versions (interview and self-rating) show good convergent validity for the YBOCS (16). With regard to construct validity, the PG-YBOCS and its two subscales correlated moderately strongly with the SOGS, which is a reliable screening instrument for pathological gambling based on the DSM-IV diagnostic criteria and a suitable measure of lifetime gambling severity (15). Moreover, PG-YBOCS showed good content validity in severity and change highly correlated with SOGS (15).

As a measure of perceived stress, the Perceived Stress Scale (PSS) developed by Cohen, Kamarck and Mermelstein (17) has been administered. It is a well-established self-report measure assessing "the degree to which situations in one's life are appraised as stressful" [(17), p. 387], and the degree to which life has been experienced as unpredictable, uncontrollable, and overloaded in the past month.

For the assessment of psychological symptoms (depression, anxiety, hostility, and somatization) and well-being (contentment, relaxation, friendliness, and physical well-being) we used the Symptom Questionnaire (SQ), which is a simple, self-rated questionnaire developed by Robert Kellner in 1976 (18). The final version of the SQ consists of 92 items and yields four main scales: depression, anxiety, hostility, and somatization. Each scale can be divided into two subscales, one concerned with symptoms and the other with well-being, for a total of eight subscales. Therefore, each of the main scales includes items from both the symptoms and the well-being subscales. Answers are dichotomous, and the respondent is asked to check YES/NO or TRUE/FALSE for each item. Scales and subscales can be scored separately, and the sum of the four main scale scores yields a total distress score. Two forms of the SQ are available (week and daily form). In this study we used the week form that is concerned with feelings experienced by the respondent during the past week. We considered the four main scale scores as well as the well-being subscales to investigate the presence of some associations between these dimensions and gambling.

Statistical Analysis

Statistical analyses were performed with the Statistical Package for the Social Sciences version 23.0 (SPSS; IBM Corp., 2015). Descriptive analyses have been reported as means, percentage and medians. For what concerns comparisons between groups regarding psychological measures, since data were not normally distributed as assessed by visual inspection of the boxplots, the Kruskal-Wallis H-test (sometimes also called the "one-way ANOVA on ranks") has been used to determine if there were statistically significant differences between chronic, new and no gamblers, while to compare chronic vs. new gamblers we used the Mann-Whitney U-test. Statistical significance was set at $p < 0.05$, two-tailed.

RESULTS

A total of 316 subjects were able to open the survey after receiving the study information, but only 281 gave their consent to participate in the study. Of these, 27 left the survey incomplete and were therefore excluded from the analysis through listwise deletion.

The final sample was composed by 254 subjects (112 males, 44.1%; 142 females, 55.9%) with a mean age of 33.65 ± 13.21. There was not a statistically significant differences among the number of participants recruited from the different social channels [$n = 135$ from Facebook, $n = 119$ from the other channels, $\chi^2_{(1)} = 0.069$, $p = 0.882$]

According to PG-YBOCS total score, pathological gambling has been found in 23.6% ($n = 60$) of our sample (53 males, 88.3%; 7 females, 11.7%). Among gamblers, 20.9% ($n = 53$) reported past and current problem gambling (and therefore they have been defined as "chronic gamblers"), whereas 2.8% ($n = 7$) did not report to gamble in the past but only in the last week (they have been classified as "new gamblers"). There was a statistically significant difference among groups (no gamblers, chronic and new gamblers). Indeed, no gamblers were predominantly females (135 vs. 59), whereas chronic gamblers were predominantly males (46 vs. 7) and new gamblers were all males (7 vs. 0) [$\chi^2_{(2)} = 62.804$, $p < 0.001$].

For what concerns occupation, 30.7% of the total sample was mainly composed by students (30.7%) followed by healthcare practitioners (20.1%) and people working in the field of administrative support (13.8%). Interestingly, the chronic gamblers were predominantly business owners, people who worked in the administrative support field, unemployed and people who worked in the production sector. Instead, new gamblers were mostly unemployed (71.4%) and business owners (28.6%). **Tables 1**, **2** show types of occupation and business ownerships according to the groups.

As **Figure 1** shows, according to the PG-YBOCS scores, the severity of gambling in chronic gamblers was mild in 24.5%, moderate in 47.2%, severe in 24.5%, and extreme in 3.8% of them. Gambling severity was mild and moderate in 14.3% of

TABLE 1 | Types of occupation according to groups.

Occupation	Total ($N = 254$) n (%)	No gamblers ($N = 194$) n (%)	Chronic gamblers ($N = 53$) n (%)	New gamblers ($N = 7$) n (%)
Business owner	25 (9.8%)	11 (5.7%)	12 (22.6%)	2 (28.6%)
Physician	2 (0.8%)	2 (1%)	–	–
Healthcare practitioner	51 (20.1%)	48 (24.7%)	3 (5.7%)	–
Student	78 (30.7%)	77 (39.7%)	1 (1.9%)	–
Arts and design	6 (2.4%)	4 (2.1%)	2 (3.8%)	–
Police	1 (0.4%)	1 (0.5%)	–	–
Unemployed	15 (5.9%)	3 (1.5%)	7 (13.2%)	5 (71.4%)
Retired	3 (1.2%)	3 (1.5%)	–	–
Legal	4 (1.6%)	2 (1%)	2 (3.8%)	–
Sales	9 (3.5%)	5 (2.6%)	4 (7.5%)	–
Administrative support	35 (13.8%)	25 (12.9%)	10 (18.9%)	–
Education	6 (2.4%)	3 (1.5%)	3 (5.7%)	–
Engineering	8 (3.1%)	4 (2.1%)	4 (7.5%)	–
Production	11 (4.3%)	6 (3.1%)	5 (9.4%)	–

new gamblers and severe and extreme in 42.9 and 28.6% of them, respectively.

A Kruskal-Wallis H-test was run to determine if there were differences in age, education, PSS and SQ scores among the three groups of participants: the "no gambling," the "chronic" and the "new gamblers." Age were lower for no gamblers compared to new and chronic gamblers [$\chi^2_{(2)} = 47.354$, $p = <0.001$]; even though education level was similar across no gamblers and new gamblers and lower in chronic gamblers, the differences were not statistically significant [$\chi^2_{(2)} = 3.823$, $p = 0.148$].

For what concerns PSS and SQ scores, those who did not report to gamble obtained lower PSS compared to chronic and new gamblers [$\chi^2_{(2)} = 67.090$, $p = <0.001$], lower SQ Anxiety compared to chronic and new gamblers [$\chi^2_{(2)} = 102.078$, $p = <0.001$], lower SQ Depression compared to chronic and new gamblers [$\chi^2_{(2)} = 69.834$, $p = <0.001$], lower SQ Somatization compared to chronic and new gamblers [$\chi^2_{(2)} = 46.719$, $p = <0.001$], lower SQ Hostility compared to chronic and new gamblers [$\chi^2_{(2)} = 52.324$, $p = <0.001$], and lower SQ Distress scores compare to new gamblers and chronic gamblers [$\chi^2_{(2)} = 97.871$, $p = <0.001$].

For what concerns SQ well-being scale and subscales scores, people who have never gambled showed higher scores at SQ Physical well-being scale compared to chronic and new gamblers [$\chi^2_{(2)} = 67.972$, $p = <0.001$], SQ Relaxation subscale compared to chronic and new gamblers [$\chi^2_{(2)} = 89.773$, $p = <0.001$], SQ Contentment subscale compared to chronic and new gamblers [$\chi^2_{(2)} = 57.949$, $p = <0.001$], and SQ Friendliness subscale compared to chronic and new gamblers [$\chi^2_{(2)} = 20.791$, $p = <0.001$].

The Mann-Whitney U-test was carried out as a *post-hoc* test for pairwise comparisons (Bonferroni correction) and results showed no statistically significant differences in the PSS and SQ scales and subscale scores ($p > 0.05$). Medians are reported in **Table 3**.

TABLE 2 | Types of business ownership according to groups.

Sectors	No gamblers (n, %)	Chronic gamblers (n, %)	New gamblers (n, %)
Retail business	5 (20.0%)	3 (12.0%)	1 (4.0%)
Restaurants/nightclubs	2 (8.0%)	5 (20.0%)	1 (4.0%)
Travel agency	0 (0.0%)	2 (8.0%)	0 (0.0%)
Construction company	0 (0.0%)	1 (4.0%)	0 (0.0%)
Transportation business	0 (0.0%)	1 (4.0%)	0 (0.0%)
Fashion business	1 (4.0%)	0 (0.0%)	0 (0.0%)
Service business	3 (12.0%)	0 (0.0%)	0 (0.0%)

DISCUSSION

The present study investigated the impact of social-distancing during the COVID-19 pandemic on gambling behavior in a sample of Italian individuals. At the time of this writing, the

TABLE 3 | Differences in median values between groups.

	No gamblers (n = 194)	Chronic gamblers (n = 53)	New gamblers (n = 7)	
Age	25	42	36	$p = <0.001$
Education	15	13	15	$p = 0.148$
PSS	19	25	25	$p = <0.001$
SQ Anxiety	7	18	18	$p = <0.001$
SQ Depression	5.50	12	12	$p = <0.001$
SQ Somatization	7	14	14	$p = <0.001$
SQ Hostility	5.50	12	15	$p = <0.001$
SQ Physical well-being	3	1	1	$p = <0.001$
SQ Relaxation	4	1	0	$p = <0.001$
SQ Contentment	4	1	1	$p = <0.001$
SQ Friendliness	4	1	1	$p = <0.001$
SQ Distress	25.50	55	57	$p = <0.001$

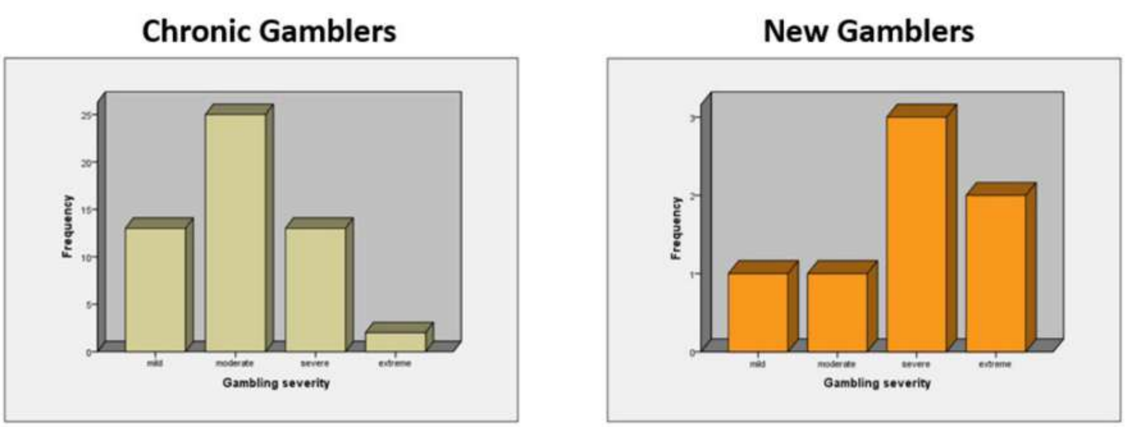

FIGURE 1 | Gambling behavior severity among chronic and new gamblers.

cases of COVID-19 in Italy were 318.065, with 35.992 deaths and 221.867 healed (https://www.epicentro.iss.it/coronavirus/sars-cov-2-dashboard). Italy was the first nation in Europe affected by COVID-19, and because of its rapid spread and dangerousness the lockdown was considered the only means to protect people, especially the most vulnerable, reorganize resources, and to give hospitals time to organize optimal care. In Italy the lockdown started on March 9th and ended on May 18th, and our survey begun 2 weeks after the starting of social isolation. Our data show that in that period 23.6% of individuals suffered from pathological gambling, a frequency that is much higher than that generally reported, they were more frequently male (88.3 vs. 11.7%), and many of them were unemployed or business owners. Even though it is not clear if such work situations as precariousness or unemployment play a role in the development and/or maintenance of gambling behavior (19, 20), it is important to consider that during the lockdown period hospitality and travel industry was hit hard, as were the owners of restaurants and clubs who had to close, with the concern that they could no longer bear the costs of running their business. In fact, what was then a concern turned out to be a reality, with many of them finding themselves unable to reopen due to the reduction in tourism and the inability to meet operating costs (https://www.thelocal.it/20200522/italys-shops-and-restaurants-struggle-to-reopen-with-new-rules-and-lack-of-customers). Some of them attempted suicide (https://www.theguardian.com/world/2020/may/21/italy-lockdown-mental-health-psychologists-coronavirus). In our sample, business owners with chronic gambling behavior were predominantly owners of restaurants/nightclubs, retail business and travel agency, while two out of five of new gamblers were owners of retail business and restaurants/nightclubs. The high number of unemployed in new gamblers group is in line with evidence suggesting that potentially problem or at-risk gamblers have difficulty in money management and are used to spend more than they earn (21, 22).

In our sample, both chronic and new gamblers obtained higher scores at measures of perceived stress, anxiety, depression, somatization, hostility, and distress compared to those who never gambled, and lower scores at measures of well-being. These findings are in line with literature reporting gambling as a means to cope with negative emotions in people characterized by high psychological distress and as associated with a higher likelihood of reporting problems related to multiple life domains, including hostility, and aggressiveness (23).

Our study confirmed findings from Hakansson (14) indicating a trend for the appearance of new gamblers during social-distancing caused by the COVID-19 pandemic. Although we do not know if this is a consequence of concerns about money or of the increase on the amount of time spent at home leading to more time spent online (24), prior national or international financial crises have been reported to have had an influence on gambling behaviors and on exacerbation of gambling problems (25), including the financial crisis in Greece (26) and in Iceland (27).

The findings of this study have to be seen in light of some limitations. First of all, our study is an anonymous web survey and not a face-to-face interview, which even though was the only way to collect data during the COVID-19 lockdown period it did not let us to collect more in-depth data nor investigate the types, patterns and severity of past gambling behaviors. Secondly, we did not use a screening tool for pathological gambling such as the SOGS, but even though our data may not be considered as an estimated prevalence, as previously reported the two subscales of PG-YBOCS showed a moderately strong correlation with the SOGS (15). Third, we did not assess the presence of pre-existing psychological vulnerability factors, other medical issues such as chronic illness making subjects more at risk of severe COVID, or co-existent psychiatric conditions such as substance use disorders (e.g., alcohol, pain killer etc.). Fourth, we did not collect data on family composition or on the presence of children who, given the closure of schools, were forced to stay at home all day, causing a possible increase in stress. Finally, we used different channels for recruitment for assuring a representative non-clinical population recruited by social media, but these findings may not be the same in the "real world."

Although the study limitations, our findings indicated a consistent proportion of business owners and unemployed individuals who reported pathological gambling during the lockdown period, and a higher level of perceived stress, distress and hostility in both chronic and new gamblers compared to those who never reported gambling behavior. As the prospect theory by Kahneman and Tvesky (28) demonstrated, agents are more sensitive to losses than to gains and even the small chance of a large win can seem very alluring. According to the prospect theory, as losses accumulate, subjects could become more willing to take additional risk, and they could therefore persevere in gambling. In the context of the economic crisis caused by the COVID-19, and considering the high availability of online gambling platforms, rapid actions for regulatory measures and prevention by multiple stakeholders are necessary.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LS and SP contributed to the conception and design of the study. LS undertook the statistical analysis and wrote the first draft of the manuscript. All the authors contributed to manuscript revision, read, and approved the submitted version.

FUNDING

Research reported in this publication was supported by the National Institute on Drug Abuse of the National Institutes of Health under Award Number R21DA042271 (SP). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

OPINION
published: 02 March 2021
doi: 10.3389/fpsyt.2021.634515

The Impact of Stigma on Treatment Services for People With Substance Use Disorders During the COVID-19 Pandemic—Perspectives of NECPAM Members

Lisa Dannatt[1], *Ramdas Ransing*[2], *Tanya Calvey*[3], *Florian Scheibein*[4], *Noha Ahmed Saad*[5], *Tomohiro Shirasaka*[6], *Rodrigo Ramalho*[7], *Sagun Pant*[8], *Ramyadarshni Vadivel*[9], *Kristiana Siste*[10], *M. J. Stowe*[11], *Kamal Narayan Kalita*[12], *Saïd Boujraf*[13], *Roberta Testa*[14], *Sidharth Arya*[15], *Nirvana Morgan*[16] and *Paolo Grandinetti*[17]*

[1] Department of Psychiatry and Mental Health, University of Cape Town, Cape Town, South Africa, [2] Department of Psychiatry, Bhaktshreshtha Kamalakarpant Laxman (BKL) Walalwalkar Rural Medical College, Pune, India, [3] Faculty of Health Sciences, School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, South Africa, [4] School of Health Science, Waterford Institute of Technology, Waterford, Ireland, [5] State Drug Dependence Treatment Centre, Ain Shams University, Cairo, Egypt, [6] Department of Psychiatry, Teine Keijinkai Medical Center, Sapporo, Japan, [7] Department of Social and Community Health, School of Population Health, University of Auckland, Auckland, New Zealand, [8] Department of Psychiatry, Institute of Medicine, Tribhuvan University, Kirtipur, Nepal, [9] Department of Mental Health and Addictions, Waikato District Health Board, Hamilton, New Zealand, [10] Department of Psychiatry, Medical Faculty, Universitas Indonesia-Cipto Mangunkusumo Hospital, Jakarta, Indonesia, [11] Department of Family Medicine, Faculty of Health Sciences, School of Medicine, University of Pretoria, Pretoria, South Africa, [12] Department of Psychiatry, Lokopriya Gopinath Bordoloi Regional Institute of Mental Health (LGBRIMH), Tezpur, India, [13] Faculty of Medicine and Pharmacy, Sidi Mohamed Ben Abdellah University, Fez, Morocco, [14] Department of Mental Health, Azienda Sanitaria Locale (ASL) 1 Avezzano-L'Aquila-Sulmona, L'Aquila, Italy, [15] State Drug Dependence Treatment Centre, Institute of Mental Health, Pt. Bhagwat Dayal Sharma (BDS) University of Health Sciences, Rohtak, India, [16] Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa, [17] Department of Mental Helth, Azienda Sanitaria Locale (ASL) Teramo, Teramo, Italy

OPEN ACCESS

Edited by:
Giuseppe Bersani,
Sapienza University of Rome, Italy

Reviewed by:
Brenda L. Curtis,
National Institute on Drug Abuse (NIDA), United States

Correspondence:
Paolo Grandinetti
grandinetti.paolo@gmail.com

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *27 November 2020*
Accepted: *08 February 2021*
Published: *02 March 2021*

Citation:
Dannatt L, Ransing R, Calvey T, Scheibein F, Saad NA, Shirasaka T, Ramalho R, Pant S, Vadivel R, Siste K, Stowe MJ, Kalita KN, Boujraf S, Testa R, Arya S, Morgan N and Grandinetti P (2021) The Impact of Stigma on Treatment Services for People With Substance Use Disorders During the COVID-19 Pandemic—Perspectives of NECPAM Members. Front. Psychiatry 12:634515. doi: 10.3389/fpsyt.2021.634515

Keywords: stigma, COVID-19, substance use disorder, access to treatment, pandemic, mental health

INTRODUCTION

Stigma is a mark of shame, disgrace, or disapproval which results in an individual being rejected, discriminated against, and excluded from society (1). Stigma toward individuals with substance use disorders (SUDs) affects the emotional, mental, and physical health of individuals (2). People with SUD are often viewed as unpredictable, dangerous, and morally responsible for their condition (2). These prejudiced and discriminatory views of the community may lead to reduced access to care, inability to make decisions regarding treatment, and forced or coerced treatment (2). Further, stigma negatively affects the policies and programs intended for the management of substance use and other addictive disorders (2). Moreover, people with addictive disorders may develop self-stigma influencing their behavior, including decreased use of healthcare services with consequent poorer health outcomes (3). Internalized stigma and self-stigma have been linked to increases in psychological distress and poorer quality of life (4, 5). People with substance use disorders (SUDs), in particular, may face significant stigmatization by healthcare practitioners (6). Of significant concern during the COVID-19 pandemic is that people with addictive disorders and concurrent COVID-19 may not be provided with adequate care (7). Therefore, people with SUDs may be experiencing increased stigmatization in different countries during the COVID-19 pandemic. This exacerbated stigma and discrimination toward people with SUDs may lead to inadequate care or poor attention from clinicians, policymakers, and other stakeholders.

To explore this important issue, in March 2020, members of the Network of Early Career Professionals working in the area of Addiction Medicine (NECPAM) were asked to share their experiences, observations, relevant published literature, and opinions from their respective countries. NECPAM members are frontline health care workers, e.g., doctors, psychiatrists, and employees of non-governmental organizations, who are actively involved in the care of people with SUDs. Opinions from NECPAM members were also requested via a qualitative online survey, of which 28 responded. Responses from the online survey were grouped into themes. Of 28 respondents there were 14 NECPAM members (six female and eight males) hailing from all WHO regions who stated that stigma in some form had affected addiction care during the COVID 19 pandemic. The opinions of these members representing 10 countries (Italy, India, Nepal, Morocco, South Africa, Egypt, Ireland, Indonesia, Japan, and New Zealand) are represented in this opinion piece. Here, we discuss the impact of stigma on individuals with substance use and other addictive disorders during COVID-19 in three themes: (i) policy, (ii) access to adequate services, and (iii) marginalized populations.

SUBSECTIONS RELEVANT FOR THE SUBJECT

Policy

Members felt that during the COVID-19 pandemic SUDs and behavioral addictions had not featured significantly in policy and program planning in most settings. Stigma toward individuals with substance use and other addictive disorders was thought to be one of the causes as these individuals may be seen as less deserving of care. This is evidenced by the quote below from a psychiatrist in South Africa:

> *"Overall, I think stigma toward people who use drugs has played a significant role in service planning and execution with the sense that these clients may not deserve or warrant the care and attention that people with medical disorders do. This has felt like a worsening of the usual stigma toward people who use alcohol and other drugs."*

When hospital-based services were planned and restructured, mental health and addiction wards in some settings had been repurposed into COVID-19 wards, with little future planning by policymakers regarding addiction services. An example given from Morocco was that, before the COVID-19 pandemic, the Ministry of Health had launched the National Strategic Plan of Prevention and Care of Addictive Disorders in January 2018 (8). This program addressed several aspects of the stigmatization of people with SUDs including their rights to access healthcare and to preserve their dignity (8). However, during the COVID-19 pandemic, there was no official plan to manage the support and treatment of substance use and other addictive disorders. The addiction health services were reduced to a minimum. Addictions input was provided by continued general psychiatric services. Addiction centers were also used to treat COVID-19 positive mental health care users. Substance users were then offered care when required in psychiatric departments of hospitals (9). Similar experiences were reported by NECPAM members from South Africa, Nepal, and Japan (10). Conversely, a member from New Zealand reported that although the initial health planning and policies were centric to the pandemic itself; there was an early response to address an increase in SUD and other addictive disorders during the COVID-19 pandemic and lockdown. An initial survey aimed at both service providers and people with SUDs identified the potential negative consequences due to harmful substance use during the COVID-19 pandemic (11). These included hesitance in seeking professional help, with most individuals with SUD opting for not reaching out for support (11). Moving with the demand, the New Zealand government mobilized new funding toward fast-tracking mental health services (12). Emphasis has been made on promoting knowledge about substance use and gambling harms, reducing stigma, and facilitating enhanced access to support.

Access to Services

According to our members, stigma affects access to services for people with substance use and behavioral addictions in a variety of ways and our members reported several different examples of this. Members from Nepal, South Africa, and New Zealand perceived this stigma as particularly prevalent toward people who accessed opioid use treatment services and other harm reduction-related services. The stigma toward people who use opioids and how this serves as a barrier to effective treatment for opioid use disorders is well-described in the literature prior to the COVID-19 pandemic (13). Regarding these specific countries, there is evidence from the literature prior to the COVID-19 pandemic that stigma toward opioid users is a barrier to access to treatment (14–16). However, establishing a Healthline helpline to facilitate testing and treatment seems to have reduced the stigma around access for service users in New Zealand (17). Some members reported their personal observation and experience. A member from Egypt described that social stigma leads to inequality in accessing medical services as communities hold individuals with SUDs morally responsible for their illness and, in her opinion, this may lead to denial of access to treatment. Members from India reported that patients presenting to treatment services were frequently questioned and fined as police believed them to be in breach of the local COVID-19 lockdown policies. Additionally, it was perceived by members from India that people who present with psychotic disorders related to substance use are more severely stigmatized than people with psychosis who do not use drugs. A member from Indonesia reported that individuals with substance use and behavioral addiction disorders are often faced with restrictions of access to healthcare services. Although some protocols were developed for people with SUD during the COVID-19 pandemic, the member noted that no policies were made to coordinate services for people with behavioral addictions. The absence of specific protocols for people with behavioral addictions during the pandemic was also noted by several other members. Therefore, the Indonesian government has released a specific protocol of HIV-AIDS health services during COVID-19 and the Indonesian Psychiatric Association in tandem published practice guidance for a psychiatrist in COVID-19 healthcare centers which also manages patients with addiction disorders. Regrettably, no policies have been made to coordinate services for patients with behavioral addiction during the COVID-19 pandemic. A member from Japan discussed that patients accessing addiction services who presented with fever were refused transportation to emergency centers or refused hospitalization Therefore, to solve these problems, the Disaster Support Committee of the Japanese Society of Psychiatry and Neurology has created guidelines on how to build and respond to medical systems for psychiatric patients with infectious diseases (18).

Street Based People and Special Population Groups

A member from South Africa stated that stigma toward street-based people contributed to inadequate service planning. In South Africa, during the COVID-19 policy of lock-down mass temporary shelters were created for street-based people in various cities (19). Although people in shelters were provided with essentials, there was inadequate planning for people with SUD's. The NECPAM member from South Africa observed that some street-based people who were moved to shelters suffered uncomfortable and unsupported withdrawal symptoms. The Department of family medicine at the University of Pretoria stepped in with the Community Orientated Substance Use Program (COSUP) to provide an emergency substance use management response within the shelter in the City of Tshwane (19). In Ireland, a range of COVID-19 policies were enacted which focused on people experiencing homelessness and using drugs (20). These included providing single-room occupancy housing for COVID-19 high-risk populations; a reduction in the homeless service occupancy levels to increase safety; dropping induction times for opioid agonist maintenance treatment (OAMT) from 12–14 weeks to 2–3 days; greater availability of takeaway doses of OAMT; delivering OAMT to those isolating; increasing availability of naloxone to all people with OAMT prescriptions and increasing availability of benzodiazepine maintenance treatment which was directly delivered to accommodation services (20). Some countries had formulated measures to prevent stigma toward marginalized populations during the COVID-19 pandemic. In Japan, the Ministry of Justice established a consultation desk for human rights issues (21). These consultations were provided telephonically or via the internet (21). In New Zealand, with the initiation of a nationwide lockdown, services were mobilized to enable emergency placement of vulnerable individuals in line with physical distancing measures (22). Services have been delivered through digital platforms, albeit with difficulty, recognizing the need to increase such technological means (11, 13).

DISCUSSION

Stigma toward people with SUDs could be one of the possible reasons for non-prioritizing SUDs and addiction services during the COVID-19 pandemic. However, people with SUD's are a vulnerable population and non-consideration can lead to serious consequences, such as increased mortality, including death by suicide. Multi-level interventions targeting multiple stages are required to address these complex issues at the policy, community, and individual level. Reframing the policy or guidelines to create a balance between COVID-19 pandemic services and addiction services is needed to provide affordable, safe, accessible, and effective care for people with SUDs. Moreover, we would like to recommend some suggestions to reduce the stigma toward people with SUDs and improve access to care during the pandemic.

Moreover, we would like to recommend some suggestions, that should be emphasized during the Pandemic, to reduce the stigma toward people with SUDs. First, the Involvement of policymakers; health care providers; and other key stakeholders for planning and co-ordinations for healthcare service provision and adjust according to a known or perceived demand. Second, Addiction services should be integrated with other health services and decentralized to provide patients with accessible health care. Third, Mass media campaigns on television or the internet should be conducted to reduce stigmatization in the community for people with SUDs. Fourth, the physical and mental health conditions of patients with SUDs should be acknowledged and addressed as a priority. Fifth, recognize the role of caregivers or relatives of people with SUDs.

AUTHOR CONTRIBUTIONS

LD wrote the first draft of the paper. RR, NM, and PG revised and all authors reviewed and commented and approved the final draft. All authors participated in on-line forums and contributed their opinions.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Public Health

ORIGINAL RESEARCH
published: 04 March 2021
doi: 10.3389/fpubh.2021.634396

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Substance Use in Mild-COVID-19 Patients: A Retrospective Study

Flavia Ismael[1,2], Beatriz Zaramella[1], Tatiane Battagin[1], João C. S. Bizario[3], Júlia Gallego[1], Victoria Villela[1], Lilian Bezerra de Queiroz[1], Fabio E. Leal[1], Julio Torales[4], Antonio Ventriglio[5], Megan E. Marziali[6], Priscila D. Gonçalves[6], Silvia S. Martins[6] and João M. Castaldelli-Maia[6]*

[1] Universidade Municipal de São Caetano do Sul, São Caetano do Sul, Brazil, [2] ABC Center for Mental Health Studies, Santo André, Brazil, [3] Faculdade de Medicina de Olinda, Olinda, Brazil, [4] Department of Psychiatry, School of Medical Sciences, National University of Asunción, Asunción, Paraguay, [5] Department of Clinical and Experimental Medicine, University of Foggia, Foggia, Italy, [6] Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY, United States

OPEN ACCESS

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****Correspondence:***
Flavia Ismael
flaviaism@yahoo.com.br

Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: *27 November 2020*
Accepted: *05 February 2021*
Published: *04 March 2021*

Citation:
Ismael F, Zaramella B, Battagin T, Bizario JCS, Gallego J, Villela V, de Queiroz LB, Leal FE, Torales J, Ventriglio A, Marziali ME, Gonçalves PD, Martins SS and Castaldelli-Maia JM (2021) Substance Use in Mild-COVID-19 Patients: A Retrospective Study. Front. Public Health 9:634396. doi: 10.3389/fpubh.2021.634396

Background: There is a need for prospective studies investigating substance use variations in mild COVID-19 patients. These individuals represent the majority of patients affected by the disease and are routinely treated at home, facing periods of quarantine.

Methods: This was a retrospective cohort study. All people who tested positive for COVID-19 and classified as mild cases (i.e., no alarm sign/symptom, no need for in-person consultation) during the treatment in the public health system of a Brazilian city with around 160,000 inhabitants were monitored by phone for all the COVID-19 symptoms listed by the Centers for Disease Control and Prevention (CDC) during the active phase of the disease (i.e., no longer experiencing symptoms, up to 14 days in mild cases). After this phase (median = 108 days after intake, IQR = 76–137), we asked these patients who were classified as experiencing mild COVID-19 (n = 993) about last-month substance use in three time-points: pre-COVID, just after COVID-19 acute phase (post-COVID acute phase) and in the period before survey (post-COVID follow-up phase).

Results: The number of COVID-19 symptoms was not associated with pre- or post-infection substance use. Pre-COVID alcohol and non-medical benzodiazepine use were associated with specific COVID-19 symptoms. However, sensitivity analyses showed that such associations could be explained by previous psychiatric and medical profiles. Alcohol and tobacco use decreased and non-medical analgesics increased in the post-COVID acute phase. However, just alcohol use remained lower in the post-COVID follow-up period. Higher pre-COVID levels of tobacco and alcohol were associated with post-COVID follow-up cannabis and non-medical analgesic use, respectively. Non-medical benzodiazepine use had positive and negative bi-directional associations with cannabis and non-medical analgesic use, respectively.

Conclusion: We were not able to find specific associations between substance use and COVID-19 symptomatology in the present study. Patients with mild COVID-19 should be monitored for substance use in the post-COVID-19 period, and preventive interventions for non-medical analgesic use should be implemented. Focused preventive interventions increasing the perceived risks of cannabis and non-medical benzodiazepine and analgesic use among people experiencing mild COVID-19 that reported previous substance use could be useful.

Keywords: COVID-19, alcohol, analgesics, cannabis, tobacco, benzodaizepine

INTRODUCTION

There is a risk for collision of two epidemics: COVID-19 and substance use (1–3). The COVID-19 pandemic is an unprecedented public health challenge, with potential for secondary effects on substance use outcomes (4). Alcohol, tobacco, and drug use have been among the top global risk factors for attributable mortality, years of life lost, years of life lived with disability, and disability-adjusted life-years in the last decades (5). People who use substances may be particularly vulnerable to COVID-19 (3, 6). There remains uncertainty, especially among those with mild COVID-19, who are the vast majority of COVID-19 patients (7).

Previous studies demonstrate that alcohol use may significantly increase the risk of contracting bacterial and viral lung infections, which could apply to SARS-CoV-2 (6). Chronic alcohol intake impairs various immunity components, such as reinforcing the inflammatory reaction and activating the CD8 response, increasing the influenzae risk infection (8). Tobacco smoking is another known risk factor for respiratory infections and functions to increase disease severity (9). However, there are mixed findings regarding the role of tobacco on the COVID-19 pandemic: a meta-analysis conducted by Patanavanich and Glantz (10) found that smokers are more likely to develop severe disease with COVID-19 compared to non-smokers, whereas another meta-analysis identified smoking as protective for COVID-19 infection (11). A recent electronic health record study showed that individuals with substance use disorder, especially those with opioid use disorder, have an increased risk for COVID-19 and its adverse outcomes (12). There is a need to further investigate the role of each substance in regards to COVID-19 clinical outcomes.

General population studies show that substance use has been predominantly increasing during the pandemic (13–18). In a web-survey during the social distance measures in Belgium, individuals reported more alcohol and tobacco use than before the lockdown (17). An extensive web survey in France also found an increase in alcohol (24.8%), tobacco (35.6%), and cannabis (31.2%) during the early phase of COVID-19 containment (16). Callinan et al. (14) conducted a cross-sectional study with 1,684 adult Australians who drink at least monthly. They found that harmful drinking decreased during social distancing measures, especially among (13, 14). In a cross-sectional survey of 12,328 adults within the 33 of Latin American and Caribbean, there was a decrease in alcohol use but a stability in heavy episodic drinking between 2019 and 2020 (during the pandemic) (18). In the U.S., alcohol use and heavy drinking before and during the COVID-19 pandemic increased by 14% in comparison to 2019 (15).

This increase has particularly affected some subgroups, such as people with previous substance use disorders, with increased levels of stress, or who engage in self-isolation (13, 14, 19, 20). In Australia, those experiencing high levels of stress have a higher increase in harmful drinking than those reporting lower stress levels (13, 14). Kim et al. (20) conducted a cross-sectional telephone survey of patients with pre-existing alcohol disorders registered in an alcohol care service in the United Kingdom, 2 months after the beginning of the containment measures. Approximately 17% had relapsed during this period. Regarding cannabis, a small survey reported an increase of 20% of cannabis use among those who engaged in self-isolation compared to those who did not. (19). It would be essential to investigate if patients with mild COVID-19 also have increased substance use after the disease's active period, as these patients could experience longer and more restrictive quarantines than the general population (7). There is a need for studies investigating substance use variations in mild COVID-19 patients.

The present retrospective cohort study aimed to investigate: differences between pre- and post-COVID-19 substance use; whether pre-COVID-19 substance use could be associated with COVID-19 amount and types of symptoms; if the number of COVID-19 symptoms would be related to post-COVID-19 substance use; and associations between pre- and post-COVID-19 substance use.

MATERIALS AND METHODS

Ethical Approval

The present study was approved by the local ethics committee (*Comissão de Ética para Análise de Projeto de Pesquisa* - CAPPesq, protocol No. 37265620.0.0000.5510, approved on September 2nd, 2020).

Study Design

All people who tested positive for COVID-19 and were classified as mild cases (i.e., no alarm sign/symptom, no need for in-person consultation) (21) were considered for inclusion. Participants were from a Brazilian city with around 160,000 inhabitants and were identified for inclusion during COVID-19 treatment. They were then monitored by phone for all the COVID-19 symptoms listed by the Centers for Disease Control and Prevention (22) during the active phase of the disease (i.e., no longer experiencing symptoms, up to 14 days in mild cases). After this phase (median = 108 days after intake, IQR = 76–137), we asked these patients who were classified as experiencing mild COVID-19 (n = 993) about last-month substance use in three time-points: pre-COVID, just after COVID-19 acute phase (post-COVID acute phase) and in the period before survey (post-COVID follow-up phase).

Sample

Residents of the municipality ≥18 years of age with suspected COVID-19 symptoms were encouraged to contact a specific website/phone platform for assessing COVID-19 (access at https://coronasaocaetano.org/) (baseline: April 6th to July 15th). They were invited to complete an initial screening questionnaire that included socio-demographic data; information on symptom type, onset, and duration; and recent contacts. People meeting the suspected COVID-19 case definition [i.e., having at least two of the following symptoms: fever, cough, sore throat, coryza, or change in/loss of smell (anosmia); or one of these symptoms plus at least two other symptoms consistent with COVID-19] were further evaluated, while people not meeting these criteria were advised to stay home and contact the service again were they to develop new symptoms or experience worsening of current ones (21). Patients were then asked to complete a risk assessment, of which there were no refusals. All patients were offered a home visit for self-collection of a nasopharyngeal swab (NPS – both nostrils and throat), which were collected at the patients' homes under trained healthcare supervision personnel. All pregnant women, and patients meeting pre-defined triage criteria for severe disease, were advised to attend a hospital service - either an emergency department or outpatient service, depending on availability. Additional details have been published elsewhere (21).

COVID-19 patients presenting with symptoms consistent with non-mild cases [i.e., dyspnea, tachypnea, persistent fever (≥72 h), altered level of consciousness, mental confusion], were evaluated in-person by a physician and were not included in the present cohort study (21). All the other patients who tested positive were classified as mild (21). and contacted over phone during the active COVID-19 phase (N = 1,983) were invited to participate in the present retrospective cohort study (online survey: September 14th to early October 27th). The response rate was 50.1%. We performed a comparison between those included in the present study (N = 993) and those who were not (N = 990), using logistic regression models. This comparison was performed to identify any potential baseline difference between the groups, which could generate bias to our outcome analysis (e.g., a higher number of COVID-19-related symptoms among those not included). **Supplementary Table 1** presents a comparison between those that agreed to participate (N = 993) and those who did not (N = 990). We found that individuals aged 60 or greater were less likely to participate (OR = 1.99; 95%CI = 1.45–2.74). No significant differences were found regarding the total number of COVID-19 symptom(s). Our final analytical sample included 993 participants who completed the online survey.

Measures

All COVID-19 measures were collected online via the dedicated Corona São Caetano web platform (access at https://coronasaocaetano.org/) or by phone. Substance use was assessed online only.

COVID-19 Symptoms

Patients testing positive for COVID-19 via RT-PCR were followed up to 14 days (a maximum of seven phone calls) from completing their initial questionnaire. They were contacted every 48 h by either a medical doctor or a medical student (supervised by a medical doctor) who completed another risk assessment and recorded any ongoing or new symptoms, following the COVID-19 clinical assessment protocol of São Caetano do Sul (21). All the COVID-19 symptoms listed by the CDC (22) were assessed during these contacts: fever or chills; cough; shortness of breath or difficulty breathing; fatigue; muscle or body aches; headache; new loss of taste or smell; sore throat; congestion or runny nose; nausea or vomiting; and diarrhea. The total number of CDC COVID-19 symptoms during the treatment was considered both as a continuous outcome (Aim 2) and exposure (Aims 3). In addition, each CDC COVID-19 symptom was also investigated as a categorical outcome for previous substance use (Aim 2).

Substance Use

We measured past-month use of alcohol, tobacco, cannabis, and non-medical use of benzodiazepines and analgesics (including opioid and non-opioid) using the ASSIST score for frequency of substance use (0 – none; 2 – monthly; 3 – fortnightly; 4 – weekly; 6 – daily or almost daily) (23). We assessed past-month substance use at three time points: the month prior to the disease diagnosis (pre-COVID); the month just after the active phase of the disease (post-COVID acute phase); and the last month before the survey (post-COVID follow-up phase). It is important to delineate the differences between post-COVID acute and post-COVID follow-up phases. The post-COVID follow-up phase allowed for variation among participants, depending on the time between the treatment intake and mental assessment. On average, the post-COVID follow-up phase assessment covered the period between 75 and 105 days after the treatment intake. In contrast, post-COVID acute phase assessment covered the month after the active phase of the disease, which could reach up to 44 days after the intake.

The psychometric properties of the Brazilian version of ASSIST proved to be satisfactory, supporting its use in patients of primary and secondary health care services (24). The Brazilian-version ASSIST scores for alcohol showed a good correlation with the AUDIT scores. This version also had good sensitivity and specificity in detecting alcohol, cannabis, and cocaine abuse and dependence, having the MINI-Plus diagnosis as the gold standard. Its reliability was good (Cronbach's alpha of 0.80 for alcohol, 0.79 for cannabis, and 0.81 for cocaine) (24). Shorter versions of ASSIST, including its frequency question, have been used to quickly screen substance use in clinical settings (25).

Potential Confounders

Lifetime diagnosis of psychiatric disorder (yes vs. no), age (categorical: 18–29; 30–39; 40–49; 50–59; and ≥60), sex (male vs. female), education (ordinal: no education; incomplete elementary education; complete elementary education; incomplete high school; complete high school; incomplete college; complete college), civil status (categorical: married; single; previously married; widow), income level (ordinal as defined by the Brazilian Institute of Geography and Statistics:

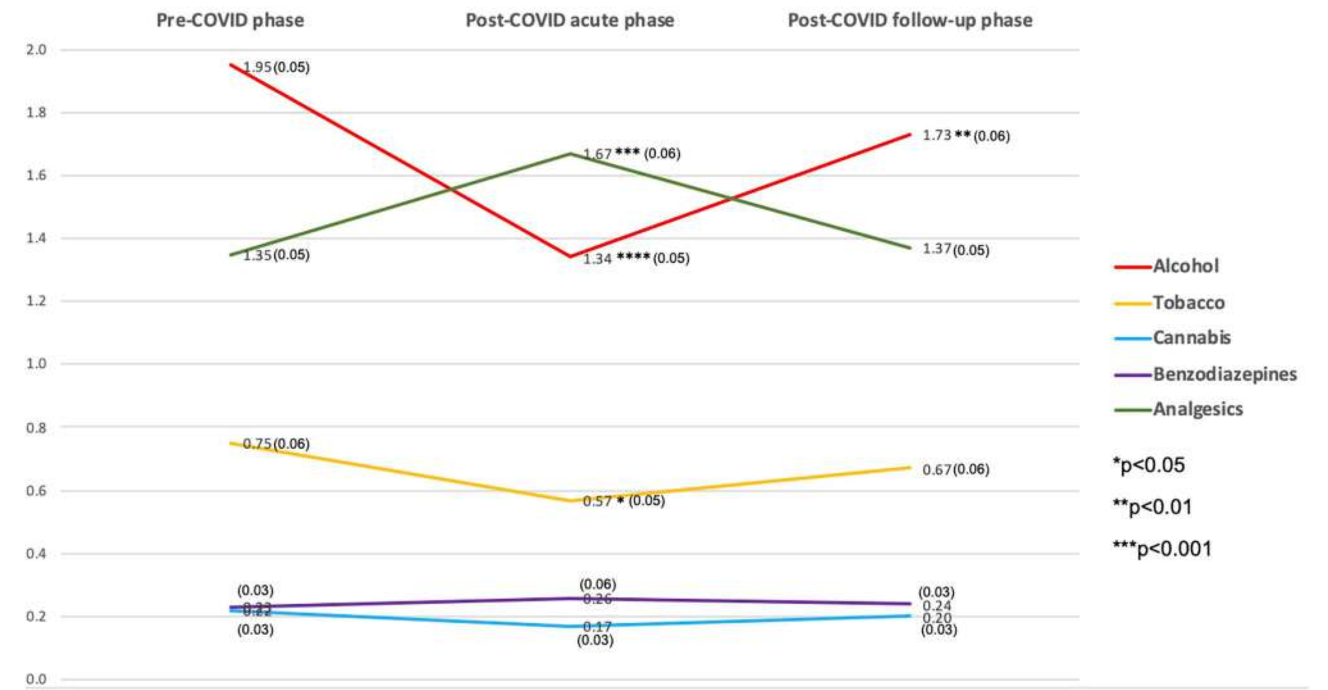

FIGURE 1 | Last-month substance use frequency ASSIST score among 993 individuals who had mild COVID-19 in São Caetano do Sul, SP, Brazil, 2020 (y-axis = ASSIST frequency mean score).

no income; up to one times the typical salary for a minimum wage job; 1–3 times; 4–6; 6–9; 10–12; 13 or more), current health treatment for any acute or chronic medical condition (yes vs. no) and time between the treatment intake and mental assessment (continuous: median = 108, IQR = 76–137), were assessed as potential confounders.

Statistical Analysis

STATA software version 16.2 was used to run the analysis. Initially, we conducted *t*-tests to compare pre-, post-COVID acute phase, and post-COVID follow-up phase substance use. We modeled the relationship between pre-COVID-19 substance use and the number of COVID-19 symptoms and using Poisson regression. We ran logistic regression models to quantify the association between pre-COVID substance use and each of the COVID-19 symptoms. Sensitivity analyses were conducted, excluding those with previous psychiatric disorders. Lastly, we ran ordinal regression modeling substance use at post-COVID acute phase and post-COVID follow-up phase time points, with number of COVID-19 symptoms and pre-COVID substance use as main exposures. All analyses were adjusted for potential confounders.

TABLE 1 | Results of the Poisson regression model for number of CDC COVID-19 symptoms among 993 individuals who had mild COVID-19 in São Caetano do Sul, SP, Brazil.

Outcome: CDC COVID-19 number of symptoms	**Coef.**	**95%CI**	
Exposure: pre-COVID phase ASSIST frequency score			
Alcohol	0.007	−0.017	0.031
Tobacco	−0.003	−0.024	0.018
Cannabis	0.002	−0.038	0.043
Benzodiazepines	−0.005	−0.044	0.035
Analgesics	0.018	−0.006	0.042

Adjusted for gender, age, city suburb, civil status, educational level, income, previous medical diseases, previous psychiatric disorder, time between intake and assessment.

RESULTS

Differences Between Pre- and Post-COVID-19 Substance Use

Figure 1 and **Supplementary Table 2** present past-month substance use for each substance across the three periods, along with the *t*-test results. Comparing substance use frequency scores, Alcohol had the highest ASSIST frequency scores in the pre-COVID and post-COVID follow-up periods, and analgesics in the post-COVID acute phase period. Post-COVID acute phase use was significantly lower for alcohol (1.34 vs. 1.95, $p < 0.0001$) and tobacco (0.57 vs. 0.75, $p < 0.05$); however, non-medical use of analgesics was higher (1.67 vs. 1.35, $p < 0.001$) compared to the pre-COVID period. Alcohol use was significantly lower in the post-COVID follow-up phase compared to the pre-COVID (1.73 vs. 1.95, $p < 0.01$). There were no significant changes for cannabis and non-medical benzodiazepine use throughout the period (**Figure 1**).

TABLE 2 | Results of the logistic regression model for CDC COVID-19 symptoms among 993 individuals who had mild COVID-19 in São Caetano do Sul, SP, Brazil.

Exposure: pre-COVID phase ASSIST frequency score	Alcohol			Tobacco			Cannabis			Benzodiazepines			Analgesics		
	aOR	95%CI		aOR	95%CI		aOR	95%CI		aOR	95%CI		aOR	95%CI	
Outcome: CDC COVID-19 symptoms															
Fever or chills	0.97	0.84	1.13	1.04	0.92	1.18	0.97	0.73	1.27	1.05	0.80	1.37	0.92	0.87	1.19
Cough	0.97	0.89	1.06	0.97	0.90	1.05	1.01	0.87	1.17	0.84*	0.71	0.98	1.02	0.94	1.11
Shortness of breath or difficulty breathing	0.84	0.56	1.26	1.01	0.72	1.42	1.26	0.78	2.03	1.53*	1.07	2.18	0.96	0.71	1.31
Fatigue	1.00	0.92	1.10	1.02	0.95	1.11	1.02	0.88	1.18	1.07	0.92	1.24	1.03	0.95	1.13
Muscle or body aches	0.94	0.85	1.03	0.97	0.90	1.05	1.03	0.88	1.21	1.01	0.87	1.17	1.08	0.99	1.19
Headache	0.97	0.89	1.06	0.98	0.91	1.06	0.94	0.81	1.10	1.06	0.91	1.23	1.06	0.97	1.16
New loss of taste or smell	1.09*	1.00	1.19	0.97	0.90	1.04	0.91	0.79	1.05	0.98	0.84	1.14	1.04	0.95	1.13
Sore throat	0.95	0.86	1.06	1.01	0.91	1.11	1.04	0.87	1.23	1.03	0.86	1.24	0.96	0.86	1.08
Congestion or runny nose	1.09*	1.00	1.19	0.99	0.92	1.07	1.08	0.94	1.25	0.89	0.76	1.04	1.04	0.95	1.13
Nausea or vomiting	1.07	0.95	1.21	1.04	0.94	1.14	1.00	0.82	1.23	0.99	0.82	1.19	1.00	0.89	1.12
Diarrhea	1.03	0.90	1.17	0.93	0.82	1.06	0.90	0.68	1.19	1.01	0.80	1.27	0.95	0.85	1.12

All the models adjusted for gender, age, city suburb, civil status, educational level, income, previous medical diseases, previous psychiatric disorder, time between intake and assessment.
*$p < 0.05$.

Symptoms During the Active Phase of COVID-19

Table 1 presents the results of the multivariable Poisson regression model assessing the relationship between substance use and number of COVID-19 symptoms. There was no significant association between pre-COVID substance use and the number of COVID-19 symptoms. **Table 2** presents the results of the multivariable logistic regression models assessing the impact of substance use for each of the symptoms of COVID-19. Alcohol use was positively associated with new loss of taste or smell (aOR = 1.09; 95%CI = 1.00–1.19) and congestion or runny nose (aOR = 1.09; 95%CI = 1.00–1.19). Non-medical benzodiazepine use increased the odds of experiencing shortness of breath or difficulty breathing by 53% (aOR = 1.53; 95%CI = 1.07–2.18), and was protective against experiencing a cough (aOR = 0.87; 95%CI = 0.71–0.98). There were no significant associations for pre-COVID tobacco, cannabis, and non-medical analgesic use. Sensitivity analyses (**Supplementary Table 3**) showed that, upon excluding those with previous psychiatric disorders or medical diseases, none of the associations found for previous alcohol or non-medical benzodiazepine use remained significant.

Post-COVID-19 Substance Use

Tables 3, **4** present the results of the ordinal regression models for post-COVID acute phase and post-COVID follow-up phase substance use, respectively. The number of COVID-19 symptoms was neither associated with post-COVID acute phase or post-COVID follow-up phase substance use. In general, those who used each substance tended to use this substance after the COVID-19 active phase. These associations had the highest coefficients in the ordinal regression models.

In addition to these strong associations found for each substance, we found some cross-substance effects throughout the COVID-19 active phase. Pre-COVID alcohol use was associated with non-medical analgesic use in post-COVID acute phase and post-COVID follow-up phases. Pre-COVID tobacco use was associated with post-COVID follow-up phase cannabis use. There was a positive bi-directional cross-substance association between non-medical benzodiazepine and analgesic use along the period evaluated in the study. An opposite situation was found for cannabis and non-medical benzodiazepine use, in which pre-COVID use of one substance was negatively associated with use of the other in the post-COVID acute phase and post-COVID follow-up phases.

DISCUSSION

The present study aimed to examine the pre- and post-infection frequency of substance use and their relationship with COVID-19 symptoms in mild patients. The number of COVID-19 symptoms was neither associated with pre- or post-infection substance use. Pre-infection alcohol and benzodiazepine use were associated with specific COVID-19 symptoms. Sensitivity analyses showed that such associations could be explained by people who use substances previous psychiatric and medical profile. Regarding variations in substance use, alcohol and tobacco use decreased, and non-medical analgesic use increased in the post-infection period. However, just the alcohol use remained lower in the post-COVID follow-up phase. Higher pre-COVID levels of tobacco and alcohol were associated with cannabis and non-medical analgesic and cannabis use in the post-COVID follow-up phase, respectively. Non-medical benzodiazepine use had negative and positive bi-directional associations with cannabis and non-medical analgesic use, respectively.

Previous studies investigated the COVID-19 vulnerability among patients with substance use disorders. An electronic health record study, which included data from more than 73 million patients, found that substance use disorder increased the risk of COVID-19 (12). They also found that individuals with substance use disorder had higher levels of pulmonary,

TABLE 3 | Results of the ordinal regression model for post-COVID-19 acute phase substance use among 993 individuals who had mild COVID-19 in São Caetano do Sul, SP, Brazil.

Outcome: post-COVID acute phase ASSIST frequency score	Alcohol			Tobacco			Cannabis			Non-medical benzodiazepine			Non-medical analgesic		
	Coef.	95%CI		Coef.	95%CI		Coef.	95%CI		Coef.	95%CI		Coef.	95%CI	
Exposures:															
Number of CDC COVID-19 symptoms	−0.190	−0.450	0.069	−0.043	−0.199	0.112	−0.149	−0.389	0.091	0.035	−0.129	0.200	−0.053	−0.118	0.012
Pre-COVID-19 alcohol use	1.445***	1.296	1.593	−0.089	−0.321	0.143	0.025	−0.373	0.423	0.024	−0.239	0.287	0.138**	0.046	0.231
Pre-COVID-19 tobacco use	−0.002	−0.075	0.072	1.276***	1.100	1.452	0.047	−0.172	0.266	−0.075	−0.345	0.194	0.022	−0.056	0.100
Pre-COVID-19 cannabis use	0.020	−0.122	0.162	0.080	−0.140	0.299	1.730***	1.372	2.088	−0.648*	−1.169	−0.127	0.039	−0.121	0.199
Pre-COVID-19 non-medical benzodiazepines use	−0.100	−0.293	0.092	−0.005	−0.290	0.279	−0.611*	−1.147	−0.075	1.684***	1.380	1.989	0.179*	0.016	0.343
Pre-COVID-19 non-medical analgesics use	−0.111	−0.214	−0.007	−0.094	−0.296	0.109	0.314*	0.011	0.617	0.399**	0.159	0.639	1.413***	1.285	1.541

All the models adjusted for gender, age, city suburb, civil status, educational level, income, previous medical diseases, previous psychiatric disorder, time between intake and assessment.
$^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

TABLE 4 | Results of the ordinal regression model for pot-COVID-19 follow-up phase substance use among 993 individuals who had mild COVID-19 in São Caetano do Sul, SP, Brazil.

Outcome: post-COVID follow-up phase	Alcohol			Tobacco			Cannabis			Non-medical benzodiazepine			Non-medical analgesic		
	Coef.	95%CI		Coef.	95%CI		Coef.	95%CI		Coef.	95%CI		Coef.	95%CI	
Exposures:															
Number of CDC COVID-19 symptoms	0.001	−0.069	0.072	−0.077	−0.259	0.106	−0.191	−0.450	0.069	0.150	0.002	0.298	0.054	−0.013	0.120
Pre-COVID-19 alcohol use	1.956***	1.783	2.128	0.129	−0.143	0.402	0.084	−0.319	0.487	−0.030	−0.269	0.209	0.099*	0.004	0.194
Pre-COVID-19 tobacco use	0.070	−0.005	0.144	1.613***	1.387	1.840	0.247*	0.038	0.456	0.053	−0.159	0.265	−0.036	−0.117	0.045
Pre-COVID-19 cannabis use	−0.044	−0.196	0.107	−0.082	−0.321	0.156	2.325***	1.862	2.788	−0.460*	−0.896	−0.023	0.120	−0.037	0.276
Pre-COVID-19 Non-medical benzodiazepines use	−0.101	−0.293	0.090	−0.121	−0.443	0.200	−0.908**	−1.540	−0.276	1.221***	0.990	1.452	0.167*	0.010	0.325
Pre-COVID-19 Non-medical analgesics use	0.042	−0.061	0.145	−0.064	−0.296	0.168	0.181	−0.146	0.508	0.315**	0.104	0.527	1.401***	1.274	1.528

All the models adjusted for gender, age, city suburb, civil status, educational level, income, previous medical diseases, previous psychiatric disorder, time between intake and assessment.
$^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

kidney, cardiovascular, metabolic, liver, and immunological diseases, which increase the likelihood of experiencing more severe COVID-19-related outcomes (12). In the present study, we were not able to observe such a broad vulnerability. However, this study was restricted to participants with mild COVID symptoms. Notwithstanding that, our study found that the vulnerability to COVID-19 specific symptoms (e.g., shortness of breath or difficulty breathing, new loss of taste or smell, and congestion or runny nose) was not significant when excluding those with previous medical and psychiatric conditions. There are some possible explanations for the association of such specific symptoms with pre-COVID alcohol and benzodiazepine use. Alcohol Long-term alcohol use could have toxic effects on gustatory function (26) and can cause rhinosinusitis hyper-responsiveness, especially among those with previous clinical diseases (27). Non-medical and non-prescribed use of benzodiazepines has been largely correlated with anxiety disorders (28), which could explain the higher rates of dyspnea among this subpopulation during COVID-19.

Regarding substance use, mild COVID-19 patients may behave differently from the rest of the population who were not infected by the disease. There was a decrease in alcohol and tobacco use in the post-COVID acute phase in the present study, with the first remaining lower than the pre-COVID period in the post-COVID follow-up phase. No differences were found for cannabis use. These results contrast with the initial studies reporting increased substance use in the general population during the COVID-19 containment period in other countries, including the U.S. (15), U.K. (20), France (16), Belgium (17), but are more in line with the findings from Latin America and Caribbean (18) and Australia (13, 14). Decreased alcohol and tobacco use in mild COVID-19 patients seem to follow the decreased levels of substance use in individuals experiencing or being afraid of contracting diseases (29), rather than the increase found in those facing stressful situations (30). The increased non-medical analgesic use during the post-COVID acute phase could be explained by some popular reasons such as pain and tension relief (31), some of the symptoms experienced by a considerable number of patients in the post-COVID-19 period (32).

COVID-19 can increase the risk of some specific transitions among substances. The transitions from alcohol and tobacco to analgesics and cannabis, respectively, could be influenced by the disease-risk perception associated with these drugs. Alcohol and tobacco have been associated with several diseases, having a higher disease-risk perception (33, 34). On the other hand, cannabis and analgesics have a lower disease-risk perception, being associated with misperceptions of medical benefits (35, 36). In the acute post-COVID-19 phase, many patients experience very uncomfortable symptoms, such as fatigue, muscle weakness, pain, dyspnea, headache, and fever, which may impact functionality (7). The positive bi-directional association between benzodiazepines and analgesics is supported by many previous studies (37–39). However, others have found a negative association between the use of cannabis and benzodiazepines (40, 41), and have identified a substitutional role between them (42). These findings could explain the negative bi-directional relationship found in the present study.

The present study has several implications. Mild COVID-19 patients should be monitored for substance use in the post-infection period. Analgesic non-medical use preventive interventions should be implemented during the disease period. Focused preventive interventions increasing the perceived risk of cannabis use and non-medical use of benzodiazepines and analgesics among previous people who use substances could be of interest.

STRENGTHS AND LIMITATIONS

A 50%-response rate is the main limitation of the present study. However, the patients included in the present study were just slightly different from those who did not attend the survey invitation. Despite the latter being older, no additional significant differences were found. In addition, we were able to collect data from a large clinical sample. The main issue for the generalization of our findings was the inclusion of individuals dependent on the public healthcare sector only. The use of an adapted measure of substance use could be cited as a limitation, but it was a feasible way of collecting timely data. Online data collection could be seen both as a strength and limitation. Undoubtedly, it allowed us to collect data quickly. However, online surveys assessing substance use are subject of two main types of biases: sampling and non-response bias (43). Online surveys could pose a challenge for achieving a high response rate among people who are less active online. In the present study, this could be the reason for a significantly lower response rate among older individuals. Thus, our findings are not generalizable to older adults. Unfortunately, we were also not able to assess whether social distance measures could have affected substance availability to our sample during the period of the study. However, São Paulo state adopted just a "partial lockdown" (i.e., industrial activities, construction, supermarkets, banks, pharmacies, pet-shops, health and basic services were allowed to remain open) during the period of the study (44). It is worth noting that drug supply did not seem to be affected even during periods of "full lockdown" (45).

CONCLUSION

We could not replicate such a broad vulnerability to COVID-19 for people who use substances found in previous studies with samples with people with more severe COVID-19 and substance use disorders symptoms. Our study found that the vulnerability of people who use substance (i.e., alcohol and non-medical benzodiazepine) to COVID-19 specific symptoms disappeared when excluding those with previous medical and psychiatric conditions. Alcohol and tobacco use decreased and non-medical analgesic use increased in the post-COVID period. Only alcohol use remained lower in the post-COVID follow-up phase. Exposure to mild COVID-19 may predispose individuals increase non-medical analgesic use in the post-COVID period and should be the target of broad prevention interventions with mild COVID-19 patients. In addition, those who report previous substance use could be at-risk for a transition to cannabis use, non-medical use of benzodiazepines and analgesics, and could be the target of more focused preventive interventions. All mild COVID-19 patients should be monitored for substance use after the active phase of COVID-19.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of confidential patient data. Requests to access the datasets should be directed to https://coronavirus.saocaetanodosul.sp.gov.br.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comissão de Ética para Análise de Projeto de Pesquisa - CAPPesq. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FI, TB, BZ, JG, VV, LBQ, JCSB, FEL, JT, AV, MEM, PG, SSM, and JMC-M designed the study. FI, JCSB, TB, BZ, and JMC-M wrote the protocol. FI, TB, BZ, JG, VV, LBQ, JCSB, and FEL managed data collection. TB, BZ, and JMC-M created the databank. JMC-M, JT, AV, MEM, PG, and SSM managed the literature searches and summaries of previous related work. JMC-M and SSM undertook the statistical analysis. FI, JT, AV, and JMC-M wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

FUNDING

The city health department of São Caetano do Sul (Secretaria Municipal de Saúde da Prefeitura de São Caetano do Sul) funded the establishment and implementation of the COVID-19 platform. The protected time for the contribution of Dr. Castaldelli-Maia towards the research reported in this publication was supported by the National Institute on Drug Abuse [NIDA, T32DA031099 (Hasin) to PG] of the National Institutes of Health under the NIDA INVEST Drug Abuse Research Fellowship. NIDA had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.634396/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

CORRECTION
published: 16 June 2021
doi: 10.3389/fpubh.2021.703562

Corrigendum: Substance Use in Mild-COVID-19 Patients: A Retrospective Study

Flavia Ismael[1,2]*, *Beatriz Zaramella*[1], *Tatiane Battagin*[1], *João C. S. Bizario*[3], *Júlia Gallego*[1], *Victoria Villela*[1], *Lilian Bezerra de Queiroz*[1], *Fabio E. Leal*[1], *Julio Torales*[4], *Antonio Ventriglio*[5], *Megan E. Marziali*[6], *Priscila D. Gonçalves*[6], *Silvia S. Martins*[6] and *João M. Castaldelli-Maia*[6]

[1] Universidade Municipal de São Caetano do Sul, São Caetano do Sul, Brazil, [2] ABC Center for Mental Health Studies, Santo André, Brazil, [3] Faculdade de Medicina de Olinda, Olinda, Brazil, [4] Department of Psychiatry, School of Medical Sciences, National University of Asunción, Asunción, Paraguay, [5] Department of Clinical and Experimental Medicine, University of Foggia, Foggia, Italy, [6] Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY, United States

Keywords: COVID-19, alcohol, analgesics, cannabis, tobacco, benzodaizepine

OPEN ACCESS

Approved by:
Frontiers Editorial Office, Frontiers Media SA, Switzerland

***Correspondence:**
Flavia Ismael
flaviaism@yahoo.com.br

Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: 30 April 2021
Accepted: 19 May 2021
Published: 16 June 2021

Citation:
Ismael F, Zaramella B, Battagin T, Bizario JCS, Gallego J, Villela V, de Queiroz LB, Leal FE, Torales J, Ventriglio A, Marziali ME, Gonçalves PD, Martins SS and Castaldelli-Maia JM (2021) Corrigendum: Substance Use in Mild-COVID-19 Patients: A Retrospective Study. Front. Public Health 9:703562. doi: 10.3389/fpubh.2021.703562

A Corrigendum on

Substance Use in Mild-COVID-19 Patients: A Retrospective Study
by Ismael, F., Zaramella, B., Battagin, T., Bizario, J. C. S., Gallego, J., Villela, V., et al. (2021). Front. Public Health 9:634396. doi: 10.3389/fpubh.2021.634396

In the original article, we neglected to include the funder **"NIDA"**, **"T32DA031099 (Hasin)"** to **"Priscila D. Gonçalves"**.

The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 10 March 2021
doi: 10.3389/fpsyt.2021.648501

Exercise and Use of Enhancement Drugs at the Time of the COVID-19 Pandemic: A Multicultural Study on Coping Strategies During Self-Isolation and Related Risks

Artemisa R. Dores[1,2], Irene P. Carvalho[3], Julius Burkauskas[4], Pierluigi Simonato[5], Ilaria De Luca[5], Roisin Mooney[6], Konstantinos Ioannidis[7,8], M. Ángeles Gómez-Martínez[9], Zsolt Demetrovics[10,11], Krisztina Edina Ábel[10], Attila Szabo[10,12], Hironobu Fujiwara[13,14], Mami Shibata[13], Alejandra Rebeca Melero Ventola[15], Eva Maria Arroyo-Anlló[16], Ricardo M. Santos-Labrador[17], Inga Griskova-Bulanova[18], Aiste Pranckeviciene[4], Kei Kobayashi[13], Giovanni Martinotti[5,19], Naomi A. Fineberg[5], Fernando Barbosa[1] and Ornella Corazza[5,20]*

[1] Laboratory of Neuropsychophysiology, Faculty of Psychology and Education Sciences, University of Porto, Porto, Portugal, [2] School of Health, Polytechnic of Porto, Porto, Portugal, [3] Clinical Neurosciences and Mental Health Department and CINTESIS, School of Medicine, Porto, Portugal, [4] Laboratory of Behavioral Medicine, Neuroscience Institute, Lithuanian University of Health Sciences, Kaunas, Lithuania, [5] Department of Clinical, Pharmaceutical and Biological Sciences, School of Life and Medical Sciences, University of Hertfordshire, Hatfield, United Kingdom, [6] Medical Sciences Division, Department of Psychiatry, University of Oxford, Oxford, United Kingdom, [7] Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, [8] Cambridge and Peterborough NHS Foundation Trust, Cambridge, United Kingdom, [9] Department of Psychology, Pontifical University of Salamanca, Salamanca, Spain, [10] Institute of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary, [11] Centre of Excellence in Responsible Gaming, University of Gibraltar, Gibraltar, [12] Institute of Health Promotion and Sport Sciences, ELTE Eötvös Loránd University, Budapest, Hungary, [13] Department of Neuropsychiatry, Graduate School of Medicine, University of Kyoto, Kyoto, Japan, [14] Artificial Intelligence Ethics and Society Team, RIKEN Center for Advanced Intelligence Project, Saitama, Japan, [15] Faculty of Psychology, Pontifical University of Salamanca, Salamanca, Spain, [16] Department of Psychobiology, Neuroscience Institute of Castilla-León, University of Salamanca, Salamanca, Spain, [17] Department of Physical Education, University Teacher's College 'Fray Luis de León', Valladolid, Spain, [18] Department of Neurobiology and Biophysics, Institute of Biosciences, Vilnius University, Vilnius, Lithuania, [19] Department of Neuroscience, Imaging, and Clinical Science "G. d'Annunzio" University of Chieti-Pescara, Chieti, Italy, [20] Department of Psychology and Cognitive Science, University of Trento, Trento, Italy

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Edited by:
Carlos Roncero, University of Salamanca, Spain

Reviewed by:
Carlos Llanes-Álvarez, Complejo Asistencial de Zamora, Spain
Marianna Mazza, Catholic University of the Sacred Heart, Italy

***Correspondence:**
Artemisa R. Dores
artemisa@ess.ipp.pt

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 31 December 2020
Accepted: 01 February 2021
Published: 10 March 2021

Citation:
Dores AR, Carvalho IP, Burkauskas J, Simonato P, De Luca I, Mooney R, Ioannidis K, Gómez-Martínez MÁ, Demetrovics Z, Ábel KE, Szabo A, Fujiwara H, Shibata M, Ventola ARM, Arroyo-Anlló EM, Santos-Labrador RM, Griskova-Bulanova I, Pranckeviciene A, Kobayashi K, Martinotti G, Fineberg NA, Barbosa F and Corazza O (2021) Exercise and Use of Enhancement Drugs at the Time of the COVID-19 Pandemic: A Multicultural Study on Coping Strategies During Self-Isolation and Related Risks. Front. Psychiatry 12:648501. doi: 10.3389/fpsyt.2021.648501

Introduction: Little is known about the impact of restrictive measures during the COVID-19 pandemic on self-image and engagement in exercise and other coping strategies alongside the use of image and performance-enhancing drugs (IPEDs) to boost performance and appearance.

Objectives: To assess the role of anxiety about appearance and self-compassion on the practice of physical exercise and use of IPEDs during lockdown.

Methods: An international online questionnaire was carried out using the Exercise Addiction Inventory (EAI), the Appearance Anxiety Inventory (AAI), and the Self-Compassion Scale (SCS) in addition to questions on the use of IPEDs.

Results: The sample consisted of 3,161 (65% female) adults from Italy (41.1%), Spain (15.7%), the United Kingdom (UK) (12.0%), Lithuania (11.6%), Portugal (10.5%), Japan (5.5%), and Hungary (3.5%). The mean age was 35.05 years (*SD* = 12.10). Overall, 4.3% of the participants were found to engage in excessive or problematic exercise with peaks registered in the UK (11.0%) and Spain (5.4%). The sample reported the use of a wide range of drugs and medicines to boost image and performance (28%) and maintained use during the lockdown, mostly in Hungary (56.6%), Japan (46.8%), and the UK (33.8%), with 6.4% who started to use a new drug. Significant appearance anxiety levels were found across the sample, with 18.1% in Italy, 16.9% in Japan, and 16.7% in Portugal. Logistic regression models revealed a strong association between physical exercise and IPED use. Anxiety about appearance also significantly increased the probability of using IPEDs. However, self-compassion did not significantly predict such behavior. Anxiety about appearance and self-compassion were non-significant predictors associated with engaging in physical exercise.

Discussion and Conclusion: This study identified risks of problematic exercising and appearance anxiety among the general population during the COVID-19 lockdown period across all the participating countries with significant gender differences. Such behaviors were positively associated with the unsupervised use of IPEDs, although no interaction between physical exercise and appearance anxiety was observed. Further considerations are needed to explore the impact of socially restrictive measures among vulnerable groups, and the implementation of more targeted responses.

Keywords: compulsive exercise, performance-enhancing substances, body image, body dysmorphic disorders, obsessive-compulsive disorder

INTRODUCTION

On March 11, 2020, the World Health Organization declared the coronavirus disease 2019 (COVID-19) outbreak to be a pandemic situation as a result of the severe acute respiratory syndrome associated with the coronavirus 2 (SARS-CoV-2) and its highly contagious nature (1). This virus can affect the immune response and, in addition to respiratory complications (2), can have adverse effects on brain function and mental health (3, 4).

Since then, governments, health authorities, and citizens have adopted several measures to combat the spread of the virus (1, 5–7). These included physical distancing (also known as social distancing), prophylactic isolation, mandatory lockdown, and mandatory quarantine (8), leading to altered lifestyles and habits and affecting millions of individuals worldwide (9), society (10, 11), and the economy (12–14). For example, exposure to chronic and daily stressors such as quarantine can affect the cardiovascular system and the emotional experience of the individual, leading to an increased risk of developing a cardiovascular disease or mental illness (15).

Such changes could lead to distress or impairment of citizens' physical, social, and occupational domains (16), generating risk conditions that potentially affect the mental well-being of the general population, especially of those who are most exposed and vulnerable, such as patients diagnosed with COVID-19, those who have been in quarantine or other forms of social isolation, frontline healthcare providers [(6, 17, 18); for a review], and possibly other key workers (i.e., those workers who are crucial to keeping the country running safely, such as police officers, journalists, people delivering food and transportation).

Some of these measures are not new and have been implemented during other outbreaks in the past, such as severe acute respiratory syndrome (SARS), Middle East respiratory syndrome-related coronavirus (MERS), or Ebola (19, 20). However, the global occurrence of this pandemic might intensify the already known effects of both the pandemic and the sanitary control measures on individuals' mental health (21), warranting additional studies (22).

The potentially addictive nature of physical exercise has received increasing interest in the mental health literature (23–30). Social pressure to have a perfect body as a synonym of personal value and success, particularly in Western societies, is transforming the value and meaning attributed to the practice of exercise. Exercise is being increasingly used as a path to boost appearance, rather than primarily as a path to health, or as a pleasurable activity in itself (23, 30). Social media have been contributing to such a "fitspirational" trend, namely, through the continuous posting of photos and videos displaying "perfect bodies," or inspirational messages encouraging exercising, often beyond the human physical limits (31–34). Such potential damaging content might have an increased effect on adolescents and individuals with mental health problems (35), who might feel unable to meet such unrealistic beauty ideals. Physical exercise can thus become excessive and even problematic, depending also on the way in which people experience their bodies (36, 37).

Excessive and problematic physical exercise, sometimes called "compulsive exercise," "excessive exercising," (38) or "exercise addiction" (EA) (24), is a matter of increasing global concern (23).

Brown's (39) and, more recently, Griffith's six components of addiction (25–27) (i.e., salience, mood modification, tolerance, withdrawal symptoms, conflict, relapse) have been used to distinguish EA from other situations in which the individuals are only highly committed to exercising (38). However, as a controversial term, the construct of EA has not been included in the section of behavioral addictions of the main manuals of mental disorders [e.g., the International Classification of Diseases 11th Revision (40) and the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) (41)], calling for the need of additional sound theory-driven research and clinical evidence that clarify its nature and manifestations.

The relationship between problematic exercise and gender has been inconsistent. Some studies show higher exercise dependence among males (42–44), and others suggest the opposite (45, 46). The association between problematic exercise and age has also been contradictory. Whereas, adulthood has been considered a critical age period for developing problematic exercise in some studies (47), previous studies have reported that the prevalence of exercise dependence should decline with age, or that older adults are less at risk for exercise dependence (42, 48, 49). These differences across studies are possibly explained by methodological issues (e.g., instruments used, sample characteristics comprising mainly college students). Exercise dependence might have changed over time as well, suggesting the need for both longitudinal and current studies with diverse populations (47).

Problematic exercise has been associated with the escalating consumption of image and performance-enhancing drugs (IPEDs) (23), also known as lifestyle drugs, "an umbrella term that encompasses a variety of different products including anabolic steroids, sexual enhancers, growth hormones, and other drugs that can alter the functions of the body to enhance muscle growth, reduce body fat, and promote weight loss" [(50) cit in 29, p. 2]. IPEDs refer to a wide range of products, which are presented as having the potential to improve mental and physical functions. They include drugs for enhancing muscle structure and function (i.e., anabolic drugs), for weight loss, for modifying the aging process, beauty, and cosmetic appearance (i.e., image-enhancing drugs), for improving sex performance [i.e., "sex drugs," aphrodisiacs, or phosphodiesterase type 5 (PDE5) inhibitors], cognitive performance (i.e., cognitive enhancers), among other functions (23). Online and TV advertisements are contributing to, and exacerbating, the use of these drugs through misleading marketing strategies that promise rapid and safe appearance, physical and mental improvement, and as alternatives to gold standard pharmaceutical products (51–55). However, IPEDs might contain undisclosed ingredients with potential damaging effects to unaware users.

Dissatisfaction with one's own body image and related anxiety about one's appearance might further motivate such a hazardous intake with the purpose of improving physical and mental well-being. In extreme cases, anxiety about appearance might be symptomatic of body dysmorphic disorder (BDD) (23). BDD, classified under the DSM-5's Obsessive–Compulsive and Related Disorders (41), is characterized by extreme dissatisfaction with minor irregularities in one's appearance alongside the irresistible urge to act to eradicate these irregularities. In males, BDD often takes the form of muscle dysmorphia, where the dissatisfaction focuses on aspects of physique that the individual attempts to remediate through the compulsive use of muscle-enhancing agents and physical exercise (23). BDD has been associated with other clinical conditions, including obsessive–compulsive disorder, eating disorders, and addictive behaviors (56, 57). BDD causes considerable distress and interferes significantly with physical and social functioning (41, 58, 59). Yet, it is an under-recognized and underdiagnosed condition (59), namely, because people suffering from it rarely seek intervention for the condition itself, rather for the perceived flaws or for the related mental disorders (e.g., addictive behaviors). Although the specific etiology and pathophysiology of BDD are still under debate, within the spectrum of severe obsessive–compulsive behaviors [e.g., (56)], this is one of the most likely mental disorders to manifest alongside both problematic exercise and the use of IPEDs (23).

In contrast, other types of psychological functioning, if present, might contribute to mitigate or prevent the excessive use of physical exercise and IPEDs. For example, self-compassion is involved in emotional self-regulation and has been associated with psychological benefits among young adults (60). This understanding attitude toward oneself is associated with self-acceptance and self-nurturing abilities and therefore might act as a buffer in a number of mental disorders (61).

Considering the restricted activity associated with the COVID-19 pandemic (e.g., closure of gyms), social distancing might also be expected to be beneficial as much as by reducing several of the most frequent everyday stressors (62), individuals may be induced to relax their exercise habits and compulsive need for IPEDs and the anxiety about body image may be reduced. However, to date, young adults have rated everyday events as more intensely stressful during physical isolation (62). Therefore, the lack of physical contact with support networks might conversely trigger additional mental health problems as a result of the quarantine (16, 17, 21). Prolonged exposure to TV and online information and advertisements during confinement might have also had an impact on people's mood, image, performance, physical exercise, and IPEDs consumption.

In this work, we investigate the impact of the socially restrictive measures imposed by the COVID-19 pandemic on self-image and the practice of excessive, or even potentially problematic, physical exercise and the use of IPEDs as coping strategies to boost appearance during the period of its most restrictive policies (April–May 2020). We also consider the role of self-compassion as a potential mitigating factor for such risky behaviors. Considering the unprecedented situation, we hypothesized that individuals might have engaged more compulsively with exercise and IPEDs intake to better cope with the pandemic's altered lifestyle, closure of fitness centers, and reiterated period of self-isolation (63, 64), mainly when self-directed negative feelings, such as anxiety about one's own body, came into play.

The hypothesis is partly based on the results of a pre-COVID-19 investigation where authors found a strong association between "exercise addiction," IPEDs use, including illicit drugs, and BDD among a large international cohort of regular exercisers (23). Evidence was supported by another more recent study on "exercise addiction" during the COVID-19 pandemic among a Spanish-speaking sporting population (65). Although the overall practice of exercise decreased by almost 50% during the pandemic, the perceived impact of the pandemic on regular exercising did not differ among the three exercise groups (asymptomatic, symptomatic, and at-risk for addiction). The risk of "exercise addiction" was found in ∼15% of the sample. As both these studies were carried out among a population of physically active individuals, who exercise on a regular basis, one might wonder about the behaviors across the general population under such extraordinary circumstances. While some individuals were prohibited from practicing their regular physical exercise/activity outdoors (12) and might have stopped their exercise practices, others might have implemented new (unsupervised) workout regimes indoors (66).

More specifically, in this work, we sought: (1) to characterize the practice of physical exercise, (2) to explore the use of IPEDs, and (3) any potential associations between these risky behaviors and self-directed negative feelings of appearance anxiety vs. the positive feelings of self-compassion, along with gender, age, occupation (e.g., key workers) during the start of the COVID-19 pandemic. Results were compared cross-culturally in the United Kingdom (UK), Italy, Hungary, Portugal, Spain, Lithuania, and Japan.

MATERIALS AND METHODS

Study Design

This is an international cross-sectional observational study.

Participants

The sample comprised 3,161 participants from seven countries: Italy (n = 1,300; 41.1%), Spain (n = 497; 15.7%), UK (n = 378; 12.0%), Lithuania (n = 367; 11.6%), Portugal (n = 332; 10.5%), Japan (n = 175; 5.5%), and Hungary (n = 112; 3.5%). **Table 1** shows the sociodemographic characteristics of the participants in total and by country. The age of the participants ranged from 15 to 80 years old (M = 35.05; SD = 12.10), and the majority was female (n = 2,046; 65.2%). Most of the sample were highly educated with a master's (n = 995; 31.6%), PhD (n = 196; 6.2%), or a bachelor's degree (n = 951; 30.2%) and employed (n = 1,749; 55.7%) or studying (n = 666; 21.2%).

A considerable number of participants were "key workers" (n = 1,106; 35.0%), most of them in health professions (n = 517; 16.4%).

A total of 564 participants reported mental health problems before the pandemic (17.4%). Anxiety was the most prevalent of the reported mental problems (n = 329; 10.5%), followed by depression (n = 152; 4.8%). Almost half of the participants who reported the presence of a mental disorder before the pandemic considered that the physical distancing has worsened their mental problem (n = 205; 47.9%).

Most of the participants engaged in fitness activities, mainly generic workouts (n = 1,018; 33.1%), running (n = 422; 13.7%), walking (n = 416; 13.5%), fight sports (e.g., boxing, kickboxing, judo, sumo, and karate) (n = 412; 13.4%), and martial arts (e.g., aikido, Brazilian Jiu-Jitsu, Krav Maga, Kung Fu) (n = 355; 11.5%). A small proportion of the respondents did not practice physical exercise (n = 422; 14.7%).

Procedure

The study was approved by the Human Sciences Ethics Committee at the University of Hertfordshire (HSK/SF/UH/00104) and by the Ethics Committees of each participating country. It complied with the Declaration of Helsinki and with the European General Data Protection Regulation. The study's presentation included the project's description and aims, followed by an informed consent form. Upon agreement to participate, a link to the questionnaire was sent to participants. The latter was translated and back-translated from English into different languages (Italian, Spanish, Japanese, Portuguese, Hungarian, Lithuanian). Data collection was implemented *via* the Web-based survey platform Qualtrics [Qualtrics, Provo, UT, 2020], and the data were stored in a secure platform at the University of Hertfordshire.

Recruitment was supported by an already established global network of collaborators in Italy, UK, Lithuania, Hungary, Portugal, Spain, and Japan. It mainly occurred *via* posts on health and well-being social media platforms, not necessarily fitness related, namely, Facebook, LinkedIn, WhatsApp, Twitter, and Instagram. A snowball sampling technique was used; participants were invited to complete the survey and share it with their contacts. These procedures ensured a heterogeneous sample inclusive of both sporting and non-sporting populations.

Data collection occurred during April and May 2020, precisely at the peak of the COVID-19 pandemic and coinciding with the lockdown period in all the participating countries.

Instruments

The questionnaire was composed of: (a) sociodemographic information; (b) the Exercise Addiction Inventory (EAI); (c) questions on the use of IPEDs (i.e., "Have you taken supplements/products to reach your fitness goal/physical appearance during self-isolation? [Choose yes or no]"; "What are they? [Tick as many as apply]"); (d) the Appearance Anxiety Inventory (AAI); and (e) the Self-Compassion Scale (SCS).

The EAI-brief (67, 68) was developed to assess the level of engagement in physical activity. The EAI-brief is based on a modified version of the components of behavioral addiction by Griffiths (24) and consists of six questions that reflect the six general components of addiction (i.e., salience, mood modification, tolerance, withdrawal symptoms, social conflict, and relapse). Participants rate their responses on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A sum score is calculated (for a maximum of 30 points), with higher scores indicating the presence of more problems. A score equal to 24 or higher indicates problematic exercise akin to addiction. This cutoff represents those individuals with scores in the top 15% of the total scale score in the original study. The EAI is a theoretically driven instrument with valid and reliable psychometric properties reported in several studies across many countries (68–70). In our sample, Cronbach's *alpha* was 0.72, ranging from 0.65 to 0.75 for the different countries.

The intake of a wide range of IPEDs was assessed with questions developed for the purposes of this study. For each question, respondents answered "yes" or "no" or selected the response from a list of options. For purposes

TABLE 1 | Sociodemographic characteristics of the sample and types of physical activities (*N* = 3,161).

	Total *N* = 3,161	UK *N* = 378	Italy *N* = 1,300	Spain *N* = 497	Hungary *N* = 112	Portugal *N* = 332	Japan *N* = 175	Lithuania *N* = 367
Age, years								
Mean	35.05	36.70	31.89	38.58	41.79	34.24	39.28	36.36
(SD)	(12.10)	(12.24)	(10.96)	(13.56)	(11.80)	(11.18)	(13.84)	(10.33)
Min–Max	15–80	15–75	16–80	15–72	18–66	18–65	18–80	16–66
Gender, Female	2,046	188	857	302	69	249	70	311
(*n*; %)	65.2%	50.7%	66.1%	61.6%	61.6%	76.4%	40.2%	84.7%
Education level (*n*; %)								
PhD	196 (6.2%)	44 (11.7%)	27 (2.1%)	25 (5.1%)	3 (2.7%)	22 (6.7%)	17 (9.7%)	58 (15.8%)
Master's degree	995 (31.6%)	140 (37.3%)	418 (32.2%)	81 (16.4%)	41 (36.6%)	97 (29.4%)	21 (12.0%)	197 (53.7%)
Bachelor's degree	951 (30.2%)	118 (31.5%)	262 (20.2%)	240 (48.7%)	24 (21.4%)	152 (46.1%)	89 (50.9%)	66 18.0%
High school	760 (24.1%)	50 (13.3%)	520 (40.0%)	32 (6.5%)	31 (27.7%)	55 (16.7%)	36 (20.6%)	36 (9.8%)
Other	249 (7.9%)	23 (6.1%)	72 (5.5%)	115 (23.3%)	13 (11.6%)	4 (1.2%)	12 (6.9%)	10 (2.7%)
Occupation (*n*; %)								
Employed	1,749 (55.7%)	231 (61.4%)	659 (51.0%)	248 (50.3%)	74 (66.1%)	136 (41.3%)	122 (70.1%)	279 (76.6%)
Student	666 (21.2%)	60 (16.0%)	332 (25.7%)	98 (19.9%)	9 (8.0%)	88 (26.7%)	37 (21.3%)	42 (11.5%)
Unemployed	244 (7.8%)	13 (3.5%)	132 (10.2%)	53 (10.8%)	6 (5.4%)	25 (7.6%)	5 (2.9%)	10 (2.7%)
Retired	200 (6.4%)	9 (2.4%)	153 (11.8%)	25 (5.1%)	4 (3.6%)	7 (2.1%)	0 (0%)	2 (0.5%)
Freelance/individual activity	282 (9.0%)	63 (16.8%)	17 (1.3%)	69 (14.0%)	19 (17.0%)	73 (22.2%)	10 (5.7%)	31 (8.5%)
Key worker (*n*; %)	1,102 (34.9%)	103 (27.4%)	392 (30.2%)	170 (34.2%)	48 (42.9%)	111 (33.6%)	98 (56.0%)	180 (49.0%)
Health care and related specialities	517 (16.4%)	52 (13.8%)	186 (14.3%)	69 (13.9%)	9 (8.0%)	65 (19.7%)	57 (32.6%)	79 (21.5%)
Teachers and tutors	90 (2.9%)	8 (2.1%)	15 (1.2%)	5 (1.0%)	10 (8.9%)	8 (2.1%)	20 (11.4%)	25 (6.8%)
Transportation	23 (0.7%)	3 (0.8%)	5 (0.4%)	4 (0.8%)	5 (4.5%)	2 (0.6%)	2 (1.1%)	2 (0.5%)
Food industry	69 (2.2%)	7 (1.9%)	20 (1.5%)	24 (4.8%)	3 (2.7%)	1 (0.3%)	2 (1.1%)	12 (3.3%)
Public sector	32 (1.0%)	4 (1.1%)	2 (0.2%)	12 (2.4%)	1 (0.9%)	4 (1.2%)	3 (1.7%)	6 (1.6%)
Government	59 (1.9%)	6 (1.6%)	22 (1.7%)	8 (1.6%)	1 (0.9%)	5 (1.5%)	2 (1.1%)	15 (4.1%)
Postal and other services	34 (1.1%)	1 (0.3%)	16 (1.2%)	13 (2.6%)	3 (2.7%)	0 (0%)	0 (0%)	1 (0.3%)
National or public security	40 (1.3%)	7 (1.9%)	9 (0.7%)	10 (2.0%)	1 (0.9%)	2 (0.6%)	4 (2.3%)	7 (1.9%)
Pharmacy and related activity	23 (0.7%)	3 (0.8%)	11 (0.8%)	4 (0.8%)	1 (0.9%)	2 (0.6%)	1 (0.6%)	1 (0.3%)
Other	187 (5.9%)	23 (6.1%)	71 (5.5%)	0 (0%)	19 (17.0%)	71 (5.5%)	6 (3.4%)	50 (13.6%)
Professional athlete	52 (1.6%)	6 (1.6%)	28 (2.2%)	3 (0.6%)	3 (2.7%)	5 (1.5%)	0 (0%)	7 (1.9%)
Mental disorder (before)	547 (17.4%)	76 (20.2%)	257 (19.9%)	89 (17.9%)	12 (10.7%)	67 (20.3%)	14 (8.0%)	32 (8.8%)
Anxiety	329 (10.5%)	58 (15.4%)	128 (9.9%)	71 (14.3%)	7 (6.3%)	39 (11.8%)	4 (2.3%)	22 (6.0%)
Depression	152 (4.8%)	44 (11.7%)	54 (4.2%)	19 (3.8%)	6 (5.4%)	13 (3.9%)	1 (0.6%)	15 (4.1%)
Other mood disorders	52 (1.7%)	7 (1.9%)	21 (1.6%)	11 (2.2%)	2 (1.8%)	7 (2.1%)	3 (1.7%)	1 (0.3%)
Psychotic disorders	7 (0.2%)	5 (1.3%)	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)	0 (0%)	1 (0.3%)
Eating disorders	73 (2.3%)	16 (4.3%)	30 (2.3%)	14 (2.8%)	2 (1.8%)	3 (0.9%)	1 (0.6%)	7 (1.9%)
Personality disorders	15 (0.5%)	6 (1.6%)	6 (0.5%)	2 (0.4%)	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)
Other(s)	87 (2.8%)	10 (2.7%)	37 (2.9%)	10 (2.0%)	6 (1.8%)	2 (1.8%)	6 (3.4%)	16 (4.4%)
Physical distancing worsened mental disorder	205 (47.9%)	26 (44.8%)	97 (45.1%)	27 (47.4%)	3 (33.3%)	32 (64.0%)	5 (55.6%)	15 (50.0%)
Physical exercise								
Generic workout	1,018 (33.1%)	112 (29.9%)	442 (35.0%)	145 (29.7%)	27 (24.3%)	124 (38.5%)	15 (9.2%)	153 (42.7%)
Running	422 (13.7%)	69 (18.4%)	165 (13.1%)	66 (13.5%)	31 (27.9%)	33 (10.2%)	21 (12.9%)	37 (10.3%)
Walking	416 (13.5%)	42 (11.2%)	133 (10.5%)	122 (25.0%)	6 (5.4%)	48 (14.9%)	15 (9.2%)	50 (14.0%)
Fighting sports	412 (13.4%)	188 (50.3%)	85 (6.7%)	33 (6.8%)	2 (1.8%)	8 (2.5%)	84 (51.5%)	12 (3.4%)

(Continued)

TABLE 1 | Continued

	Total $N = 3,161$	UK $N = 378$	Italy $N = 1,300$	Spain $N = 497$	Hungary $N = 112$	Portugal $N = 332$	Japan $N = 175$	Lithuania $N = 367$
Martial arts	355 (11.5%)	181 (48.4%)	42 (3.3%)	30 (6.1%)	1 (0.9%)	6 (1.9%)	83 (50.9%)	12 (3.4%)
Yoga	306 (9.9%)	47 (12.6%)	110 (8.7%)	43 (8.8%)	15 (13.5%)	31 (9.6%)	14 (8.6%)	46 (12.8%)
Swimming	216 (7.0%)	26 (7.0%)	90 (7.1%)	24 (4.9%)	32 (28.8%)	17 (5.3%)	8 (4.9%)	19 (5.3%)
Weight lifting	210 (6.8%)	32 (8.6%)	99 (7.8%)	10 (2.0%)	12 (10.8%)	26 (8.1%)	5 (3.1%)	26 (7.3%)
Cycling	172 (5.6%)	28 (7.5%)	64 (5.1%)	22 (4.5%)	18 (16.2%)	13 (4.0%)	4 (2.5%)	23 (6.4%)
Ball sports	160 (5.2%)	19 (5.1%)	79 (6.3%)	27 (5.5%)	8 (7.2%)	17 (5.3%)	3 (1.8%)	7 (2.0%)
Other	129 (4.2%)	32 (8.6%)	48 (3.8%)	10 (2.0%)	8 (7.2%)	7 (2.2%)	7 (4.3%)	17 (4.7%)
Dance	118 (3.8%)	15 (4.0%)	49 (3.9%)	17 (3.5%)	6 (5.4%)	9 (2.8%)	2 (1.2%)	20 (5.6%)
Mountaineering	85 (3.1%)	15 (4.0%)	38 (3.0%)	20 (4.1%)	6 (5.4%)	-	1 (0.6%)	5 (1.4%)
Cross fit	82 (2.7%)	8 (2.1%)	32 (2.5%)	16 (3.3%)	3 (2.7%)	17 (5.3%)	0 (0%)	6 (1.7%)
Tennis	57 (1.9%)	7 (1.9%)	8 (0.6%)	19 (3.9%)	6 (5.4%)	4 (1.2%)	4 (2.5%)	9 (2.5%)
Triathlon	30 (1.0%)	1 (0.3%)	25 (2.0%)	0 (0%)	2 (1.8%)	1 (0.3%)	0 (0%)	1 (0.3%)
No activity	452 (14.7%)	11 (2.9%)	239 (18.9%)	67 (13.7%)	2 (1.8%)	51 (15.8%)	13 (8.0%)	69 (19.3%)

Note: The percentages do not add up to 100 because some people reported more sports they use and more than one key worker job.

of comparison, listed products included all those used in a previous study by Corazza et al. (23), developed after consultation with experts, namely, sport nutritionists and clinicians.

The AAI (71) measures the cognitive and behavioral dimensions of anxiety about body image in general and provides an indication of symptoms associated with BDD. It is a 10-item self-report questionnaire that assesses the frequency of avoidance behavior and of monitoring threats (e.g., checking, self-focused attention) that are characteristic of responses to a distorted body image. In its original version, each item is rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (all the time), yielding a summary score with a maximum of 40 points. Higher scores indicate a higher occurrence of appearance anxiety. It has been used to assess change in psychotherapy with patients suffering from BDD. In our version, the AAI included a four-point Likert scale ranging from 1 (not at all) to 4 (all the time), for a maximum of 40 points. The cutoff score for this version was defined using the same methodology as for the EAI questionnaire, i.e., values $\geq$21 based on the scores falling in the top 15% of the total scale score. In our sample, Cronbach's *alpha* was 0.87, ranging from 0.81 to 0.90 for the different countries in this study.

The SCS-Short Form (72) consists of compassion turned to oneself and is related to emotional self-regulation. It consists of 12 items distributed by six subscales: Self-Kindness, Self-Judgment, Common Humanity, Isolation, Mindfulness, and Over-Identification. Respondents are asked to answer each item on a 5-point scale ranging from 1 (almost never) to 5 (almost always) according to "how I typically act toward myself in difficult times." The total score of the SCS (maximum of 60 points) is computed through the sum of the scores on the six subscales (with some of them being reversed previously). Higher scores indicate greater self-compassion. The SCS lacks an official cutoff score. Consistent with the procedures for the AAI, we used the cutoff score <27 to represent those 15% of the study group who were the least self-compassionate. In our sample, Cronbach's *alpha* was 0.82, ranging from 0.80 to 0.84 for the different countries in this study.

Data Analysis

Normality checking yielded adequate values, and SPSS for Windows, version 17.0 (SPSS Inc., Chicago, Illinois), was used for all analyses.

Descriptive analyses (frequency, central tendency, and dispersion measures) were used for the following variables: sociodemographic characteristics (age, gender, occupation), use of IPEDs and sources where the IPEDs were obtained, the EAI, the AAI, and the SCS. Student's t-tests were calculated to compare means on the EAI, AAI, and SCS between male and female participants. Chi-square tests were used for categorical variables, to compare scores (e.g., above/below the cutoff point for each instrument) between male and female participants, and by country.

Binary logistic regressions were calculated to inspect (1) how AAI, SCS, and IPEDs use predict the practice of physical exercise (classified as 0, "no practice," or 1, "practice"), controlling for age, and (2) how AAI, SCS, and EAI predict IPEDs consumption (classified as 0, "not used," or 1, "used"), also controlling for age. These same logistic regression models were then run for each gender. In addition, (3) logistic regressions were conducted to inspect reported changes in physical exercise, in IPEDs consumption, and in mental health state during the lockdown (as outcome variables) and the predictors of such changes. A new predictor was entered in these latter models [namely, whether or not respondents were key workers (0, "non-key worker"; 1, "key worker")] in addition to the other variables mentioned above [AAI, SCS, IPEDs use, EAI, gender (0, men; 1, women), and age] for inspection of the role of key workers in these changes. Professional athletes represented a very small proportion of the total sample and were removed from the first regression analysis so that results better reflect the population at large. With a given sample size allowing R^2

TABLE 2 | Problematic exercise (EAI ≥24): total and by country.

	Total *n* (%)	UK *n* (%) *N* = 363	Italy *n* (%) *N* = 1,211	Spain *n* (%) *N* = 463	Hungary *n* (%) *N* = 107	Portugal *n* (%) *N* = 316	Japan *n* (%) *N* = 172	Lithuania *n* (%) *N* = 337	Country differences
EAI	128	40	37	25	4	9	5	8	$\chi^2 =$ 51.17
(scores ≥ 24) *n* = 2,969	(4.3%)	(11.0%)	(3.1%)	(5.4%)	(3.7%)	(2.8%)	(2.9%)	(2.4%)	$p < 0.001$

TABLE 3 | Use of fitness supplements (IPEDs): total and by country.

	***N* 2,684**	UK *n* (%)	Italy *n* (%)	Spain *n* (%)	Hungary *n* (%)	Portugal *n* (%)	Japan *n* (%)	Lithuania *n* (%)	Country differences
Have never used	1,945 (72.5%)	219 (66.2%)	822 (76.2%)	380 (85.8%)	34 (44.2%)	197 (69.1%)	88 (55.0%)	205 (66.3%)	
Have used	739 (28.0%)	112 (33.8%)	257 (24.3%)	63 (14.4%)	43 (56.6%)	88 (31.5%)	72 (46.8%)	104 (34.4%)	$\chi 2 = 118.47$ $p < 0.001$
Used before and during isolation	528 (19.7%)	106 (32.0%)	150 (13.9%)	38 (8.6%)	41 (53.2%)	50 (17.5%)	66 (41.3%)	77 (24.9%)	
Used before isolation, have not used during isolation	39 (1.5%)	2 (0.6%)	14 (1.3%)	7 (1.6%)	2 (2.6%)	4 (1.4%)	2 (1.3%)	8 (2.6%)	
Started using during isolation	172 (6.4%)	4 (1.2%)	93 (8.6%)	18 (4.1%)	0 (0.0%)	34 (11.9%)	4 (2.5%)	19 (6.1%)	

IPEDs, Image and performance-enhancing drugs.

for a 2% change and the number of predictor variables ranging from 4 to 7, we were able to achieve power ranging from 0.74 to 0.99.

RESULTS

Physical Exercise

Among 3,161 participants from seven countries included in this study, results showed a mean score of 16.63 ($SD = 4.32$) on the EAI, with male participants displaying significantly higher values ($M = 16.99$; $SD = 4.41$) than their female counterparts ($M = 16.43$; $SD = 4.25$), $t_{(2946)} = 3.31$; $p = 0.001$; $d = 0.13$. Scores equal to or above the cutoff point of 24, indicating problematic exercise akin to addiction, were observed among 4.3% ($n = 128$) of the total sample. This group of high scorers also included a significantly greater proportion of male ($n = 60$; 5.9%) than female participants ($n = 66$; 3.4%), χ^2 (1, $N = 2{,}946$) $= 9.58$, $p = 0.002$; $N = 126$. In addition, major cross-cultural differences were found in the comparison among those scoring above/below the cutoff point of 24 across the participating countries (**Table 2**). Those at risk of more problematic forms of exercise were mainly found in the UK (11%) and Spain (5.4%).

Use of Image and Performance-Enhancing Drugs (IPEDs)

Just over a quarter of participants (28%, $N = 2{,}684$) had used IPEDs (**Table 3**). Among them, 19.7% reported using IPEDs before the restrictive measures and maintaining this behavior during the lockdown; only 1.5% had stopped consuming IPEDs (**Table 3**). In addition, 6.4% of the total sample started consuming IPEDs during this period.

Major differences emerging from the cross-cultural comparison are displayed in **Table 3**. Hungary presented the largest percentage of participants who reported using IPEDs (56.6%), followed by Japan (46.8%), then Lithuania (34.4%), the UK (33.8%), and Portugal (31.5%).

Those who started the consumption of IPEDs during self-isolation were mainly from Portugal (11.9%), while those who were already consuming such products and continued during lockdown were mainly from Hungary (53.2%), Japan (41.3%), and the UK (32.0%) (**Table 3**). A gender difference was found among those who were already using IPEDs before isolation and continued consuming during isolation, χ^2 (2, $N = 2{,}618$) $=$ 40.41, $p < 0.001$; $N = 525$, with a greater proportion of male ($n =$ 241, 26.8%) than female participants ($n = 284$; 16.5%) reporting continued use.

Across the overall sample, the products that were most frequently used with the purpose of enhancing image and performance were vitamins (40.5%), proteins (40.4%), caffeine (36.2%), tea or infusions (35.7%), multivitamin supplements (33.6%), and amino acids (27.8%), along with other substances such as ibuprofen (10.3%) and antioxidants (8.3%). Participants also reported consumption of stimulants, nitric oxide, beta blockers, and ketones, used by around 2.0%, androgenic substances, namely, steroids and hormones or hormone-related products (each used by 1.4% of the sample), and other products that were reported in smaller percentages (**Table 4**). These products were purchased mostly in pharmacies (43.8%), followed

TABLE 4 | Use of fitness supplements: type and source of purchase (total and by country).

Type of fitness product (*n* = 785)	*n* (%)	UK *n* (%)	Italy *n* (%)	Spain *n* (%)	Hungary *n* (%)	Portugal *n* (%)	Japan *n* (%)	Lithuania *n* (%)
Vitamins	318 (40.5%)	61 (54.5%)	91 (32.9%)	14 (20.3%)	25 (56.8%)	30 (31.9%)	23 (29.5%)	74 (66.7%)
Proteins	317 (40.4%)	70 (62.5%)	105 (37.9%)	27 (39.1%)	14 (31.8%)	43 (45.7%)	29 (37.2%)	29 (26.1%)
Caffeine	284 (36.2%)	41 (36.6%)	91 (32.9%)	22 (31.9%)	16 (36.4%)	42 (44.7%)	27 (34.6%)	45 (40.5%)
Tea or infusions	280 (35.7%)	34 (30.4%)	106 (38.3%)	22 (31.9%)	13 (29.5%)	35 (37.2%)	26 (16.3%)	44 (39.6%)
Multivitamin supplement	264 (33.6%)	39 (34.8%)	103 (37.2%)	12 (17.4%)	20 (45.5%)	25 (26.6%)	19 (24.4%)	46 (41.4%)
Amino acids	218 (27.8%)	33 (29.5%)	87 (31.4%)	16 (23.2%)	11 (25.0%)	17 (18.1%)	30 (38.5%)	24 (21.6%)
Omega 3 fish oil	208 (26.5%)	42 (37.5%)	51 (18.4%)	9 (13.0%)	12 (27.3%)	26 (27.7%)	10 (12.8%)	58 (52.3%)
Multimineral supplement	172 (21.9%)	19 (17.70)	91 (32.9%)	5 (7.2%)	7 (15.9%)	14 (14.9%)	9 (11.5%)	27 (24.3%)
Creatine	152 (19.4%)	35 (31.3%)	52 (18.8%)	19 (27.5%)	3 (6.8%)	21 (22.3%)	7 (9.0%)	15 (13.5%)
Carnitine	98 (12.5%)	8 (7.1%)	34 (12.3%)	12 (17.4%)	5 (11.4%)	19 (20.2%)	3 (3.8%)	17 (15.3%)
Mineral salt	96 (12.2%)	6 (5.4%)	66 (23.8%)	4 (5.8%)	4 (9.1%)	6 (6.4%)	3 (3.8%)	7 (6.3%)
Turmeric	93 (11.8%)	19 (17.0%)	27 (9.7%)	7 (10.1%)	5 (11.4%)	8 (8.5%)	7 (9.0%)	20 (18.0%)
Fish oil	89 (11.3%)	17 (15.2%)	12 (4.3%)	2 (2.9%)	6 (13.6%)	8 (8.5%)	7 (9.0%)	37 (33.3%)
Herbal medicine	88 (11.2%)	13 (11.6%)	24 (8.7%)	9 (13.0%)	7 (15.9%)	4 (4.3%)	6 (7.7%)	25 (22.5%)
Green tea extract	79 (10.1%)	13 (11.6%)	23 (8.3%)	10 (14.5%)	8 (18.2%)	14 (14.9%)	3 (3.8%)	8 (7.2%)
Ibuprofen	71 (10.3%)	20 (17.9%)	1 (0.4%)	9 (13.0%)	1 (2.3%)	0 (0.0%)	8 (10.3%)	32 (28.8%)
Antioxidants	65 (8.3%)	9 (8.0%)	23 (8.3%)	0 (0.0%)	7 (15.9%)	9 (9.6%)	5 (6.4%)	12 (10.8%)
Glutamate	64 (8.2%)	10 (8.9%)	19 (6.9%)	7 (10.1%)	5 (11.4%)	10 (8.9%)	5 (6.4%)	8 (7.2%)
Glucosamine	52 (6.6%)	17 (15.2%)	10 (3.6%)	0 (0.0%)	8 (18.2%)	5 (5.3%)	3 (3.8%)	9 (8.1%)
Taurine	51 (6.5%)	4 (3.6%)	18 (6.5%)	6 (8.7%)	1 (2.3%)	10 (10.6%)	5 (6.4%)	7 (6.3%)
Diuretics	49 (6.2%)	3 (2.7%)	17 (6.1%)	9 (13.0%)	1 (2.3%)	17 (18.1%)	1 (1.3%)	1 (0.9%)
Ginseng	48 (6.1%)	8 (7.1%)	17 (6.1%)	2 (2.9%)	4 (9.1%)	8 (8.5%)	3 (3.8%)	6 (5.4%)
Laxatives	43 (5.5%)	7 (6.3%)	11 (4.0%)	4 (5.8%)	1 (2.3%)	6 (6.4%)	9 (11.5%)	5 (4.5%)
Guaran	38 (4.8%)	7 (6.3%)	11 (4.0%)	2 (2.9%)	1 (2.3%)	12 (12.8%)	1 (1.3%)	4 (3.6%)
Beta alanine	25 (3.2%)	4 (3.6%)	9 (3.2%)	5 (7.2%)	1 (2.3%)	2 (2.1%)	1 (1.3%)	3 (2.7%)
Other*	24 (3.2%)	9 (8.0%)	0 (0.0%)	1 (1.4%)	–	6 (6.4%)	6 (7.7%)	2 (1.8%)
Nitric oxide	16 (2.0%)	2 (1.8%)	5 (1.8%)	3 (4.3%)	1 (2.3%)	2 (2.1%)	2 (2.6%)	1 (0.9%)
Stimulants (e.g., amphetamine, modafinil)	15 (1.9%)	5 (4.5%)	1 (0.4%)	0 (0.0%)	1 (2.3%)	5 (4.5%)	1 (1.3%)	2 (1.8%)
Ketones	14 (1.8%)	7 (6.3%)	2 (0.7%)	0 (0.0%)	1 (2.3%)	2 (2.1%)	1 (1.3%)	1 (0.9%)
Beta blockers	13 (1.7%)	1 (0.9%)	1 (0.4%)	0 (0.0%)	3 (6.8%)	3 (3.2%)	2 (2.6%)	3 (2.7%)
Androgenic substances (e.g., steroids)	11 (1.4%)	3 (2.7%)	0 (0.0%)	1 (1.4%)	1 (2.3%)	4 (4.3%)	1 (1.3%)	1 (0.9%)
Hormones (e.g., EPO, insulin) or related (e.g., beta-2 agonists)	11 (1.4%)	2 (1.8%)	1 (0.4%)	0 (0.0%)	1 (2.3%)	3 (3.2%)	2 (2.6%)	2 (1.8%)
Pyruvate	8 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (9.1%)	1 (1.1%)	2 (2.6%)	1 (0.9%)
Orlistat	8 (1.0%)	0 (0.0%)	0 (0.0%)	1 (1.4%)	1 (2.3%)	3 (3.2%)	2 (2.6%)	1 (0.9%)
Glucocorticoids	4 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.3%)	1 (1.1%)	1 (1.3%)	1 (0.9%)
Source of purchase	**Total *n* (%)**	**UK *n* (%)**	**Italy *n* (%)**	**Spain *n* (%)**	**Hungary *n* (%)**	**Portugal *n* (%)**	**Japan *n* (%)**	**Lithuania *n* (%)**
Pharmacy	313 (43.8%)	40 (38.8%)	101 (40.2%)	17 (29.3%)	22 (52.4%)	24 (28.9%)	38 (52.1%)	71 (67.6%)
Internet	309 (43.2%)	51 (49.5%)	113 (45.0%)	16 (27.6%)	22 (52.4%)	30 (36.1%)	34 (46.6%)	43 (41.0%)

(Continued)

TABLE 4 | Continued

Type of fitness product ($n = 785$)	*n* (%)	UK *n* (%)	Italy *n* (%)	Spain *n* (%)	Hungary *n* (%)	Portugal *n* (%)	Japan *n* (%)	Lithuania *n* (%)
Specialized food store	178 (24.9%)	33 (32.0%)	58 (23.1%)	23 (39.7%)	12 (28.6%)	30 (36.1%)	6 (8.2%)	16 (15.2%)
Food store	156 (21.8%)	33 (32.0%)	47 (18.7%)	16 (27.6%)	5 (11.9%)	26 (31.3%)	17 (23.3%)	12 (11.4%)
Other	33 (4.6%)	4 (3.9%)	15 (6.0%)	3 (5.2%)	3 (7.1%)	2 (2.4%)	3 (4.1%)	3 (2.9%)
Black market	6 (0.8%)	2 (1.9%)	1 (0.4%)	0 (0.0%)	0 (0.0%)	2 (2.4%)	0 (0.0%)	1 (1.0%)

*Note: Selected from multiple choice; *Main answers to the option "Other" products: berberine; black garlic; casein; Chlorella; collagen; collagen UC2; collagen peptides; hydration sport drinks; pea protein isolate. The percentages do not add up to 100 because some people reported more forms of supplements they use.*

TABLE 5 | Appearance Anxiety Inventory (AAI) and Self-Compassion Scale (SCS) results per country.

	UK	Italy	Spain	Hungary	Portugal	Japan	Lithuania	Country differences
AAI (scores ≥21) $n = 2{,}873$	45 (12.8%)	214 (18.1%)	39 (8.6%)	15 (15.2%)	51 (16.7%)	29 (16.9%)	48 (14.5%)	$\chi^2 = 25.53$ $p < 0.001$
SCS (scores <27) $n = 2{,}785$	81 (23.9%)	278 (24.3%)	62 (13.9%)	14 (14.9%)	32 (10.8%)	19 (11.2%)	39 (12.2%)	$\chi^2 = 64.52$ $p < 0.001$

χ^2, chi-square test.

by the Internet (43.2%), and food stores and specialized food stores (24.9 and 21.8%, respectively). The category "others" was chosen by 4.6% of the respondents, and 0.8% made a purchase from the black market (**Table 4**). Lithuanians had the highest rates of vitamins, omega 3, and fish oil use as well as positive attitude toward herbal medicine and herbal infusions; the highest prevalence of ibuprofen use was also observed in Lithuania. Participants in Lithuania acquired IPEDs from pharmacies in a very large percentage and larger than respondents from all other countries.

Appearance Anxiety vs. Self-Compassion

Regarding anxiety about one's appearance, the sample's mean value on the AAI was 15.82 ($SD = 5.11$). Female participants ($M = 16.62$; $SD = 5.29$) scored significantly higher than male participants ($M = 14.31$; $SD = 4.36$), $t_{(2872)} = -11.85$; $p < 0.001$; $d = 0.48$. About 15% ($n = 441$) of the participants scored 21 or above, which may be indicative of symptom domains associated with BDD. There was a significant relationship between participants' gender and scoring above/below 21. Female participants were more likely than male participants to score 21 or above, χ^2 (2, $N = 437$) = 60.60, $p < 0.001$, indicating that they were more at risk. Analyses by country showed that values above the cutoff point on the AAI registered the highest percentage of participants in Italy (18.1%), followed by several countries registering similar values (**Table 5**).

The sample's mean score on the SCS was 31.43 ($SD = 5.71$), with male participants ($M = 32.35$; $SD = 5.25$) showing significantly higher values than female participants ($M = 30.92$; $SD = 5.89$), $t_{(2784)} = 6.55$, $p < 0.001$, $d = 0.26$. The percentage of participants scoring below the cutoff point (i.e., values <27) was 16.6% ($n = 525$). The chi-square test showed that there was a significant association between gender and scoring above/below 27. Female participants were more likely than their male counterparts to score below 27, χ^2 (2, $N = 523$) = 29.13, $p < 0.001$. The countries with the largest percentages of participants scoring below the cutoff point were Italy and the UK. These two countries registered similar percentages of low scorers (respectively, 24.3 and 23.9%) and greater percentages than the remaining countries (**Table 5**).

Predictors of Physical Exercise and of Image and Performance-Enhancing Drugs (IPEDs) Use

Logistic regression on physical exercise [classified as 0, "no practice," or 1, "practice," according to the question, "Do you practice any sport(s)?"] included IPEDs consumption (0, "not used"; 1, "used"), AAI scores (0, <21; 1, ≥21), SCS scores (0, <27; 1, ≥27), and age in the model (**Table 6**). The strongest predictor of physical exercise was IPEDs use, with an odds ratio of 2.507, 95% CI 1.824–3.445, $p < 0.001$. The probability of practicing exercise almost tripled when participants used IPEDs compared to when they did not use them. Age was also significant and was positively related with physical exercise [odds ratio (OR) = 1.014, 95% CI 1.003–1.025, $p = 0.012$]. Appearance anxiety and self-compassion were non-significant predictors of physical exercise.

Among male participants, the two significant predictors of physical exercising were IPEDs consumption (OR = 4.165, 95% CI 2.191–7.917, $p < 0.001$) and age (OR = 1.026, 95% CI 1.006–1.046, $p = 0.012$). IPEDs consumption was a strong positive predictor. All else being constant, men who use IPEDs were over four times more likely to practice exercise than not practice it. Among female

TABLE 6 | Physical exercise logistic regression model (total and by gender).

		B	ES	Wald	df	*p*	Odds ratio (OR)	Confidence interval (CI)	
								Min	Max
Model I: physical exercise (total sample) $N = 1,995$	AAI (scores ≥21)	−0.280	0.164	2.921	1	0.087	0.756	0.548	1.042
	SCS (scores <27)	0.225	0.152	2.193	1	0.139	1.252	0.930	1.687
	IPEDs	0.919	0.162	32.122	1	0.000	2.507	1.824	3.445
	Age	0.014	0.005	6.251	1	0.012	1.014	1.003	1.025
	Constant	0.822	0.429	3.663	1	0.056	2.275		
Model II: physical exercise (men) $N = 564$	AAI (scores ≥21)	−0.108	0.418	0.066	1	0.797	0.898	0.395	2.038
	SCS (scores <27)	0.377	0.318	1.409	1	0.235	1.458	0.782	2.719
	IPEDs	1.427	0.328	18.950	1	0.000	4.165	2.191	7.917
	Age	0.025	0.010	6.348	1	0.012	1.026	1.006	1.046
	Constant	−0.142	0.865	0.027	1	0.870	0.868		
Model III: physical exercise (women) $N = 1,421$	AAI (scores ≥21)	−0.315	0.182	2.988	1	0.084	0.730	0.511	1.043
	SCS (scores <27)	0.183	0.174	1.109	1	0.292	1.201	0.854	1.688
	IPEDs	0.720	0.188	14.641	1	0.000	2.054	1.421	2.969
	Age	0.008	0.007	1.583	1	0.208	1.008	0.995	1.022
	Constant	1.145	0.502	5.197	1	0.023	3.141		

Note: Physical exercise (0, "no practice"; 1, "practice"); IPEDs (0, "not used"; 1, "used"); AAI (0, scores <21; 1, scores ≥21), SCS (0, scores <27; 1, scores ≥27).
AAI, Appearance Anxiety Inventory; IPEDs, image- and performance-enhancing drug; SCS, Self-Compassion Scale.

participants, IPEDs use was also a significant predictor of exercising (OR = 2.054, 95% CI 1.421–2.969, $p < 0.001$). However, unlike male participants, age was not a significant predictor of physical exercise among female respondents. Appearance anxiety and self-compassion were not significant predictors of physical exercise among both male and female participants (**Table 6**).

The logistic regression on IPEDs consumption (classified as 0, "not used," or 1, "used," according to the question, "Have you taken supplements/products to reach your fitness goal/physical appearance during self-isolation?") included problematic exercise (0, scores <24; 1, scores ≥24), AAI scores (0, <21; 1, ≥21), SCS scores (0, <27; 1, ≥27), and age (**Table 7**). The results showed that the strongest predictor of IPEDs use was problematic exercise (OR = 2.726, 95% CI 1.843–4.030; $p < 0.001$), followed by appearance anxiety (OR = 1.443, 95% CI 1.125–1.850, $p = 0.004$). Thus, the probability of using IPEDs was almost triple for those scoring 24 or above the cutoff point of 24 on the EAI, and almost one and a half times greater for those who scored on or above the cutoff point of 21 on the AAI, than for those who scored below the cutoff points. Like in the previous regression, self-compassion was statistically non-significant. However, unlike in the previous regression, age was also a non-significant factor here.

When only male participants were considered, the results were similar to those obtained for the whole sample. Problematic exercise was the strongest predictor of IPEDs use (OR = 2.227, 95% CI 1.215–4.084, $p = 0.010$), followed by appearance anxiety (OR = 1.912, 95% CI 1.146–3.189, $p = 0.013$), and both variables were positively associated with IPEDs use (**Table 7**). This suggests that male participants who scored above the cutoff points (in both instruments) had about double the probability to use IPEDs than male participants who scored below the cutoff points. When only female respondents were considered, again, the strongest predictor of IPEDs use was problematic exercise (OR = 3.003, 95% CI 1.781–5.063, $p < 0.001$), followed by appearance anxiety (OR = 1.511; 95% CI 1.122–2.035, $p = 0.007$), and both variables were positively associated with IPEDs use as well (**Table 7**). Additionally, age was significant, though only for female participants (OR = 1.013; 95% CI 1.003–1.023; $p = 0.014$). This indicates that problematic exercise was a strong predictor among female respondents, increasing by three times their probability of using IPEDs. This probability also increased with appearance anxiety and with age, though to a lesser extent (**Table 7**).

Predictors of Change in Physical Exercise, in the Use of Image and Performance-Enhancing Drugs (IPEDs), and in Mental Health State During the Self-Isolation Period

To assess changes during the self-isolation period, logistic regressions were conducted on three questions. One question assessed changes in physical exercise: Whether participants had a significant change in their fitness routine during this self-isolation period (0, "no"; 1, "yes"). Another assessed changes in their use of IPEDs (0, "never used"; 1, "never used, but started during isolation"). The third assessed changes in their mental health state, and only participants who had responded "yes" to the question on whether they had a mental health diagnosis were included: Whether this self-isolation period worsened their

TABLE 7 | Use of IPEDs logistic regression model (total and by gender).

		B	ES	Wald	df	*p*	Odds ratio (OR)	Confidence interval (CI)	
								Min	Max
Model I: IPEDs use (total sample) *N* = 2,468	AAI (scores ≥21)	0.366	0.127	8.330	1	0.004	1.443	1.125	1.850
	SCS (scores <27)	−0.047	0.118	0.160	1	0.689	0.954	0.757	1.202
	EAI (scores ≥24)	1.003	0.200	25.247	1	0.000	2.726	1.843	4.030
	Age	0.004	0.004	1.294	1	0.255	1.004	0.997	1.012
	Constant	−2.391	0.392	37.290	1	0.000	0.092		
Model II: IPEDs use (men) *N* = 843	AAI (scores ≥21)	0.648	0.261	6.160	1	0.013	1.912	1.146	3.189
	SCS (scores <27)	−0.092	0.212	0.187	1	0.665	0.912	0.602	1.382
	EAI (scores ≥24)	0.801	0.309	6.699	1	0.010	2.227	1.215	4.084
	Age	−0.007	0.006	1.555	1	0.212	0.993	0.982	1.004
	Constant	−1.668	0.638	6.833	1	0.009	0.189		
Model III: IPEDs use (women) *N* = 1,613	AAI (scores ≥21)	0.413	0.152	7.379	1	0.007	1.511	1.122	2.035
	SCS (scores <27)	−0.078	0.145	0.286	1	0.593	0.925	0.697	1.229
	EAI (scores ≥24)	1.100	0.267	17.019	1	0.000	3.003	1.781	5.063
	Age	0.013	0.005	6.176	1	0.013	1.013	1.003	1.023
	Constant	−2.961	0.512	33.512	1	0.000	0.052		

IPEDs use (0, not used; 1, used); problematic exercise (0, scores <24; 1, scores ≥24); AAI (0, scores <21; 1, scores ≥21); SCS (0, scores <27; 1, scores ≥27).
AAI, Appearance Anxiety Inventory; IPEDs, image- and performance-enhancing drug; SCS, Self-Compassion Scale.

psychological discomfort (0, "no"; 1, "yes"). The results of the regressions are presented in **Table 8**, respectively, on (1) change in physical exercise, (2) change in the use of IPEDs, and (3) change in mental health. The same predictors as before were included in the regression models. To inspect whether changes in physical exercise, use of IPEDs, and mental health were associated with being a key worker, the latter aspect was additionally included in the models (0, "non-key worker"; 1, "key worker").

Significant aspects associated with the change in physical exercise were IPEDs consumption (OR = 1.327, 95% CI 1.070–1.645, $p = 0.010$) and being a key worker (OR = 0.725, 95% CI 0.592–0.888, $p = 0.002$). This means that changes in practicing exercise were more likely when participants used IPEDs and were non-key workers.

The only predictor of change in IPEDs consumption was scoring 24 or above the cutoff of 24 on the EAI (OR = 2.272, 95% CI 1.121–4.606, $p = 0.006$). This was a strong predictor, reflecting the idea that initiating IPEDs use during self-isolation was about two times more likely when participants scored above the cutoff point for problematic exercise.

Change in mental health was significantly and positively associated with anxiety about appearance (OR = 1.912, 95% CI 1.203–3.039, $p = 0.002$) and negatively associated with self-compassion (OR = 0.510, 95% CI 0.334–0.779, $p = 0.002$). This means that, all else held constant, discomfort during the confinement period among participants with mental health history was more likely to worsen with increased anxiety about appearance and decreased self-compassion.

DISCUSSION

This study sought mainly to (1) characterize the practice of physical exercise and the consumption of IPEDs in a sample of the general population from seven countries worldwide during the lockdown and other restrictive measures, (2) analyze the potential associations of these behaviors with appearance anxiety (and the risk of BDD) and with self-compassion as a possible buffer of negative effects, and (3) analyze changes in those behaviors and in psychological discomfort during the lockdown and associated factors.

Scores of 24 or above such a cutoff score on the EAI are indicative of problematic exercising and are suggestive of exposure to the adverse effects of exercise, namely, injuries [e.g., (24, 73)]. Excessive exercise also negatively impacting well-being and becoming harmful (28, 29). Although studies in this area are recent and scarce, the percentage of respondents at risk of problematic exercising in our sample (4.3%) was large,

TABLE 8 | Logistic regression on change in physical exercise, in IPEDs use, and in mental health.

		B	ES	Wald	df	*P*	Odds ratio (OR)	Confidence interval (CI)	
								Min	Max
Model I: Change in physical exercise Have you had a significant change in your fitness routine during this self-isolation period? 0, "no"; 1, "yes" *N* = 2,464	AAI (scores ≥21)	0.234	0.153	2.355	1	0.125	1.264	0.937	1.704
	SCS (scores <27)	−0.045	0.132	0.116	1	0.733	0.956	0.738	1.239
	IPEDs	0.283	0.110	6.633	1	0.010	1.327	1.070	1.645
	Gender	−0.114	0.105	1.194	1	0.275	0.892	0.727	1.095
	Age	0.002	0.004	0.227	1	0.634	1.002	0.994	1.011
	Key worker (No/Yes)	−0.321	0.103	9.678	1	0.002	0.725	0.592	0.888
	Constant	1.189	0.410	8.408	1	0.004	3.283		
Model II: Change in IPEDs use Have you taken more supplements/products to reach your fitness goal/physical appearance during self-isolation 0, "never used"; 1, "never used, but started during isolation" *N* = 1,917	AAI (scores ≥21)	0.060	0.252	0.057	1	0.812	1.062	0.648	1.739
	SCS (scores <27)	−0.204	0.218	0.877	1	0.349	0.815	0.532	1.250
	EAI (scores ≥24)	0.821	0.360	5.184	1	0.023	2.272	1.121	4.606
	Gender	−0.198	0.179	1.220	1	0.269	0.820	0.577	1.166
	Age	0.000	0.007	0.004	1	0.951	1.000	0.985	1.014
	Key worker (No/Yes)	−0.068	0.186	0.134	1	0.714	0.934	0.648	1.346
	Constant	−2.613	0.789	10.975	1	0.001	0.073		
Model III: Change in mental health Has this self-isolation period worsened your psychological discomfort 0, "no"; 1, "yes" *N* = 438	AAI (scores ≥21)	0.648	0.236	7.514	1	0.006	1.912	1.203	3.039
	SCS (scores <27)	−0.674	0.216	9.722	1	0.002	0.510	0.334	0.779
	EAI (scores ≥24)	0.271	0.413	0.428	1	0.513	1.311	0.583	2.947
	IPEDs	0.0072	0.224	0.104	1	0.748	1.075	0.693	1.665
	Gender	0.277	0.262	1.119	1	0.290	1.319	0.790	2.203
	Age	−0.005	0.010	0.209	1	0.648	0.995	0.975	1.016
	Key worker (No/Yes)	−0.018	0.250	0.005	1	0.943	0.982	0.602	1.604
	Constant	−0.992	0.905	1.202	1	0.273	0.371		

Note: AAI (0, scores <21; 1, scores ≥21); SCS (0, scores <27; 1, scores ≥27); IPEDs use (0, not used; 1, used); EAI (0, scores <24; 1, scores ≥24); Gender (0, men; 1, women); key worker (0, "non-key worker"; 1, "key worker").
AAI, Appearance Anxiety Inventory; IPEDs, image- and performance-enhancing drug; SCS, Self-Compassion Scale.

comparing with the proportions found in other studies also conduced within community samples but prior to the COVID-19 pandemic [e.g., reported percentages range between 0.3 and 0.5% (24)]. This percentage was smaller than the proportion found among gym users before the COVID-19 pandemic (11.7%) (23) or among the exercise practitioners of Spanish-speaking countries (15.2%) in the recent study that was carried out during the COVID-19 lockdown period—in April of 2020 (65). Our results further showed that more male than female respondents displayed a risk of problematic exercising, which is consistent with previous studies [e.g., (23, 42–44)].

The multicultural nature of our study made it possible to identify a significant association between problematic exercise and country. The UK registered the largest percentage of participants at risk for problematic exercising (11.0%). This was more than double the value found in Spain (5.4%) and generally more than triple the values registered in the remaining countries that ranged from 2.4% (in Lithuania) to 3.7% (in Hungary). The percentage in the UK was similar to that previously reported among gym users (23); this may be explained by the fact that the UK also had a large percentage of participants who practice exercise (97.1%; **Table 1**), greater than five of the other countries. However, Hungary had a larger number of participants who practice exercise (98.2%; **Table 1**), yet showed a much smaller percentage of respondents at risk for problematic exercising (3.7%) than the UK (11.0%) or Spain (5.4%). The remaining three countries (Portugal, Italy, and Lithuania) displayed the largest percentages of participants who did not practice exercise with scores ranging between 15% and 20% (**Table 1**), and their respective percentages of participants at risk for problematic exercising (ranging between 2.4% for Lithuania and 3.1% for Italy) were closer to Japan's than to their European counterparts (i.e., the UK and Spain). It is possible that cross-cultural differences play a role in determining the rationale behind the practice of physical exercise (74). Such a hypothesis is supported by the fact that even within fitness settings, where risk of problematic exercising is higher, a larger percentage of problematic exercisers was found in the UK (16.1%) compared to that in Hungary (9.3%) or Italy (7.9%) in a study that was carried out just before the COVID-19 pandemic (23). In Spain, high scores of problematic exercising were found in the pre-COVID-19 period among university students (6%), although a different measurement was used [Exercise Dependence Scale (EDS-R)] (75). Another study found an even greater percentage (14.9%) of students at risk of addiction on the EAI (76). The prevalence of problematic exercising in the general Spanish population in other studies was about 3% (74).

Although the concept of EA is not consensual, the comparatively high number of participants displaying such risk among the general population during the COVID-19 lockdown period suggests that results emerging from our study should be taken into consideration and inform future restrictive measures, while emphasizing group vulnerabilities in cross-cultural differences.

The same argument is valid for IPEDs consumption. Overall, 28% of the respondents across the general population used these products during the lockdown. Among these, 6.4% began a new use of IPEDs, while only 1.5% reduced their use. This might suggest that the use of IPEDs is a coping strategy to deal with the challenges posed by the COVID-19 pandemic, including distress related to body image experienced during quarantine. As previously suggested (50), the social pressure to achieve a "perfect body," combined with the easy online access to IPEDs supported by aggressive and misleading advertisement strategies, promising fast solutions, could be a possible explanation for the observed growing phenomenon during the lockdown. Further, participants in our study mostly boosted their image and performance with the consumption of legal compounds (e.g., medicine, supplements), which in 43.2% of the cases were acquired from the Internet possibly with no professional advice and supervision as previously noticed (29).

Male respondents reported using IPEDs significantly more than female respondents, and their intake significantly differed across countries, with Hungary and Japan displaying the largest consumption (**Table 3**). In the case of Hungary, this might have been influenced by the fact that the sample had the lowest representation of students (9%) and, consequently, had the highest mean age, which could be a contributing factor to such difference with other countries. Further, Hungarians recorded the smallest percentage of participants who did not exercise (1.8%) and, compared to the others, their sample was composed of the highest proportion of both runners (27.9%) and swimmers (28.8%). Based on such characteristics, it appears that either by chance, or due to self-selection, the Hungarian population was the most physically active population within our sample, thus explaining the results concerning the IPEDs use.

Considering that, so far, the widespread consumption of IPEDs has been associated only with professional fitness settings (23), the results from our study across the general population are surprisingly high compared with those emerged from previous studies (23). Interestingly, the countries registering the greatest percentages of IPEDs consumers were also those presenting the greatest percentages of participants practicing exercise with the exception of Lithuania (**Table 1**). In this latter case, the smallest percentage of participants at risk of EA across the entire sample was also reported (**Table 2**). Overall, our results are indicative that IPEDs are also used outside the context of problematic or excessive exercise and, especially in the case of Lithuania, outside the context of the practice of exercise. Nevertheless, excessive levels of exercise have been suggested to be associated with a greater tendency for using IPEDs (23), indicating that careful attention should be given to excessive supplement use among individuals engaging in problematic levels of exercise practice.

Finally, those most affected by appearance anxiety were in Italy (18.1%) and Japan (16.9%), mainly female participants. Although the literature is limited, a previous study indicated that Italian women compared with South Asians and British women seemed to consider themselves more "overweight" and "fairly unhappy with the way they look" (77). Another study also indicated higher levels of thin-ideal internalization and peer and media pressure across Italian women (78). Such an attitude might have been magnified by stricter national lockdown at the time of the data collection compared to other countries. Italy was in fact the first country in the European Union to be affected by the pandemic (79), causing an unprecedented negative impact on the mental well-being and significant emotional distress that could have reinforced the high scores on the AAI in our study.

At the same time, young Japanese females have been shown to have a stronger desire to get slender bodies, manifested by the feelings of ideal body images in individuals with lower body mass index (BMI) compared to Europeans (80). This difference in "ideal body image" among the countries could explain the higher rate of Japanese population with high AAI scores.

Our regression models showed a strong relation between physical exercise and IPEDs use. Using IPEDs significantly predicted the probability of practicing exercise in the whole sample, particularly among males (for whom the probability increased by four and a half times). An unexpected result was that self-compassion was non-significantly associated with practicing exercise.

Our regressions on the use of IPEDs additionally showed that the risk of addiction to exercise (i.e., scores $\geq$24 on the EAI) significantly predicted IPEDs use across the three considered groups and note in the three groups considered (whole sample and male and female participants), doubling or tripling the probability of consumption. As expected, high anxiety about physical appearance also significantly increased the probability of using IPEDs in the three groups (by at least one and a half to two times more), underscoring the role of psychological discomfort on the consumption of these products. However, again, self-compassion was non-significantly associated with using IPEDs.

In sum, consumption of IPEDs predicted the practice of physical exercise, thus the risk of problematic exercising predicted IPEDs consumption. These results support those in a recent study reporting, for the first time, the association between the consumption of IPEDs and problematic exercising (23). High appearance anxiety predicted more consumption of IPEDs but not the practice of exercise. Vulnerable groups are thus particularly likely to use IPEDs. This is consistent with the easy access to IPEDs and the notion that advertising strategies promising easy and quick results from their consumption might be transforming such consumption into a preferred strategy compared to exercising, particularly during the period in which its practice has become more difficult due to restrictive measures and possible lack of space at home.

Regarding changes in habits during the COVID-19 lockdown period, a small proportion of the sample participants reported having started using IPEDs during isolation (6.4%). Changes in fitness routines (though not in the use of IPEDs) were significantly less likely to occur if participants were key workers rather than non-key workers. Seemingly, key workers were able to maintain the various domains of their lives functioning during the lockdown. The fact that IPEDs use was one aspect that significantly contributed to the changes in exercise practice and that the risk of problematic exercising was the only aspect that significantly contributed to the increase in the use of IPEDs during the quarantine period underlines the potential influence that the particular circumstances of restriction might have in exacerbating these phenomena and the association between them.

Several participants with mental health conditions considered that their psychological discomfort has worsened during isolation (47.9%) (**Table 1**). Both increased symptom domains associated with BDD and decreased self-compassion contributed significantly to this change. Such changes in mental health, related to body image (dis)satisfaction and with difficulties in emotional self-regulation, could contribute to alter behaviors and habits that, although intended to minimize or supress the dissatisfaction, could become harmful to vulnerable groups, affecting several life dimensions. In this study, however, we found no evidence for the occurrence of these altered behaviors in the sequence of worsening psychological discomfort because the association of these changes in mental health with both the risk of problematic exercising and the use of IPEDs was statistically non-significant.

Regarding age, there was a positive association between the age of the participants and exercising in the total sample but, also between the age of the participants and consumption of IPEDs among female respondents. According to Szabo (28, 49), adherence to a healthier lifestyle should increase with age, and it is necessary to understand the effect of this variable on exercising and the type of IPEDs used to better understand this association.

Overall, our culturally enriched investigation was a timely contribution to a better understanding of the risks, and not only the benefits, associated with exercise and the IPEDs consumption as coping strategies during a period of highly restrictive measures of freedom and social contact due to the COVID-19 pandemic. Despite the adversities faced by all of us, we were able to rapidly capture a large set of data from a cross-cultural sample in seven countries worldwide right at the beginning of the pandemic, which reflected significant changes in variables of interest. However, our effort is not exempt from limitations. First, the study is based on a non-stratified sample and on voluntary participation, which might introduce selection bias because the representativeness of the population is not ensured. Second, the snowball recruitment process and the online nature of data collection might help explain some of the high prevalences obtained. Nevertheless, the studies on this topic were based on similarly voluntary participation, making comparisons possible. Third, the study relies on self-reported measures, thus it is subject to the biases that characterize this modality of inquiry, namely, regarding consumption of IPEDs, which was not validated through any biological testing. Fourth, clinical interpretations of the results require caution because, for some instruments (notably the AAI), a statistical cutoff point was used to identify high anxiety about physical appearance and the symptom domains associated with BDD, instead of a clinical cutoff point, which is not available. Fifth, information on the individual's history of exercise and consumption of IPEDs is lacking, to support a better understanding of the excessive and the problematic nature of such behaviors, including their frequency and duration. Sixth, the study design does not allow causal inferences, although conclusions on the relative associations between the variables were possible.

We are confident that future studies can further illuminate our findings by addressing and overcoming such limitations, which we were unable to control during this narrow window of opportunity. Additional evidence should be collected on the so far poorly understood relationships between physical exercise and the use of IPEDs and the role of precipitating and of protecting factors (i.e., problematic exercising and appearance anxiety as precipitating factors and self-compassion as a protecting factor) that very recent investigations, including this study, have started to show. The inclusion of psychiatric interviews and/or objective tests would also contribute to further validate the self-reported responses of our online sample. Having identified the most at risk population, more targeted and effective prevention strategies could be more easily be implemented, even more importantly during periods of personal confinement. Some reinforcement programs on addiction health care have been launched during the pandemic (81). They address behaviors other than exercise or the use of enhancement drugs, but similar initiatives could be created in the future, targeting the latter aspects as well. It is worth noting that those affected by problematic exercise and IPEDs use under normal conditions rarely come to the attention of health professionals in part because of the "normalization" of their behavior in society and the fact that they do not consider themselves "drug users" in a traditional sense. If care is sought, primary care doctors, as opposed to psychiatrists or psychologists, are consulted. By identifying those who are most affected, including frequent exercisers, public health and clinical interventions can be developed and more adequately help them to adjust better, thereby relieving personal distress, improving health and well-being, restoring family and occupational and social functioning, and ultimately supporting the economic growth of our countries.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Sciences Ethics Committee at the University of Hertfordshire (HSK/SF/UH/00104). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Conceptualization: OC, PS, GM, and NF. Methodology: OC, PS, GM, NF, AD, and IC. Formal analysis: JB and AD. Investigation and data collection: ID, KÁ, AD, PS, RM, MG-M, AV, EA-A, RS-L, JB, IG-B, AP, ZD, AS, HF, MS, and KK. Resources: AD, OC, and NF. Data curation: OC, AD, JB, RM, and ZD. Writing-original draft preparation: AD. Writing-review and editing: IC, RM, JB, FB, and KI. Visualization: AD and IC. Supervision: OC, AD, and IC. Project administration: OC. Funding acquisition: NF, OC, and AD. All authors have read and agreed to the published version of the manuscript.

FUNDING

This article/publication is based upon work from COST Action CA16207 European Network for Problematic Usage of the Internet, supported by COST (European Cooperation in Science and Technology). www.cost.eu. This research was supported by Fundação para a Ciência e Tecnologia (FCT) through R&D Units funding (UIDB/05210/2020).

ACKNOWLEDGMENTS

The authors wish to thank Dorotea Cicconcelli, Valentina Giorgetti, Antonino Todaro, Attilio Negri, Viviane Beretta, Elisabeth Prevete, Katinka van de Ven, among other frontline professionals, and other contributors within the COST Action Project, who supported the dissemination of the study during an extremely busy and challenging time in human history due to the pandemic.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The handling editor declared a shared affiliation with several of the authors MG-M, AV, and EA-A at time of review.

frontiers in Psychiatry

OPINION
published: 12 March 2021
doi: 10.3389/fpsyt.2021.634309

Responding to COVID-19: Emerging Practices in Addiction Medicine in 17 Countries

*Florian Scheibein[1], M. J. Stowe[2], Sidharth Arya[3], Nirvana Morgan[4], Tomohiro Shirasaka[5], Paolo Grandinetti[6], Noha Ahmed Saad[7], Abhishek Ghosh[8], Ramyadarshni Vadivel[9], Woraphat Ratta-apha[10], Sagun Ballav Pant[11], Ramdas Ransing[12], Rodrigo Ramalho[13], Angelo Bruschi[14], Tanay Maiti[15], Anne Yee HA[16], Mirjana Delic[17], Shobhit Jain[18], Eric Peyron[19], Kristiana Siste[20], Joy Onoria[21], Saïd Boujraf[22], Lisa Dannatt[23], Arnt Schellekens[24] and Tanya Calvey[25]**

[1] School of Health Sciences, Waterford Institute of Technology, Waterford, Ireland, [2] Department of Family Medicine, School of Medicine, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa, [3] State Drug Dependence Treatment Centre, Institute of Mental Health, Pt Bhagwat Dayal Sharma University of Health Sciences, Rohtak, India, [4] University of the Witwatersrand, Johannesburg, South Africa, [5] Department of Psychiatry, Teine Keijinkai Medical Center, Sapporo, Japan, [6] Addiction Services (SerD), Department of Territorial Services, ASL Teramo, Teramo, Italy, [7] Department of Psychiatry, Ain Shams University, Cairo, Egypt, [8] Drug Deaddiction and Treatment Centre, Postgraduate Institute of Medical Education and Research, Chandigarh, India, [9] Waikato District Health Board, Waikato, New Zealand, [10] Faculty of Medicine Siriraj Hospital, Mahidol University, Salaya, Thailand, [11] Department of Psychiatry and Mental Health, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal, [12] Department of Psychiatry, BKL Walawalkar Rural Medical College, Ratnagiri, India, [13] Department of Social and Community Health, School of Population Health, The University of Auckland, Auckland, New Zealand, [14] Department of Mental Health, ASL Viterbo, Viterbo, Italy, [15] Department of Psychiatry, All India Institute of Medical Sciences (AIIMS), New Delhi, India, [16] Department of Psychological Medicine, University Malaya Centre of Addiction Sciences (UMCAS), Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia, [17] Center for Treatment of Drug Addiction, University Psychiatric Clinic Ljubljana, Ljubljana, Slovenia, [18] Department of Psychiatry, Heritage Institute of Medical Sciences (HIMS), Varanasi, India, [19] AddiPsy, Lyon, France, [20] Department of Psychiatry, Faculty of Medicine Universitas Indonesia-Ciptomangunkusumo Hospital, Jakarta, Indonesia, [21] Department of Psychiatry, College of Health Sciences, Makerere University, Kampala, Uganda, [22] Faculty of Medicine and Pharmacy, Sidi Mohamed Ben Abdellah University of Fez, Fes, Morocco, [23] Department of Psychiatry and Mental Health, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa, [24] Radboud University Medical Centre, Nijmegen, Netherlands, [25] Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

OPEN ACCESS

Edited by:
Hironobu Fujiwara,
Kyoto University Hospital, Japan

Reviewed by:
Kentaro Kawabe,
Ehime University, Japan

***Correspondence:**
Tanya Calvey
tanyac@polka.co.za

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *27 November 2020*
Accepted: *15 February 2021*
Published: *12 March 2021*

Citation:
Scheibein F, Stowe MJ, Arya S, Morgan N, Shirasaka T, Grandinetti P, Saad NA, Ghosh A, Vadivel R, Ratta-apha W, Pant SB, Ransing R, Ramalho R, Bruschi A, Maiti T, HA AY, Delic M, Jain S, Peyron E, Siste K, Onoria J, Boujraf S, Dannatt L, Schellekens A and Calvey T (2021) Responding to COVID-19: Emerging Practices in Addiction Medicine in 17 Countries. Front. Psychiatry 12:634309. doi: 10.3389/fpsyt.2021.634309

Keywords: COVID-19, drug policy, addiction medicine, substance use, behaviourial addictions, best practice, guidelines

INTRODUCTION

Following the classification of the Coronavirus disease (COVID-19) as a pandemic by the World Health Organization (WHO), countries were encouraged to implement urgent and aggressive actions to change the course of the disease spread while also protecting the physical and mental health and well-being of all people. The challenges and solutions of providing prevention, treatment, and care for those affected with issues related to substance use and addictive behaviors are still being discussed by the global community. Several international documents have been developed for service providers and public health professionals working in the field of addiction medicine in the context of the pandemic (1–3), however, less is known about country-level responses. In the current paper we, as individual members of the Network of Early Career Professionals working in Addiction Medicine (NECPAM), discuss emerging country-level guidelines developed in the 6 months following the outbreak.

We identified a number of pertinent, country-level documents in the 17 countries represented here and we summarized country-level briefing notes, practice documents, guidelines, discussion papers and other documents containing recommendations on prevention, harm reduction, treatment, and care for people who use drugs (PWUD). Documents were identified in 12 out of the 17 countries. These documents are summarized and charted in **Table 1**. Additionally, several documents were under development at the time of our exercise in the Netherlands, Slovenia, and Paraguay and have not been included in this work. No specific documents or intentions to develop any were identified in Egypt, Uganda, or South Africa. Below we provide a summary of the identified documents.

Documents developed in Indonesia (4), Italy (5), and Nepal (6) discuss the use of personal and protective equipment (PPE). Malaysian (7), Moroccan (8), New Zealand (9–11), and Australian (12) organizations published documents which outlined risk assessment and mitigation practices. Documents in India (13), Malaysia (7), and Thailand (14, 15) discussed reducing admission of patients. Documents in India (16), Indonesia (17), and Japan (18) outlined strategies for maintaining physical distance in clinics and Standard Operating Procedures (SOP) were developed for isolation units in Ireland (19).

Italian (20) and Thai (15) documents discussed reducing addiction services and limiting group meetings. Documents in France (21), India (13), Italy (20), Ireland (19), Japan (22), Malaysia (7), New Zealand (11), and Thailand (15) advocated for the increased use of telemedicine to address the reduction in services.

Documents published in India (23) and Thailand (24) addressed substance withdrawal. The Thai document included strategies for the management of alcohol withdrawal that may have occurred due to local restrictions on alcohol sales. In Japan (22), there were discussions regarding the potential increase in the use of the internet, gambling, gaming, and higher prevalence of drinking at home during the COVID-19 pandemic.

Documents in France (21), Japan (25), and Ireland (26) described emerging practices of expedited access to opioid agonist maintenance treatment (OAMT). Documents in Ireland (26), India (23), Italy (20), Japan (25), Malaysia (7), Morocco (8), Nepal (6), and New Zealand (11) advocated for increased take-home doses (TADs) of OAMT. SOPs for buprenorphine-naloxone TADs in a hospital context have been developed in India (27) and documents in Indonesia (17), Nepal (6), Malaysia (7), and Italy (5) advocated for increased TADs of OAMT to 7 days, 14 days and 1 month, respectively. An Irish document (26) advocated for prescriptions for naloxone for all new OAMT patients and changes in the naloxone administration procedure (move toward intramuscular injection and chest compression in the absence of specialized equipment during opioid overdose interventions).

Guidelines, SOPs and recommendations in Nepal (6), Ireland (28, 29), and France (21), respectively, have also advocated for increased access to harm reduction services. In New Zealand, guidelines addressed practices of adopting a health equity/social determinant lens, developing culturally and trauma informed approaches, awareness, and education efforts, development of self-help resources and the inclusion of people with lived experience of substance use and gambling into the evaluation of interventions (10, 11).

DISCUSSION

A range of practices have been suggested at the country-level to deal with the challenges brought about by the ongoing pandemic. These include those around mitigating the spread of the corona virus, managing the risks associated with lockdown policies and changing trends in substance use and addictive behaviors.

In order to limit the spread of COVID-19, guidance has been drawn up to limit in-person meetings, physical support meetings, and contact time with physicians. Guidance suggests that this be operationalised through shifting services online, increased availability of TADs of OAMT, increased duration of TADs and increased availability of naloxone and injecting equipment allocations. Protocols have also been drawn up for the operation of clinics and outreach services for patients in isolation.

Several potential negative effects associated with the pandemic and resulting lockdown procedures have been identified which may require service adaptions. These include increased risks of substance withdrawal (30), access to service issues and potential changes in trends related to gambling, gaming, and internet related disorders. Several guidance documents discuss meeting these challenges through increased access to TADs, expedited access to OAMT and increased availability of online-based self-help groups and other services (11, 17–30). The increased commitment to TADs, telemedicine and access to harm reduction supplies are likely to address several issues brought about by the pandemic for people who use opioids and/or inject drugs. However, few documents explicitly discuss the increased availability of harm reduction supplies (for example, naloxone and injecting equipment) and service adaptions for people who use non-opioid drugs and/or engage in addictive behaviors (such as gambling and gaming) continue to be neglected by most documents.

There are also concerns regarding the implementation of COVID-19-related policy documents as a recent global survey indicates that among 130 countries, 60% reported disruptions to mental health services for vulnerable people, 67% reported disruptions to counseling and psychotherapy, 35% reported disruptions to emergency interventions, and 30% reported disruptions to access for medications for mental, neurological, and substance use disorders (31). The combination of a reduction in the availability of services, increased reliance on telemedicine, physical distancing protocols, and travel restrictions may exasperate underlying health inequities in terms of access to addiction services (31–34). This seems to disproportionately affect the most marginalized and socioeconomically disadvantaged patients (32) who may lack access to internet-enabled devices, sufficient internet, the necessary private spaces to engage in telemedicine and means of transport to services.

The lack of representation of country-level documents from the Americas, Eastern Europe, the Middle East, Africa, and other regions is a limitation of this paper. Future research should document emerging practices in additional regions and monitor and evaluate the implementation of country-level policies. Country-level documents may be useful as they may allow clinicians to adapt to their given local context. Such documents should consider best emerging practices as it relates

TABLE 1 | Country specific COVID-19 guidance documents for clinical practice in addiction medicine.

Country	Author	Type	Topics
India	AIIMS (All India institute of medical sciences, New Delhi	Guidelines	• TADs of buprenorphine and methadone (bi weekly or alternate days) • Take home doses to be managed by "responsible adults"
	Basu D, Ghosh A, Subodh BN et al.	SOP	• Hospital SOP for buprenorphine-naloxone TADs
	Indian Psychiatric Society	Position statement, guidelines	• Warns of potentially increased incidence of AOD withdrawal and associated complication • Advocates for seven-day TADs • Advocates for physical distancing in OAMT clinic • Discusses supply/travel restrictions and human resource issues
	Indian Psychiatric Society and National Institute of Mental Health and NeuroSciences	Guidance document	• Advocates for reducing admissions • Physical distancing guidelines • Tobacco use • Telemedicine for follow up • Discusses challenges associated with physical distancing in emergency case management
Indonesia	Ministry of Health		• Advocates for TADs • Increased use of telemedicine • Safety procedures including PPE
Ireland	Health Service Executive	Guidelines, guidance documents, SOPs	• Recommends expedited access to OAMT (using telemedicine where possible) • Increased TADs • Increased naloxone availability (all inducted patients to be offered prescription) • Changes in naloxone administration (preference for IM, chest compressions only unless specially trained and with special equipment) • Telemedicine for follow up • Details procedure for expedited emergency induction • Standard operating procedure for operating National Drug Treatment Center Pharmacy OAMT program • Outlines general procedures for operating NSPs • Supply management • Advocates for increased harm reduction • Discusses challenges associated with human resources • Recommendations for storage and handling of prescription medication • Recommendations for conducting addiction telemedicine consultations
Italy	Federazione Italiana Operatori Dipartimenti e Servizi Dipendenze (FeDerSerD)	Guidance documents	• Detailed hygiene practices • Reduction of services • Suspension of groups (unless physical distancing is possible) • Promotion of telehealth • TADs OAMT (1 month) • Reduction of urine testing • Care with breathalyzers • Guidelines for service delivery in prison • Increased availability of extended-release preparations
France	Ministères des Solidarités et de la Santé	Recommendations	• Advocates for easier access to OAMT and nicotine replacement therapies (NRTs) • Advocates for maintaining communication with patients using telemedicine and reserve in-person meetings for emergencies • Improved prescription renewal procedures
Japan	Ministry of Health, Labor, and Welfare.	Policy	• Procedures for expedited emergency induction • Increased TADs • Physical distancing
	Japanese Medical Society of Alcohol and Addiction Studies	Guidelines	• Warns of overuse of the internet, gambling, gaming and drinking at home
	The Japanese Society of Psychiatry and Neurology	Guideline	• Use of online-based self-help groups
Malaysia	Ministry of Health	SOP Guidance document	• Increased TADs • Mental health and psychosocial support in COVID-19: 1) For general population 2) For healthcare workers 3) For team leaders in health facilities 4) For care providers for children 5) For older adults, care providers, people with underlying health conditions • COVID-19 Management Guideline for special settings, including prisons, lockup and detection camps

(Continued)

TABLE 1 | Continued

Country	Author	Type	Topics
	National Anti-Drugs Agency	Guidance document	• Use of online- and telephone - based counseling
Morocco	Moroccan Addictology Association	Guidelines	• Advocates for TADs, home deliveries and take home naloxone • Warns of particular interactions between methadone and hydroxychloroquine and chloroquine- QT interval • Vigilant stock management of methadone • General PPE and risk reduction/control measures
Nepal	Ministry of Health and Population and National Center of AIDS & STD Control	Guidelines	• Provisions for OAMT and other harm reduction services • Guidance for PWID harm reduction program including TADs for OAMT (upto 7 days), family involvement, social support unit and NSP. • Recommendation for continuing HIV services • PPE recommendations in ART centers and OAMT clinics • Guidelines for community-based care and community care center for PLHIV
New Zealand	Ministry of Health	Guidelines and Resources	• Advocates for linking of employment, addiction and mental health services • Advocates for addressing the housing needs of people with severe mental health and substance harm issues • Advocates for harm reduction approaches for substance use and gambling • Promotes education and raising awareness • Promotes mental health and addiction telemedicine support • Promotes access to self-help tools for substance use and gambling • Promotes inclusion of people with lived experiences of addiction in service design • Advocates for Maori specialist services and increased primary care services
	The Royal Australian and New Zealand College of Psychiatrists	Guideline and resources	• Advocates for increased TADs and reduced supervised dosing • Provides risk assessment and mitigation procedures for TADs • Outlines medication management procedures for 'isolated' patients • Advocates for buprenorphine depot • Advocates for telehealth
Thailand	Department of Medical Services, Ministry of Public Health	Guidance document	• Practical guide for admission rehabilitation and follow-up • Individual treatment only; limit group treatment • Decreased admissions except for emergency (e.g. delirium tremens) • Use of telemedicine • Use of public health volunteers
	Department of Medical Services, Ministry of Health	Guidance document	• Limit admissions to severe emergency cases and advocate for screening for COVID-19 • Provide information regarding COVID-19 to patients • Limit family visit and group activity • Physical distancing in treatment centers
	Royal College of Psychiatrists of Thailand	Guidance document	• Recommendations concerning alcohol withdrawal for physicians, nurses, and public health personnel

to issues surrounding a wide range of substances, addictive behaviors, harm reduction, and health inequities exasperated by the pandemic and restrictions.

AUTHOR CONTRIBUTIONS

FS and TC developed the initial draft of the document. The commentary was then reviewed by MS and NM. All authors subsequently reviewed their sections and the overall document. All authors identified their own local documents or confirmed the lack of their existence.

FUNDING

This research was funded by the South African Medical Research Council grant held by TC.

ACKNOWLEDGMENTS

We would like to acknowledge NECPAM and its members. We would also like to acknowledge Dr. Dzmitry Krupchanka who provided feedback for this commentary.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

MINI REVIEW
published: 16 March 2021
doi: 10.3389/fpsyt.2021.623508

Internet and Pornography Use During the COVID-19 Pandemic: Presumed Impact and What Can Be Done

*Hashir Ali Awan[1], Alifiya Aamir[1], Mufaddal Najmuddin Diwan[1], Irfan Ullah[2], Victor Pereira-Sanchez[3], Rodrigo Ramalho[4], Laura Orsolini[5], Renato de Filippis[6], Margaret Isioma Ojeahere[7], Ramdas Ransing[8], Aftab Karmali Vadsaria[9] and Sanya Virani[10,11]**

[1] Dow University of Health Sciences, Karachi, Pakistan, [2] Kabir Medical College, Gandhara University, Peshawar, Pakistan, [3] Department of Child and Adolescent Psychiatry, School of Medicine, New York University, New York, NY, United States, [4] Department of Social and Community Health, School of Population Health, University of Auckland, Auckland, New Zealand, [5] Unit of Clinical Psychiatry, Department of Neurosciences/DIMSC, School of Medicine and Surgery, Polytechnic University of Marche, Ancona, Italy, [6] Psychiatry Unit, Department of Health Sciences, University Magna Graecia of Catanzaro, Catanzaro, Italy, [7] Department of Psychiatry, Jos University Teaching Hospital, Jos, Nigeria, [8] Bhaktshreshtha Kamalakarpant Laxman Walawalkar Rural Medical College, Kasarwadi, India, [9] Smt. Kashibai Navale Medical College and General Hospital, Pune, India, [10] Veterans Affairs Connecticut Healthcare System, Yale University School of Medicine, West Haven, CT, United States, [11] School of Medicine Yale University, New Haven, CT, United States

OPEN ACCESS

Edited by:
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Macedonian Academy of Sciences and Arts, North Macedonia

***Correspondence:**
Sanya Virani
sanya.virani@yale.edu

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 30 October 2020
Accepted: 08 February 2021
Published: 16 March 2021

Citation:
Awan HA, Aamir A, Diwan MN, Ullah I, Pereira-Sanchez V, Ramalho R, Orsolini L, de Filippis R, Ojeahere MI, Ransing R, Vadsaria AK and Virani S (2021) Internet and Pornography Use During the COVID-19 Pandemic: Presumed Impact and What Can Be Done. Front. Psychiatry 12:623508. doi: 10.3389/fpsyt.2021.623508

The COVID-19 pandemic continues to cause an immense psychosocial strain worldwide. Excessive use of the internet during these psychologically trying times, fueled by physical isolation as a result of lockdowns, has translated into dysfunctional behaviors. A growing body of evidence suggests an unprecedented increase in internet use and consumption of online pornography during the pandemic, and possibly even directly caused by it. In this review, the authors report data from relevant sources to show the rise in pornography use during lockdowns in different countries worldwide. In addition to a brief overview of the neurobiology of internet addiction broadly and problematic online pornography use specifically, similarities with substance use disorders are explained. Further, the current status of the debate about defining diagnostic criteria is discussed. Finally, the review sheds light on the potential detrimental outcomes during the future post-pandemic "re-adaptation," while simultaneously offering preventative and management strategies for harm reduction. The authors conclude that foresightedness with utilizing existing tools and therapies and exercising appropriate amounts of caution could go a long way in addressing the challenges that lie ahead in the post-pandemic era.

Keywords: COVID-19, problematic internet use, pornography, behavioral addictions, mental health

INTRODUCTION

Crossing a 100 million cases and with more than 2 million deaths recorded globally to date (1), the COVID-19 pandemic has transformed the world. The socioeconomic consequences have been dire, leaving many unemployed and grappling with a constant state of uncertainty and anxiety, reinforced by the tremendous amounts of "free time" they now have in the absence of jobs and the compounding isolation due to COVID-19 enforced regulations. This in turn has led to a rapid uptake of maladaptive and dysfunctional behaviors among all age groups, at the crux of which lies excessive internet consumption (2, 3).

BBC and Netflix© recorded 16 million new subscribers in the first 3 months of 2020, almost 100% higher than the new subscribers during the last few months of 2019 (4). In April, Microsoft's© game servers had 10 million users, showing how the internet gaming industry has thrived in the pandemic (5). A preliminary study in China comparing data between October 2019 and March 2020 reported a sharp increase (23%) in the prevalence of severe internet addiction with a 20-fold rise in the dependence degree of those already addicted to the internet (6). Another study conducted in China limited to adolescents depicted a rise in internet use, especially in subjects considered as "Addictive Internet Users" based on the questionnaire's cutoff (2). A cross-sectional study in Taiwan claimed that the prevalence of internet addiction in adolescents was much higher than other previously recorded samples worldwide (7).

This review summarizes viewpoints on behavioral addictions with focus on problematic internet use and pornography, elucidates what is known to date about their neurobiology, describes how the pandemic has intensified the problem by providing most current statistics, and discusses the need for diagnostic criteria, while offering strategies for prevention and harm reduction during the pandemic and post-pandemic era.

Internet Addiction

Internet addiction, also referred to as "pathological internet use" or "problematic use of internet" (PUI), has been defined as "a psychological dependence on the internet" (8), and is characterized by excessive or poorly controlled preoccupations, urges, or behaviors regarding internet usage, leading to impairment or distress (9, 10). The need for defining a specific behavioral addiction to the internet has been a subject for debate since the early 1990s, when the first cases of internet addiction were described (11). Two discrete manifestations of PUI are (12): (a) generalized—a non-specific, multifaceted overuse of the internet, not directly related to any one activity; and (b) specific—a pathological indulgence in one (or more, but separate) activity on the internet, using internet as a medium. In a 2014 study, they were referred to as GIA (generalized internet addiction) and SIA (specific internet addiction) (13).

The use of internet addiction as an umbrella term is, hence, closely related to considering the internet as just the channel to online content. Various internet-mediated problematic behaviors have been described, including but not limited to problematic online pornography use, internet gaming disorder, online gambling, and excessive use of social media and communication sites.

Pornography Addiction

A 2006 longitudinal study on internet addiction concluded that of the many internet-related activities, "erotica" (or online pornography) had the greatest potential to be addictive (14). According to Stein et al. in persons with Compulsive Sexual Behavior Disorder (CSBD), the behavior becomes a central focus of their life, with unsuccessful efforts to control or significantly reduce it as well as adverse consequences (e.g., repeated relationship disruption, occupational consequences, negative impact on health) (15).

Known as both a type of internet-mediated addiction and a component of hypersexuality, problematic online pornography use is rapidly turning into a topic that demands deeper empirical research due to its potentially addictive nature and perceived negative outcomes.

Despite its presumed pervasiveness, "internet pornography addiction" (IPA) or "problematic online pornography use" (POPU) is under-researched, and usually fitted into the umbrella construct of hypersexual behavior or "compulsive sexual behavior" (CSB). Some have attempted to characterize IPA/POPU as an "impulse-control disorder" while the International Classification of Diseases (ICD-11) has placed it under compulsive sexual behavior disorder (CSBD), following the impulse-control disorder model. On the contrary, the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-5) seems to follow the addiction model since IPA shares various classic characteristics (like tolerance) with other addictions. Additionally, some authors argue that there is a considerable overlap between compulsive (anxiety-reducing) behaviors and impulsive (rewarding) behaviors when it comes to IPA, despite noticeable dissimilarities. It is important to note that Stein et al. present thought-provoking arguments in favor of using the underlying mechanisms for classification rather than solely adopting a "descriptivist" approach (15).

NEUROBIOLOGY OF INTERNET AND PORNOGRAPHY ADDICTION

Evidence Related to Internet Addiction

While behavioral factors make internet addiction clinically recognizable, neurobiological studies have to be combined with this behavioral analysis in what has been labeled "parallel and contiguous paradigms" (16). Some important studies investigating the neurobiological aspect of internet addiction have found similarities between it and pathological gambling and substance use disorders, especially in the loss of executive control (13). Negative associations of internet addiction to activity in brain areas which are core components of the default mode network (precuneus, posterior cingulate gyrus) were similar to those in other substance and behavioral addictions, and some impaired brain mechanisms in the inhibitory control network could explain the lack of control found in such behavioral addictions (17). It is hypothesized that dysfunctions in dopaminergic circuits make the individual more prone to addictive behaviors (like internet gaming or pornography) that feed reward mechanisms (18).

As with disordered gambling, the Taq1A1 allele of the DRD2 gene (19) and homozygosity of the short allelic variant of the 5-HTTLPR gene (20) have been associated with PUI.

Neural Mechanisms of Pornography Addiction and Supranormal Stimuli

A common neurobiological stem between addiction resulting from consumption of psychoactive substances and CBSD/IPA is recognizable. Some studies have proposed commonalities between neural mechanisms of drug-related and behavior-related addictions, especially when CSBD/IPA is brought into focus (21). A malfunctioning of the brain's reward center has been suggested as being responsible for turning these behaviors into addictions (22). A significant negative association between watching more pornographic content per week and right caudate volume, and between cue-reactivity and left putamen was also found, which could be the result of a constant stimulation of the reward centers or a neuroplastic change allowing for greater pleasure while consuming pornographic content (23). Furthermore, men with problematic use of online pornography were found to have greater ventral striatal activity when predicting erotic pictures (24), concluding that this processing of cues was similar to conventional addictions (SUD) and contributed to the clinical presentation.

A peculiar addition to the neurobiology of IPA is the concept of "supranormal stimulus," introduced in the book "The Study of Instinct" (25) published in 1951. It refers to the brain's reward systems as being activated at greater levels by an artificial (or engineered) stimulus than by a natural stimulus of a similar type. In 2010, internet pornography was added as an example illustrating the phenomenon of supranormal stimulus (26), owing to the "infinite" number of artificial scenarios available online for the consumer to choose from. This allows for the individual to seek greater reward and compulsively consume pornography, entering the "addictive mode." This has a tie-end to novelty-seeking behavior found in people with a pornography addiction and the desire for unique, new, and more perfect content to make it a subject of masturbation/sexual desire—also called a "pathological pursuit" (27). This can also manifest in the shift from pornographic magazines to online video pornography (28). Park et al. builds upon pornography as a supranormal stimulus by highlighting the "novelty" it registers and uses case reports to explain the negative effects it may bear on a person's life because of the inability to achieve the same response in real-life as compared to person's response to pornography (29).

Of note, according to Stein et al. (15), CSBD is not considered a true compulsion that occurs in relation to intrusive, unwanted and typically anxiety-provoking thoughts (obsessions) as in OCD but a repetitive, typically initially rewarding behavior pattern that the person feels unable to control, which appears to have both impulsive and compulsive elements (30). While the earlier course is predominantly related to impulsivity and positive reinforcement, the latter is more about compulsive behaviors and negative reinforcement (31). The dual-control model posits that CSBD becomes an issue when self-control and sexual responsiveness/excitability are high and low, respectively (32).

THE NEED FOR DIAGNOSTIC CRITERIA

In a post-COVID world, there is potential for mounting complaints of behavioral addictions requiring robust actions to prevent them from becoming another major public mental health problem, as substance abuse disorders already are. Accurate and holistic diagnostic patterns would need to be found before categorizing each symptom or even a slightly problematic use of internet content(s) as an addiction. Fineberg et al. included the development of diagnostic criteria as 1 of the 9 fundamental aims for their European task force to broaden the understanding of internet addiction (33). While diagnostic criteria for internet addiction have been proposed, consensus is still lacking. The most holistic criteria, which considered previous proposals and conducted a validation and clinical trials, was brought about in 2010 (34). Previously, Young's Diagnostic Questionnaire and Young's Internet Addiction Test were developed by using the criteria for diagnosis of pathological gambling or other conventional addictions as a basis (35, 36).

The current situation engenders a precedent for other, more specific types of internet-related addictions (like IPA) to be diagnosed with a precisely developed and targeted criteria by using existing models for generalized internet addiction. This is closely linked with internet addiction being viewed as a misnomer and an obsolete description by Starcevic (37). The author suggests the use of independent terms describing addictions caused by different types of content on the internet (for e.g., IPA, internet gaming disorder, etc.) instead of using just internet addiction (which is too generalized and non-specific) (37). Therefore, the need for a more wide-spectrum diagnostic criteria, especially in the backdrop of COVID-19, is rapidly becoming more and more pressing. A subjective method is needed to ascertain and diagnose the addictive aspect of specific types of content (comparable to conventional types of substances) being consumed while using the internet as a conduit. The I-PACE model (38) is one recent development that can be used as a basis to develop further screening or diagnosing methods for different types of internet addiction, or at least as a way of labeling the disorders (for e.g., based on the "first-choice" content used and/or mixed if 2 types of contents are co-dominant). This, however, will only be possible if enough empirical data is collected to ascertain the validity of this framework in clinical scenarios.

In contrast to the ICD-10 that included the category of "excessive sexual drive" without a description of symptoms but referencing "nymphomania" and "satyriasis," the ICD-11 guidelines describe Compulsive Sexual Behavior Disorder (placed in the Mental and Behavioral Disorders chapter) as a "persistent pattern of failure to control intense, repetitive sexual impulses or urges resulting in repetitive sexual behavior" (15). However, the ICD-11 avoids focusing on etiological issues like traumatic sexual experiences that might lead an individual to use sex as a coping strategy in response to negative emotions.

THE INFLUENCE OF COVID-19 AND THE LOCKDOWN

During the COVID-19 imposed lockdowns across the world, the internet offered never-ending distractions for people forced to stay home. A study conducted on subjects older than 60 showed significantly increased internet use with a 64.1% rise in usage of online communication applications like Zoom/WhatsApp and a 41.7% rise in using the internet for daily errands, showing how even middle-aged subjects and older adults who were not spending a long time on the internet previously, have been quasi-forced to adopt online activities because of multiple pressures such as conversion of on-site workplaces to internet-based work-from-home environments and the need to stay updated with COVID-related news and family (39).

The COVID-19 lockdown translated into physical isolation, driving individuals to waste time online with no definite purpose, spending longer, abnormal durations of time online when bored (40), leading to increased consumption of online pornography. In 2019, Pornhub©, one of the world's largest pornographic video-sharing websites, received 42 billion visits—roughly 5 times the world's population (41). But the pandemic seems to have caused an even sharper and more noticeable surge in traffic on pornographic websites. Pornhub© has shared statistics on a regular basis revealing the changes and trends in the consumption of their content, showing a constantly positive deviation from average traffic on an average pre-pandemic day (42). A study employing Google© Trends and joint point regression analysis demonstrated a significant rise (compared to last 4 years) in interest for pornographic websites in countries with "stay at home orders" (43).

To put the 2 timelines (lockdown and rise in pornographic websites' traffic) relative to each other, **Figure 1** presents the peak percentage change of 8 countries, along with the date on which the peak was reached and the date when a major lockdown was instated.

It is relevant to discuss Cooper's "Triple-A Engine" model (44) based on accessibility, affordability, and anonymity and how these factors may have been impacted by the lockdown. Smartphones dramatically increased accessibility to online content, enticing some people, who otherwise might have not done it, to consume pornography (45). On March 17, 2020, Pornhub© announced free services for France on its Twitter© account, which was followed by the highest increase in traffic the same day. Italy and Spain were also offered free premium content from Pornhub©, causing an enormous spike in user traffic. Affordability, even pre-COVID, was at an all-time high with most video-sharing websites allowing users to watch free content without any kind of financial commitment.

Cooper's concept of anonymity can be extrapolated to the idea of privacy as well. Due to the taboo nature of pornography in several cultures (46), individuals prefer anonymity online. This attraction to anonymity is also related to feelings of sexual freedom and expression (44). While some areas of India and most Islamic countries restrict access to pornography online due to social and/or religious reasons (47), laws regarding pornography vary widely across the world. Still, a ban/restriction can be circumvented due to the advent of virtual private networks (VPN), increasing accessibility and providing an additional layer

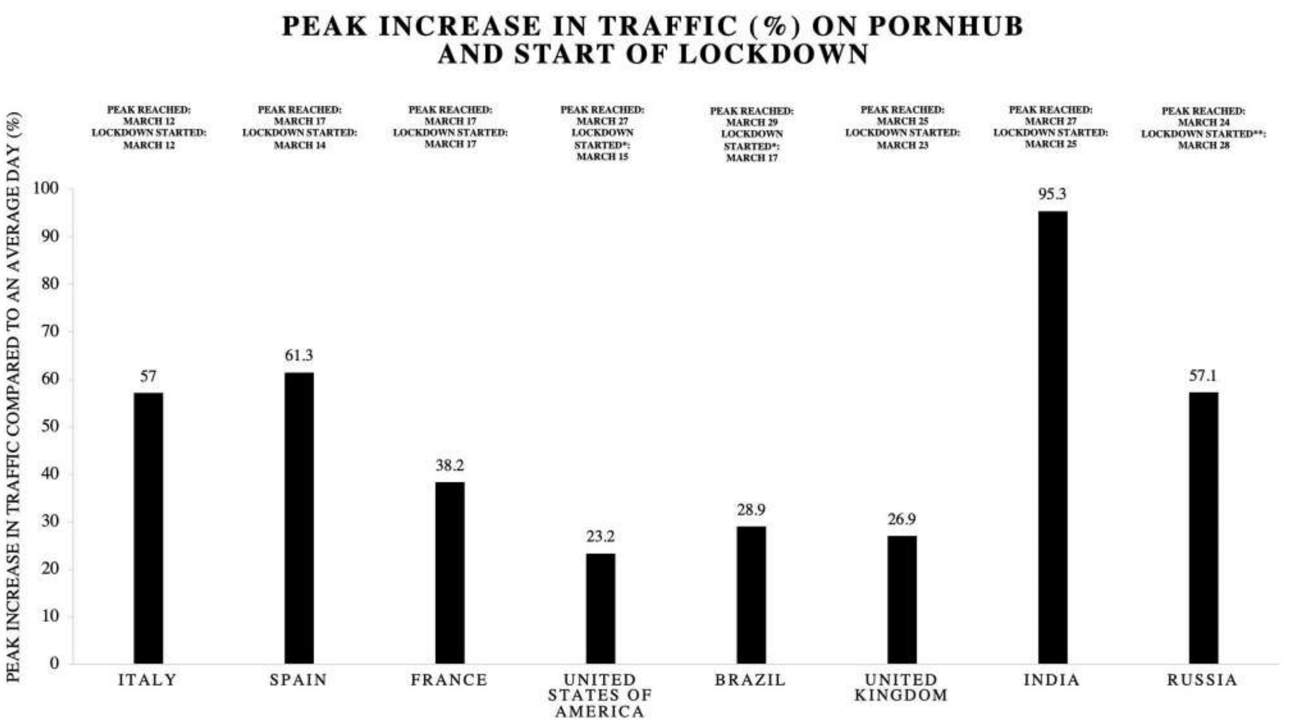

FIGURE 1 | Peak Increase in Traffic compared to an average day (before the pandemic) on Pornhub© during COVID-19 Pandemic with Starting Date of Lockdown and Date of Peak Increase in Traffic in Selected Countries. This figure has been generated by the authors of this review based on data from Pornhub Insights (data from observations in the period from February 24 to March 17, 2020, retrieved from: https://www.pornhub.com/insights/corona-virus) and BBC News (data from observations in the period from January 15 to April 1, 2020, retrieved from: https://www.bbc.com/news/world-52103747). *Date of lockdown unclear **Localized lockdowns started earlier (date here refers to nationwide lockdown).

of online anonymity. In fact, worldwide interest in VPNs on Google© has shown a peak on 17th March 2020, and countries that were hit the hardest by pandemic there have been up to a 160% increase in VPN usage between March 8 and 22 (48) (temporally associated with a rise in Pornhub© use, as shown in **Figure 1**). Furthermore, on August 28th, due to a technical error, Zoom© had stopped working from 8 a.m. to 2 p.m. (in the United Kingdom and East Coast of the United States), and a peak 6.8% increase in porn usage was noticed during that time' (42).

Döring explains how technology-mediated sexual contact, which was previously a relatively taboo subject, was now normalized, and sometimes even openly endorsed by authorities as the safer option compared to in-person sexual interactions. Pornography use, specifically, is considered positive and called a "constructive coping behavior" to overcome "boredom and fear" (49). Searches using the words 'corona' (18 million) or 'quarantine' (11 million) have also been notable on Pornhub©. This is what some have termed "eroticization of fear" (50), but others feel that viewing aggressive pornographic content could potentially fuel an individual's abusive sexual tendencies (51). The COVID-19 pandemic has limited possibilities for casual sex and other behaviors, making individuals lean to pornography as the most accessible, affordable, and anonymous alternative (52). An intriguing risk-factor is described under "moral incongruence" and connected to religiosity and morality of an individual (53). It argues that a person will be at higher risk of developing an addiction to pornography due to the perceived misalignment with one's behaviors and one's beliefs (for example, religious). Even a "normal" duration spent on pornography can cause symptoms of pornography addiction (54) (distress and preoccupation) due to the conflicting behaviors and beliefs. Return to troubled families can also be a risk-factor during COVID-19, as dysfunctional or weak family relations have also been correlated with greater pornography use, particularly in adolescents (55).

Davis proposed that the combination of a "diathesis" (an underlying vulnerability) with a "stress" (such as the current pandemic and/or the lockdown) could prompt the development of a PUI (12), a proposition supported by other authors (56–58). This would place individuals with underlying psychopathology at greater risk. Studies have also proven an association of conditions like attention-deficit/hyperactivity disorder (ADHD) with increased risk of internet addiction (49). Underlying psychopathology may also cause an increase in porn consumption as a "compensation" method. "Forced abstinence" from an addictive behavior (like a period of inability to play an online game) has the potential to cause withdrawal, leading the individual to explore other ways to compensate and fill in the gaps (59), explaining how such behavior toward one medium can outgrow into others. A study from South Africa highlighted the possible "substitution" of an original addiction with new behaviors during periods of forced abstinence, specifically highlighting a case that used pornography as a substitute due to its easy attainability even during the lockdown (60).

Further, "escapism" is a relevant concept when analyzing the use of pornography by those suffering from body image issues. There is a presumed association with excessive internet (and pornography) use and body image avoidance (61) as individuals can control their image online and find this escape sexually liberating. It has been reported through a cross-sectional study (62) and explained through etiological models (12, 63, 64) that an association between social anxiety and internet addiction exists because individuals like their "ideal self" online (65) and prefer it over face-to-face communication.

PREVENTION AND HARM REDUCTION IN THE POST-PANDEMIC ERA

Keeping in mind the current COVID-19 pandemic and the related restrictive and containment measures (e.g., the lockdown), addiction and mental health professionals should take into account not only the subsequent psychosocial burden, the emergence of new psychiatric onset (or relapse and/or worsening of preexisting psychopathologies) amongst the most vulnerable people, but also the tangible and concrete risk that the emergence of behavioral addictions has steeply risen. Local and international authorities have released guidelines to curb problematic internet use (66) and **Table 1** adapts them to present suggestions specific to POPU.

Pornography or internet addiction can make "re-adaptation" after the pandemic complicated and difficult to cope for individuals who have, owing to elongated periods of staying at home, adopted this lifestyle and have developed a dependence on these activities as an essential part of their lives (67). Some articles have warned about pornography consumption normalizing

TABLE 1 | General and Specific guidance for curbing problematic online pornography use.

General	Specific
Scheduling daily time for physical activity to allow for "destressing" and raising dopamine levels	Creating an abstinence list detailing specific problematic behaviors with a specific plan for avoidance of or non-engagement in the identified behaviors
Engaging in other vocational activities like reading, writing, listening to music, etc	Focusing on mindfulness exercises to carefully observe habits, time spent on various activities, urges, etc
Enjoying social activities and maintaining relationships with family on a regular basis	Actively building trust with closest members in family, especially the significant other, and practicing healthy communication and transparency
Intentionally limiting daily screen time for outside work-related activities and using apps that provide reports about how much time was spent on online activities per week	Installing internet accountability software on digital devices
Keeping in touch with friends, relatives and acquaintances during times of physical distancing	Seeking out programs that might support individual recovery and foster a sense of accountability through a sponsor, e.g., Sex and Love Addicts Anonymous meetings

violence against women and potentially leading people to engage in it in real life during the lockdown when women are alone with men in the house (68). Döring therefore stresses on target-specific sex education, especially for adolescents, to avoid any negative outcome (49). While many recommendations for treatment plans of internet addiction and IPA have been published, they essentially revolve around supporting the individual's needs, controlling damage to and rehabilitating interpersonal relationships, and preventing relapse (69).

Pharmacological interventions with different drugs like naltrexone (22) or quetiapine with citalopram (70) have been examined. Paroxetine has been used to treat IPA and has shown partial efficacy (71). Psychological treatments have acted as a key tool in treating addictions. Showing positive results for internet addiction in 2013 (72), cognitive-behavioral therapy (CBT), which lasts for 12 weeks and has a 6-month follow up, has been one of the most-studied psychological therapy used for behavioral addictions (73, 74). Another 12-week model is the acceptance and commitment therapy (ACT) (75), shown to be effective in IPA. Twelve-step treatment programs have been historically successful in tackling addictions by also significantly reducing comorbidities like depression. It is however suggested that a combination of both pharmacological and psychological is essential to effectively tackle addiction (76). Brand et al. suggests that combined intervention to target the mediating and moderating factors (in the I-PACE model explaining the development) of such behaviors as predisposing vulnerability (genetic or neurobiological) usually remains unaffected (38). In 2014, Brand et al. highlighted the importance of evaluating patients' coping style for effective treatment and recovery (77). In the COVID-19 era and beyond, employing telepsychiatry with online support groups is possibly going to prove beneficial (78).

Greater awareness of the potential risks during the lockdown can help break the stereotype of behavioral addictions and encourage seeking help from competent professionals. Realizing that such behaviors potentially affect the community as a whole can help in prevention by means of more thorough guidelines and easy-to-access information.

As opposed to many substances of abuse, the object and means of behavioral addictions, including the internet, are ubiquitous in daily life and hard to avoid; they are even needed. Prevention of first exposure to the internet, and then complete abstinence from the internet for people already using it seems particularly unrealistic. Thus, primary prevention of PUI and rehabilitation of individuals with internet-related psychopathology will usually require the integration of internet use into a healthy lifestyle, having its own place and priorities within the personal, professional, and relational goals and duties of each individual.

Table 1 offers specific and general guidance for prevention and alleviation of problematic online pornography use; most of the points presented there are valid for PUI in general. These include the incorporation of healthy physical routines and leisure activities as alternatives or replacements of pornography, the maintenance of meaningful social relationships, monitoring screen time, and seeking specific help when needed.

CONCLUSION

Problematic internet and online pornography use have been reported to constitute an increasing burden in public mental health since the 2000s, yet psychopathological models and diagnostic criteria have lacked consensus, and the body of evidence on the effectiveness of therapeutic approaches is still in scarce. The COVID-19 pandemic has forced millions indoors and needed of the mediation of screens to work, maintain social interactions, and carry out everyday activities such as shopping; this has exposed many to a higher risk of developing or worsening problematic use of internet and pornography.

The current pandemic and its aftermath represent a challenge and an opportunity to revisit the conceptual discussions on these internet-mediated problems and to advance etiological and epidemiological research, agree on diagnostic criteria, and identify effective interventions to better understand and minimize the individual and social impact of these. We hope our review provides an up-to-date perspective on the topic and guidance to start addressing the problems of pathological internet and online pornography use.

AUTHOR CONTRIBUTIONS

AA and IU conceived the original idea and designed the outlines of the study. HA, AA, MD, IU, VP-S, and SV wrote the draft of the manuscript. HA, AA, MD, and IU prepared the figures of the manuscript. VP-S, RRam, LO, RF, MO, RRan, AV, and SV performed the literature review and improved the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 22 March 2021
doi: 10.3389/fpsyt.2021.636706

The Impact of the COVID-19 Pandemic on Male Strength Athletes Who Use Non-prescribed Anabolic-Androgenic Steroids

Barnaby N. Zoob Carter [1]*, ***Ian D. Boardley*** [1] ***and Katinka van de Ven*** [2,3,4]

[1] School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Birmingham, United Kingdom, [2] Centre for Rural Criminology, School of Humanities, Arts, and Social Sciences, University of New England, Armidale, NSW, Australia, [3] Drug Policy Modelling Program, Social Policy Research Centre, University of New South Wales, Sydney, NSW, Australia, [4] Human Enhancement Drugs Network, University of New England, Armidale, NSW, Australia

Background: One sub-population potentially affected by the COVID-19 pandemic are strength athletes who use anabolic-androgenic steroids (AAS). We examined links between disruption in AAS use and training due to the pandemic and mental health outcomes in this population, hypothesising: (a) the pandemic would be linked with reduced training and AAS use; and (b) athletes perceiving greater impact on their training and AAS use would report increases in detrimental mental health outcomes.

Methods: Male strength athletes using AAS ($N = 237$) from 42 countries completed an online questionnaire in May 2020. A sub-sample ($N = 90$) from 20 countries participated again 4 months later. The questionnaire assessed pre-pandemic and current AAS use and training, alongside several mental health outcomes.

Results: At Time 1, most participants perceived an impact of the pandemic on AAS use (91.1%) and/or training (57.8%). Dependent *t*-tests demonstrated significant reductions in training frequency ($t = 7.78$; $p < 0.001$) and AAS dose ($t = 6.44$; $p < 0.001$) compared to pre-pandemic. Linear regression showed the impact of the pandemic on training was a significant positive predictor of excessive body checking ($B = 0.35$) and mood swings ($B = 0.26$), and AAS dose was a significant positive predictor of anxiety ($B = 0.67$), insomnia ($B = 0.52$), mood swings ($B = 0.37$). At Time 2, fewer participants perceived an impact of the pandemic on AAS use (29.9%) and/or training (66.7%) than at Time 1. Training frequency ($t = 3.02$; $p < 0.01$) and AAS dose ($t = 2.11$; $p < 0.05$) were depressed in comparison to pre-pandemic. However, AAS dose had increased compared to Time 1 ($t = 2.11$; $p < 0.05$). Linear regression showed the impact of the pandemic on training/AAS use did not significantly predict any mental-health outcomes. However, AAS dose was a significant negative predictor of depressive thoughts ($B = -0.83$) and mood swings ($B = -2.65$).

Conclusion: Our findings showed impact of the pandemic on the training and AAS use, reflected in reduced training frequency and AAS dose. However, whilst we detected some short-term consequential effects on mental health, these did not appear to be long-lasting.

Keywords: COVID-19, strength athletes, anabolic-androgenic steroids, mental health, exercise

Edited by:
Ornella Corazza, University of Hertfordshire, United Kingdom

Reviewed by:
Daria Piacentino, National Institutes of Health (NIH), United States
Emilien Jeannot, Centre Hospitalier Universitaire Vaudois (CHUV), Switzerland

****Correspondence:***
Barnaby N. Zoob Carter
bxc869@student.bham.ac.uk

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *01 December 2020*
Accepted: *22 February 2021*
Published: *22 March 2021*

Citation:
Zoob Carter BN, Boardley ID and van de Ven K (2021) The Impact of the COVID-19 Pandemic on Male Strength Athletes Who Use Non-prescribed Anabolic-Androgenic Steroids. Front. Psychiatry 12:636706. doi: 10.3389/fpsyt.2021.636706

INTRODUCTION

Originating in Wuhan, China, the outbreak of the SARS-CoV-2 virus of 2019 (hereafter, COVID-19) rapidly evolved into a worldwide pandemic (1), forcing many national governments to implement isolation procedures. These measures have negatively impacted many aspects of life through termination of jobs, restrictions in travel, cessation of recreational activities, and producing a decline in national economies. Included in the impacts of the pandemic are disruptions in drug supply chains (2, 3) and access to training facilities [i.e., gymnasia, hereafter referred to as gyms (4, 5)]. One group at particular risk are strength athletes who use image and performance enhancing drugs (IPEDs), as the pandemic may have disrupted their ability to train and access certain IPEDs, potentially leading to detrimental mental health outcomes. Thus, the overarching aim of this research was to investigate whether the COVID-19 pandemic has disrupted the drug use and training behaviours of strength athletes who use IPEDs, and whether such disruption was linked with detrimental mental health outcomes.

To curb the spread of the pandemic many countries adopted strategies of social distancing and self-isolation as part of national lockdown procedures (6, 7). These strategies included the closure of gyms, thus hampering leisure and social activities. Disruption of social habits through isolation procedures has been demonstrated to negatively impact the psychological state of individuals (8–10), potentially exerting long-term detrimental psychological effects (11). Research during the COVID-19 pandemic has linked extended periods of self-isolation with confusion, anxiety, insomnia, depression, and post-traumatic stress disorder (12–16).

It is known that a sub-population of strength athletes utilise IPEDs to aid in achieving their performance- and aesthetic-based goals (17–19). Presently we focus specifically on strength athletes who use anabolic-androgenic steroids (AAS), a sub-category of IPEDs, due to the relative prevalence of AAS use amongst the range of IPEDs used by male strength athletes (20). Anabolic-androgenic steroids (AAS) are a family of chemical derivatives of the male hormone testosterone, typically taken in cycles that extend over periods of 8–16 weeks interspersed with drug free intervals (21, 22). However, research has identified presence of an AAS dependency syndrome (20), whereby AAS are administered in an almost unbroken manner despite developing adverse physical and psychological effects (23, 24). Motivations for AAS use include increasing strength, enhancing user's aesthetics, and improving performance (18, 25, 26), achieved by combining supraphysiological doses of AAS with adequate diet and training protocols (27, 28). Due to the illicit nature of AAS, purchase without a prescription may occur via several means, including buying from personal contacts and over the internet from online stores (29–33).

Anabolic compounds used in the manufacture of AAS are distributed from countries that have been heavily impacted by the COVID-19 pandemic, including China and India (34, 35), meaning that disruption in the AAS supply chain is therefore highly likely. In turn, disruptions in AAS supply may alter AAS procurement and patterns of use, forcing some athletes to prematurely terminate AAS use, potentially increasing the likelihood of developing mental health issues associated with AAS withdrawal [e.g., depressive mood, fatigue, sleep disturbances, and loss of libido (22, 36)]. Those particularly at risk from psychiatric effects are AAS dependent athletes, who have been noted to administer AAS to self-medicate withdrawal symptoms (37). Researchers have begun to explore the psychological impact of the pandemic on mental well-being (38–40). However, there is a dearth in such research with strength athletes' who use AAS.

One strategy often advocated to prevent and/or treat mental health issues is physical exercise (5, 41, 42). Research has demonstrated how exercise can alleviate symptoms of depression, anxiety, and post-traumatic stress disorder (43–45). As such, physical exercise has been encouraged to counteract the adverse physical and psychological consequences of the pandemic (46). Further, research has shown that maintenance of sport-specific fitness may be achievable for team and multidisciplinary athletes through cardiovascular based training (47), despite the COVID-19 restrictions on physical activity. However, cardiovascular training is not a viable alternative to resistance training for strength athletes (e.g., bodybuilders and weightlifters) who primarily focus on developing strength and muscle mass, as high volumes of aerobic based training can negatively affect muscle mass and hypertrophy (48–51). Lockdown protocols have seen the closure of gyms affecting professional and recreational athletes alike through disruption to training (52, 53). Strength athletes have been particularly affected by gym closures, as they require access to specialist resistance training equipment usually only available in gyms (54). Disruptions in training, therefore, present a fundamental challenge for strength athletes, further evidenced by studies showing how the inability to train effectively and access associated social support can lead to emotional distress and psychological disorders amongst athletes (55).

One psychological issue potentially affected by the pandemic is muscle dysmorphia, classified as a fixation with muscle, whereby individuals believe themselves to be inadequately small and weak, when in fact they possess a heavily muscled body. This condition elicits an obsession with exercise and intense anxiety associated with body image (56). Muscle dysmorphia is overrepresented amongst strength athletes (57, 58), and disruptions in the ability to train effectively may exacerbate psychological symptoms associated with it. To date, researchers have not examined whether psychological issues associated with muscle dysmorphia have been accentuated by the pandemic.

Based upon the arguments made to this point, through this research we sought to further our understanding on how changes in AAS use and reduced access to training facilities due to the pandemic have impacted strength athletes who use AAS. Specifically, we aimed to (a) assess the impact of COVID-19 on strength athletes' AAS use and training and (b) explore whether any disruptions in AAS use and training were linked with mental health outcomes. Based on the reviewed literature, we hypothesised the COVID-19 pandemic would have a considerable impact on athletes' use of AAS (H1), and that those who felt the pandemic had a greater impact on their use would present with greater adverse psychological effects (H2). Further, we hypothesised the pandemic would have a considerable impact on strength athletes' training (H3), and those who felt the pandemic had a higher impact on their training would present more adverse psychological issues (H4).

METHODS

Participants

Participants at time point 1 (T1) were male strength athletes who used AAS ($N = 237$), originating from 42 countries ($n_{\text{USA}} = 107$; $n_{\text{UK}} = 47$; $n_{\text{Canada}} = 19$). They were predominantly 21–30 years of age (62.4%), single (44.7%), heterosexual (92.8%), and full-time employed or in furlough (59.9%; see **Table 1**). Time point 2 (T2) was a sub-sample of T1 participants ($N = 90$), originating from 20 countries ($n_{\text{USA}} = 41$; $n_{\text{UK}} = 17$; $n_{\text{Canada}} = 6$). Athletes were 21–30 years of age (66.7%), single (46.7%), heterosexual (93.3%), and full-time employed or in furlough (56.7%; see **Table 1**).

Measures

Data on use of IPEDs were collated at each time point. Status of use was determined at each time point by items enquiring if participants were presently "on-cycle," "off-cycle," "blasting," "cruising," or on "testosterone replacement therapy (TRT)." Weekly doses of AAS were self-reported before the onset of COVID-19 (i.e., "Prior to the COVID-19 lockdown, what was your weekly average dose of anabolic steroids?") and at the time of the data collection (i.e., "Please indicate what estimated combined weekly dosage of anabolic steroid/s you are currently using"). Response options included "Nothing (i.e. off-cycle)," "<300 mg," "300–500 mg," "501–1,000 mg," "1,000–2,000 mg," and "Over 2 g per week." Ranges of AAS doses were based upon literature on therapeutic doses (59), findings from a recent literature review (20), and primary research papers (60–64), indicating current understanding of low (i.e., clinical doses <300 mg per week) and high doses (>2,000 mg per week) of AAS.

To determine the impact of the pandemic on the use of AAS, participants were asked to self-report the impact of COVID-19 on their current use of AAS (i.e., "To what degree would you rate the impact of COVID-19 on your current use of anabolic steroids?"), using a 7-point Likert scale anchored at 1 (*No Impact*) and 7 (*Extremely High Impact*). Participants were then presented with a list of different AAS and other IPEDs, and asked to identify which compounds they were currently using (e.g., ancillary drugs, peptide hormones, selective androgen receptor modulators, etc.). The AAS and IPEDs listed were based upon the extant literature [i.e., (23, 61, 65–67)].

The self-reported detrimental effects associated with AAS use were also examined at T1 and T2. Items examined psychological effects resulting from AAS use currently being experienced by participants (i.e., "Are you currently experiencing any of these effects associated with the use of anabolic steroids?"). Psychological effects included depressive thoughts, excessive body checking, increased anxiety, insomnia, and mood disturbance. These effects were based upon those associated with AAS use within the present literature (20, 26, 61, 67, 68). Items were self-reported dichotomously via "Yes" and "No" responses.

Frequency of training at T1 and T2 was self-reported (i.e., "Currently, how often do you train?"). At T1, we also asked participants to report their average training frequency in the 3 months prior to the pandemic (i.e., "Prior to the COVID-19 lockdown, how often did you train?"). Response options for training frequency ranged from 1 (*Not training*) to 6 (*More than seven times per week*). Training frequency items were derived from relevant literature [i.e., (49, 50)]. Participants were also asked to self-report the impact of COVID-19 on their training at T1 and T2 (i.e., "To what degree would you rate the impact of COVID-19 on your current training?"), using a 7-point Likert scale anchored at 1 (*No Impact*) and 7 (*Extremely High Impact*).

Procedures

Data collections occurred at two time points during the COVID-19 pandemic. T1 occurred in April–May 2020, followed 4 months later by T2 in September–October 2020. Participants were required to be male, over the age of 18 and have taken AAS in the last 12 months prior to T1. Full ethical approval was obtained from the University of Birmingham Ethics Committee (ERN_19-1955). Participants were recruited through advertisements on bodybuilding and strength training forums where the use of IPEDs such as AAS is regularly discussed. Interested respondents were provided with a brief description of the study and a hyperlink to access the survey. Once accessed, participants were presented with an information sheet, general data protection regulation information and a consent form. Written informed consent was obtained from all participants at each time point. Participants were informed that their participation would remain entirely confidential throughout and following the study. Email addresses were required for follow-up contact at T2, and to provide successful participants with Amazon vouchers from the prize draw (see below). At the end of the T1 survey, participants were informed they would be contacted through their provided email address when it was time to complete the T2 survey in 4 months' time. Participants who completed the survey at both time points were entered into a prize draw to win a £25, £50, or £100 Amazon voucher. T1 took approximately 15 min to complete, T2 took approximately 10 min to complete.

RESULTS

Descriptive Statistics

Participants reported age of first use, total number of AAS cycles and number of AAS cycles in the last 12-months for both T1 and T2 samples (**Table 1**). Almost all (99.2%) participants reported training regularly pre-COVID-19, with participants training predominantly ranging between four to five times per week (49.8%; see **Table 2**). Pre-COVID-19 weekly doses of AAS were mostly distributed between 300 and 1,000 mg per week (65.4%; see **Table 2**).

T1 saw slightly lower frequencies of participants still training regularly (87.3%), training mostly occurred between four to seven sessions per week (65.9%; see **Table 2**). 86.9% of participants reported using AAS at T1, with participants primarily indicating

TABLE 1 | Frequencies of participants' self-reported demographics for participants at Time 1 and Time 2.

	T1			T2		
	Frequency	Percent	Mean ± Standard Deviation	Frequency	Percent	Mean ± Standard Deviation
Age range (years of age)						
18–20	22	9.3		6	6.7	
21–25	79	33.3		26	28.9	
26–30	69	29.1		34	37.8	
31–35	33	13.9		13	14.5	
36–40	17	7.2		4	4.4	
41–45	7	3		4	4.4	
46–50	4	1.7		1	1.1	
51–55	3	1.3		0	0	
>55	3	1.2		2	2.2	
Sexual orientation						
Heterosexual	220	92.8		84	93.3	
LGBTQ+	16	6.8		6	6.7	
Prefer not to say	1	0.4		0	0	
Marital status						
Single	106	44.7		42	46.7	
Relationship	88	37.1		28	31.1	
Married	40	16.9		18	20	
Divorced	3	1.3		2	2.2	
Work status						
No income	5	2.1		2	2.2	
Temporary benefit	7	3		2	2.2	
Student	56	23.6		25	27.8	
Pension	2	0.8		0	0	
Dependent	1	0.4		0	0	
Part-time	15	6.3		6	6.7	
Full-time (in furlough)	142	59.9		51	56.7	
Self-employed	6	2.6		3	3.3	
Prefer not to say	3	1.3		1	1.1	
Participant's average age of first use (years of age)			24.5 ± 6.3			25.2 ± 6.9
15–20	63	26.6		21	23.3	
21–25	102	43.0		40	44.4	
26–30	40	16.9		14	15.7	
31–35	18	7.6		9	10.0	
36–40	8	3.4		3	3.3	
>40	6	2.5		3	3.3	
Total number of cycles			4.5 ± 4.6			4.4 ± 4.0
0	2	0.8		0	0.0	
1	44	18.6		16	17.8	
2	53	22.4		19	21.1	
3	36	15.2		15	16.7	
4	26	11.0		11	12.2	
5	18	7.6		9	10.0	
6	11	4.6		5	5.6	
≥7	47	19.8		15	16.7	
AAS cycles in last 12 months			1.6 ± 0.9			1.7 ± 0.7
0	9	3.8		2	2.2	
1	110	46.4		38	42.2	

(Continued)

TABLE 1 | Continued

	T1			T2		
	Frequency	Percent	Mean ± Standard Deviation	Frequency	Percent	Mean ± Standard Deviation
2	91	38.4		38	42.2	
3	23	9.7		11	12.2	
≥4	4	1.7		1	1.2	
Status of AAS use						
On-cycle	50	21.1		27	30	
Off-cycle	31	13.1		13	14.4	
Blasting	42	17.7		19	21.1	
Cruising	73	30.8		21	23.3	
TRT	41	17.3		10	11.11	

Table includes all participants at T1 (n = 237) and the participants who completed at T2 (n = 90).

cruising (30.8%; see **Table 1**). Strength athletes mostly reported weekly doses being <300 mg per week (40.9%; see **Table 2**). Almost a third (32.9%) of participants self-reported experiencing one to four psychological effects, with excessive body checking being the most frequently reported (15.6%; see **Table 2**). Chi-square analyses identified no significant associations between off-cycle status and any psychological effects [depressive thoughts ($X^2 = 0.00, p > 0.05$), excess body checking ($X^2 = 0.95, p > 0.05$), increased anxiety ($X^2 = 0.58, p > 0.05$), insomnia ($X^2 = 1.38, p > 0.05$), or mood swings ($X^2 = 0.36, p > 0.05$)].

T2 indicated most participants still trained regularly (94.4%), training remained cantered between four to seven sessions per week (76.7%; see **Table 2**). The majority (85.6%) of participants reported using AAS at T2, with participants indicating being on-cycle (30.0%; see **Table 1**). Reported weekly doses mainly ranged between <300 and 500 mg (44.4%; see **Table 2**). Just under a quarter (22.2%) of participants reported experiencing one to five effects, with insomnia being the most frequently reported (11.1%; see **Table 2**). Chi square analyses identified significant associations between being off-cycle and depressive thoughts ($X^2 = 13.67, p < 0.001$), increased anxiety ($X^2 = 4.96, p < 0.05$), and mood swings ($X^2 = 14.19, p < 0.001$).

Impact of Pandemic on Training and AAS Use at Time 1

Most (91.1%) participants reported some impact of the pandemic on their current training, with 48.5% reporting a high to extremely high impact (see **Table 2**). Dependent *t*-tests demonstrated significant reductions ($t = 7.78$; $p < 0.001$) in average training frequency at T1 ($M = 3.85$; $SD = 1.23$) in comparison to pre-COVID levels ($M = 4.41$; $SD = 0.68$). More than half (57.8%) of the sample reported some impact of the pandemic on their AAS use, with 27.1% reporting a high to an extremely high impact (see **Table 2**). Dependent *t*-tests demonstrated significant reductions ($t = 6.44$; $p < 0.001$) in average AAS dose at T1 ($M = 2.76$; $SD = 1.14$) in comparison to pre-COVID levels ($M = 3.31$; $SD = 0.95$).

To examine whether the impact of the pandemic on training and AAS use at T1 predicted mental health outcomes at this time point, we conducted a series of hierarchical logistic regression analyses (see **Table 3**). In each of these analyses we entered T1 training frequency and AAS dose in the first step to examine and control for their effects on the outcome variable, before entering the impact of the pandemic on training and AAS use at T1 in the second step. These analyses showed that at T1, AAS dose was a significant positive predictor of anxiety, insomnia, and mood disturbance, and the impact of the COVID-19 pandemic on training was a significant positive predictor of excessive body checking and mood disturbance when controlling for the effects of training frequency and AAS dose. There were no significant predictors of depressive thoughts.

Impact of Pandemic on Training and AAS Use at Time 2

Two-thirds (66.7%) of participants reported some impact of the pandemic on their training at T2, with 13.7% reporting a high to extremely high impact (see **Table 2**). Dependent *t*-test analyses demonstrated that training frequency at T2 ($M = 4.13$; $SD = 1.07$) was depressed ($t = 3.02$; $p < 0.01$) in comparison to pre-COVID levels ($M = 4.43$; $SD = 0.69$). Further, although training frequency at T2 was higher than at T1 ($M = 3.94$; $SD = 1.27$), the difference was not statistically significant ($t = 1.44$; $p > 0.05$). Almost a third (29.9%) of participants reported some impact of the pandemic on their AAS use at T2, with 8.8% reporting a high to extremely high impact (see **Table 2**). Dependent *t*-tests demonstrated average AAS dose at T2 ($M = 3.03$; $SD = 1.44$) was significantly higher ($t = 2.11$; $p < 0.05$) than at T1 ($M = 2.67$; $SD = 1.13$), but still significantly lower ($t = 2.11$; $p < 0.05$) than the average pre-COVID dose ($M = 3.36$; $SD = 0.94$).

To examine whether the impact of the pandemic on training and AAS use at T2 predicted mental health outcomes at this time point, we conducted a series of hierarchical logistic regression analyses (see **Table 4**). In each of these analyses we entered T2 training frequency and AAS dose in the first step to examine and control for their effects on the outcome variable, before entering the impact of the pandemic on training and AAS use at T2 in the second step. These analyses showed that at T2, AAS dose was a significant negative predictor of mood disturbance and

TABLE 2 | Self-reported weekly frequencies of training and doses of AAS, impact of the pandemic on training, AAS use and psychological effects at Time 1 and Time 2.

	Pre-COVID		T1		T2	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Training frequency						
Not training	0	0	19	8	5	5.5
Once per week	2	0.8	11	4.6	0	0
2–3 times per week	12	5.1	43	18.1	10	11.1
4–5 times per week	118	49.8	85	35.9	44	48.9
6–7 times per week	97	40.9	71	30	25	27.8
>7 times per week	8	3.4	8	3.4	6	6.7
Weekly dose of AAS						
Not using	0	0	25	10.6	13	14.5
<300 mg per week	56	23.6	97	40.9	30	33.3
300–500 mg per week	77	32.5	42	17.7	10	11.1
501–1,000 mg per week	78	32.9	56	23.6	15	16.7
>1,000 mg per week	26	11	17	7.2	22	24.4
Impact of COVID on training						
No impact			21	8.9	30	33.3
Slight impact			36	15.2	26	28.9
Mild impact			23	9.7	11	12.2
Moderate impact			42	17.7	11	12.2
High impact			32	13.5	4	4.4
Very high impact			31	13.1	3	3.3
Extremely high impact			52	21.9	5	5.6
Impact of COVID on AAS						
No impact			100	42.2	63	70
Slight impact			26	11	6	6.7
Mild impact			19	8	5	5.6
Moderate impact			28	11.8	8	8.9
High impact			21	8.9	3	3.3
Very high impact			16	6.8	2	2.2
Extremely high impact			27	11.4	3	3.3
Psychological effects						
Depressive thoughts			15	6.3	9	10.0
Excess body checking			37	15.6	8	8.9
Increased anxiety			15	6.3	7	7.8
Insomnia			31	13.1	10	11.1
Mood swings			31	13.1	6	6.7

Table includes all participants at T1 (n = 237) and the participants who completed at T2 (n = 90).

depressive thoughts. The impact of the COVID-19 pandemic on training and AAS did not predict any of the mental health outcomes at T2, and there were no significant predictors of excessive body checking, anxiety, and insomnia at this time point.

DISCUSSION

This study aimed to assess the impact of the COVID-19 pandemic on strength athletes' AAS use and training, and whether any impact/s on AAS use and training were linked with mental health outcomes. Our findings partly confirmed our hypotheses in that the COVID-19 pandemic demonstrated impact on the AAS use behaviours and training of strength athletes who use AAS (H1 and H3), but did not demonstrate any long-term consequential effects on mental health (H2 and H4). These findings are important, as until now there has been a dearth in research identifying just how strength athletes who use AAS have been affected by the COVID-19 pandemic.

Our findings show that at T1, 57.8% of strength athletes perceived some impact of the pandemic on their AAS use, reducing to 29.9% of participants at T2. This was reflected in average AAS dose being lower than it was pre-pandemic at both T1 and T2. However, the impact of COVID-19 on AAS did not predict any of the mental health issues under study at either time point. This may be because only around a quarter

TABLE 3 | Logistic regression of mental health outcomes on impact of the pandemic on training and AAS use at Time 1.

Variable	*B*	*SE B*	Wald χ^2	Odds ratio	R^2	Model χ^2
EXCESSIVE BODY CHECKING						
Step 1					0.06	7.95*
Training frequency	0.30	0.18	2.79	1.35		
AAS dose	0.28	0.16	3.08	1.32		
Step 2					0.13	18.95**
Impact on training	0.35	0.12	8.21**	1.42		
Impact on AAS use	−0.02	0.10	0.02	0.99		
DEPRESSIVE THOUGHTS						
Step 1					0.04	3.71
Training frequency	−0.37	0.23	2.73	0.69		
AAS dose	0.36	0.24	2.26	1.43		
Step 2					0.05	4.61
Impact on training	0.13	0.18	0.55	1.14		
Impact on AAS use	0.02	0.14	0.03	1.02		
ANXIETY						
Step 1					0.09	8.15*
Training frequency	−0.13	0.26	0.27	0.87		
AAS dose	0.67	0.24	7.70**	1.94		
Step 2					0.11	10.31*
Impact on training	0.23	0.17	1.86	1.26		
Impact on AAS use	−0.04	0.15	0.05	0.97		
INSOMNIA						
Step 1					0.07	9.24*
Training frequency	−0.11	0.18	0.38	0.90		
AAS dose	0.52	0.17	8.86**	1.68		
Step 2					0.09	11.08*
Impact on training	−0.15	0.13	1.38	0.86		
Impact on AAS use	0.14	0.12	1.36	1.15		
MOOD DISTURBANCE						
Step 1					0.04	4.70
Training frequency	−0.14	0.17	0.72	0.87		
AAS Dose	0.37	0.17	4.63*	1.45		
Step 2					0.07	9.28
Impact on training	0.26	0.13	4.21*	1.30		
Impact on AAS use	−0.06	0.11	0.29	0.94		

All dependent variables were coded 0 = No, 1 = Yes.
**p 0.05, **p 0.01.*

TABLE 4 | Logistic regression of mental health outcomes on impact of the pandemic on training and AAS Use at Time 2.

Variable	*B*	*SE B*	Wald χ^2	Odds ratio	R^2	Model χ^2
EXCESSIVE BODY CHECKING						
Step 1					0.11	4.49
Training frequency	0.84	0.45	3.34	2.32		
AAS dose	−0.25	0.28	0.85	0.78		
Step 2					0.11	4.54
Impact on training	−0.05	0.30	0.03	0.95		
Impact on AAS use	0.07	0.31	0.06	1.08		
DEPRESSIVE THOUGHTS						
Step 1					0.16	7.35*
Training frequency	0.04	0.30	0.02	1.04		
AAS dose	−0.83	0.38	4.81*	0.44		
Step 2					0.17	7.65
Impact on training	0.12	0.26	0.20	1.12		
Impact on AAS use	0.02	0.27	0.00	1.02		
ANXIETY						
Step 1					0.02	0.82
Training frequency	−0.03	0.35	0.01	0.97		
AAS dose	−0.25	0.31	0.67	0.78		
Step 2					0.03	1.22
Impact on training	0.13	0.28	0.22	1.14		
Impact on AAS use	0.03	0.29	0.01	1.03		
INSOMNIA						
Step 1					0.04	1.86
Training frequency	0.47	0.37	1.58	1.60		
AAS dose	−0.15	0.24	0.35	0.87		
Step 2					0.05	2.11
Impact on training	−0.13	0.27	0.23	0.88		
Impact on AAS use	0.11	0.27	0.15	1.11		
MOOD DISTURBANCE						
Step 1					0.48	18.60***
Training frequency	0.95	0.49	3.73	2.58		
AAS dose	−2.65	1.02	6.79**	0.07		
Step 2					0.55	21.71***
Impact on training	0.38	0.42	0.82	1.46		
Impact on AAS use	0.34	0.41	0.69	1.41		

All dependent variables were coded 0 = No, 1 = Yes.
**p 0.05, **p 0.01, and ***p 0.001.*

at T1 and a tenth at T2 perceived this impact to be a high impact or greater. Thus, although their AAS use was reduced, it seems on the whole the degree of impact was not sufficient to negatively impact mental health. However, our findings did illustrate that at T1, AAS dose was a significant positive predictor of anxiety, insomnia, and mood swings, meaning that individuals who took higher doses were more likely to experience these mental health issues. Although less common, it has been reported in the literature that some individuals will use non-prescribed AAS to cope with stressful circumstances (69) or anxiety (70). It therefore could be that individuals who took higher doses were more anxious and stressed about the COVID-19 pandemic and therefore took higher doses in an attempt to cope with stress they were experiencing. As such, support services for AAS users should keep in mind that an increase in an athletes' AAS dose may not always be training related, and could be associated with an increase in mental health issues.

Interestingly, when looking at T2, we see that AAS dose was a significant negative predictor of mood disturbance and depressive thoughts, such that lower doses were associated with increases in these mental health issues. This was particularly the case for those who were not using at all (i.e., off-cycle), with such athletes more likely to experience depressive thoughts, increased anxiety, and mood swings compared to those on-cycle. Although these findings contrast with the equivalent analyses at T1, they are more consistent with the extant AAS use literature, as this pattern is consistent with symptoms of AAS withdrawal. Such symptoms typically appear upon discontinuation of AAS use due to AAS-induced hypogonadism (deficiency in testosterone), especially if individuals have used AAS for prolonged periods (71, 72). The return to a more regular pattern of associations between AAS dose and mental health outcomes at T2 further reinforces the possibility that the positive associations between AAS dose and detrimental mental health outcomes at T1 represented a specific response to the COVID-19 pandemic. The links between AAS use and mental health identified here highlights the importance of people who use AAS having access to health services to obtain treatment. It is, however, well-established that access to health services for this sub-population is generally limited; not only due to the lack of treatment available (73) but also due to a lack of knowledge amongst health professionals about these substances (74, 75). This lack of access has been exacerbated due to the COVID-19 pandemic with health services, including alcohol and other drugs services, needing to close down or restricting their access (76, 77). It is therefore imperative that more is done to produce well-informed and accessible health services specific to those who use non-prescribed AAS, which can be utilised despite the presence of a global pandemic such as COVID-19.

The perceived impact of COVID-19 on training alongside subsequent reductions in training frequency comparative to pre-COVID-19, at both T1 and T2, indicate notable disruptions in the ability of strength athletes' to train effectively during the pandemic. This is concerning, as several studies in the early COVID-19 stages have shown that a reduction in physical activity has a negative impact on mental health and well-being (78, 79). Our findings likewise showed the perceived impact of the pandemic on their training was negatively linked with aspects of their psychological health at T1. Specifically, it was a significant positive predictor of excessive body checking and experiencing mood swings. Importantly, excessive body checking can be indicative of body image (e.g., muscle dysmorphia) or eating (80, 81) disorders. Considering muscle dysmorphia is not uncommon amongst strength athletes (57, 58), elevated rates of stress due to reduced training may contribute to increasing risk for developing a body image disorder. Indeed, Swami et al. (82) showed COVID-19-related stress and anxiety was associated with negative body image, and for men in particular, it was associated with greater muscularity dissatisfaction which likewise can be a sign of muscle dysmorphia. It is therefore important to better understand the impact of COVID-19, and associated factors including gym closures and disruptions in training, on body image disorder risk in strength athletes who use AAS. Such increased understanding would help inform interventions to better support this population.

Of note though, at T2 the impact of the COVID-19 pandemic on training did not predict any of the mental health outcomes. Whilst our data cannot speak to mechanistic pathways, it may be that many individuals were able to come to terms with the restrictions and adapt their training regimes and/or training goals to lessen the perceived impact of the pandemic on their training. This possibility is supported by the reduction in the number of athletes (i.e., 91.1% at T1 and 66.7% at T2) perceiving an impact of the pandemic on their training at T2 compared to T1. Especially when you consider the change in the percentage of athletes (i.e., 48.5% at T1 and 13.7% at T2) perceiving a high, very high, or extremely high impact of the pandemic on their training. However, the question remains as to how long strength athletes can continue to adapt in this way and keep up this routine to accommodate the impact the pandemic has had on their ability to train normally. Further, reduced access to the gym and associated social-support networks may lead to increased social isolation over time, which can increase psychical inactivity (83), for example, due to factors such as reduced motivation and boredom.

Limitations and Future Recommendations

The present study was not without limitations. The study experienced a high attrition rate (62.1%) during the transition from T1 to T2 data collection, but not to a level that would render the results as non-meaningful [see (84)]. Although statistically significant results were determined at T2, the reduction in power—due to the attrition rate—reduced our ability to detect statistically significant results with weaker effect sizes in comparison to at T1. Possible explanations for this attrition rate include reminder emails being automatically redirected to spam/junk folders, participants experiencing COVID survey fatigue, participants forgetting their participation in the study, and participants having reduced motivation to continue their participation as lockdown restrictions were eased (i.e., strict restrictions may have been a primary motivator of participation for many at T1). Generalizability may also have been affected due to the openness of participants about their use of AAS. Specifically, those who are more open about their AAS use may have opted to partake in the study, with those who are not avoiding participation. Further, use of self-report items may have led to socially desirable responses and incidences of recall bias. This study was also limited due to the two time-point longitudinal design, limiting the analyses that could be conducted on the data; increasing the frequency of time-points would facilitate a design in which longitudinal relationships could be determined.

Our recommendations for future research are aimed at developing longitudinal studies to further understand the impact of COVID-19 and the risk of developing body image disorders and longitudinal investigations on the robustness of strength athletes maintaining their training through social isolation protocol. Further recommendations include the provision of position statements identifying the importance of access to adequate training facilities suitable for all exercise disciplines during pandemics, to aid in guiding governmental procedures for future lockdown protocols.

CONCLUSION

Our findings support our hypotheses that the COVID-19 pandemic demonstrated impact on the training and AAS use behaviours of strength athletes who use non-prescribed AAS.

Reductions in both training frequency and weekly dose of non-prescribed AAS reflected the impact of the global pandemic on the athletes' training and drug-use behaviours. However, our analyses did not support any consequential effects of the impact of COVID-19 on non-prescribed AAS use and adverse mental health outcomes. Ongoing longitudinal analyses will help determine whether more time was needed for such effects to manifest, especially if the athletes under study return to lockdown conditions when consequent impacts are heightened.

DATA AVAILABILITY STATEMENT

We will not be making the raw data available as it was not in the remit of our ethics application.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Birmingham Ethics Committee. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BZ and IB collaborated to develop and design the project. BZ collected the data for the project. BZ wrote the initial draft of the introduction and method sections. IB conducted the data analysis, in collaboration with BZ. KV wrote the initial draft of the discussion. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

The researchers would like to thank the Economic Social Research Council for their funding (ES/P000711/1) and studentship enabling this study. We would also like to thank the strength athletes and gatekeepers in giving up their time to support and partake in this study.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 29 March 2021
doi: 10.3389/fpsyt.2021.630730

COVID-19 Impact on Healthcare and Supportive Services for People Who Use Drugs (PWUDs) in Malaysia

Balasingam Vicknasingam[1]*, *Nur Afiqah Mohd Salleh*[2,3], *Weng-Tink Chooi*[4], *Darshan Singh*[1], *Norzarina Mohd Zaharim*[4], *Adeeba Kamarulzaman*[3,5] and *Marek C. Chawarski*[6]

[1] Centre for Drug Research, Universiti Sains Malaysia, Penang, Malaysia, [2] Department of Social and Preventive Medicine, Faculty of Medicine, Universiti Malaya, Kuala Lumpur, Malaysia, [3] Centre of Excellence for Research in AIDS, University Malaya, Kuala Lumpur, Malaysia, [4] School of Social Sciences, Universiti Sains Malaysia, Penang, Malaysia, [5] Department of Medicine, Faculty of Medicine, University Malaya, Kuala Lumpur, Malaysia, [6] Yale School of Medicine, New Haven, CT, United States

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Edited by:
Ornella Corazza,
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Reviewed by:
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Attilio Negri,
Azienda Socio Sanitaria Territoriale di Mantova, Italy

***Correspondence:**
Balasingam Vicknasingam
vickna@usm.my

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 18 November 2020
Accepted: 04 March 2021
Published: 29 March 2021

Citation:
Vicknasingam B, Mohd Salleh NA, Chooi W-T, Singh D, Mohd Zaharim N, Kamarulzaman A and Chawarski MC (2021) COVID-19 Impact on Healthcare and Supportive Services for People Who Use Drugs (PWUDs) in Malaysia. Front. Psychiatry 12:630730. doi: 10.3389/fpsyt.2021.630730

Background: Restrictive orders and temporary programmatic or *ad hoc* changes within healthcare and other supportive systems that were implemented in response to the COVID-19 epidemic in Malaysia may have created hindrances to accessing healthcare and/or receiving other supportive services for people who use drugs (PWUDs).

Design: A primarily qualitative study has been conducted to evaluate how service providers and recipients were adapting and coping during the initial periods of the COVID-19 response.

Settings: The study engaged several healthcare and non-governmental organizations (NGOs) in the peninsular states of Penang, Kelantan, Selangor, and Melaka.

Participants: Medical personnel of methadone maintenance treatment (MMT) programs ($n = 2$) and HIV clinics ($n = 3$), staff of NGO services ($n = 4$), and MMT patients ($n = 9$) were interviewed using a semi-structured format.

Results: Interviewed participants reported significant organizational, programmatic, and treatment protocols related changes implemented within the healthcare and support services in addition to nationally imposed Movement Control Orders (MCOs). Changes aimed to reduce patient flow and concentration at the on-site services locations, including less frequent in-person visits, increased use of telemedicine resources, and greater reliance on telecommunication methods to maintain contacts with patients and clients; changes in medication dispensing protocols, including increased take-home doses and relaxed rules for obtaining them, or delivery of medications to patients' homes or locations near their homes were reported by the majority of study participants. No significant rates of COVID-19 infections among PWUDs, including among those with HIV have been reported at the study sites.

Conclusions: Although the reported changes presented new challenges for both services providers and recipients and resulted in some degree of initial disruption, generally, all participants reported successful implementation and high levels of compliance with the newly introduced restrictions, regulations, and protocols, resulting in relatively low rates of treatment disruption or discontinuation at the study sites.

Keywords: people who use drugs, COVID-19, methadone, HIV, Malaysia

INTRODUCTION

In response to the coronavirus (COVID-19) threat, Malaysia imposed several phases of the Movement Control Order (MCO) nationwide, beginning on March 18, 2020 (1). During the initial MCO phase, only essential services were allowed to operate; activities of educational institutions and religious services and organizations were suspended; restaurants, bars, entertainment outlets, cinemas were ordered to close; international and interstate travel was not permitted; locally, only those working for essential services were allowed to leave homes; all other citizens were asked to stay at home and only one person per each family living together was allowed to go out to obtain food, essential supplies, and medicine. Between March 18 and May 4, 2020, 5,563 COVID-19 cases in a population of 32.7 million people (2) were recorded in Malaysia. Subsequently, the Malaysian government imposed the Conditional Movement Control Order (CMCO) lasting from May 5 to June 10, 2020. During the CMCO period, most business and services were allowed to open, but entertainment outlets including cinemas, theme parks, religious and education institutions were ordered to remain closed. Interstate travel was allowed only for essential services, including food and medical transports. During the CMCO, 1,955 cases were recorded in the whole country. As the cases continued to decrease, the Recovery Movement Control Order (RMCO) was established between June 11 and August 31, 2020 and only 971 cases were recorded during this period (3). During this phase, more businesses were allowed to re-open. Large scale social, religious, education activities, and international and interstate travel were still not permitted. Throughout the MCO, CMCO, and RMCO all imposed restrictions were enforced by the law enforcement agencies and included police patrols in residential areas, road check-points, and by issuing citations and penalties for non-compliance.

Though these restrictive orders were intended to slow the spread of the COVID-19, and indeed they have shown considerable reduction of new infections in Malaysia, there is a concern that for people who use drugs (PWUDs), including those with substance use disorders (SUDs), the various types of measures to control or restrict peoples' movement, distancing or limiting social contacts, or restricting access to various social and healthcare facilities may have created particularly challenging hindrances to receiving social support or accessing healthcare and other supportive services (4–10).

The present study aimed to collect information and qualitative and quantitative data on the potential impact of the MCO on PWUDs in Malaysia to evaluate how service providers and recipients of these services were adapting and coping during this period in Malaysia.

METHODS

Design

The study combined a qualitative component, consisting of interviews with key personnel, service providers, and SUD patients receiving treatment in participating clinics, and a quantitative component based on data from pre-MCO and during MCO/CMCO/RMCO periods from the MMT program at Sungai Buloh Hospital (SBH) in Selangor.

Ethical Considerations

The study was reviewed and approved by the Human Ethics Committee of Universiti Sains Malaysia, Penang (protocol # USM/JEPeM/COVID19-30). A written informed consent was obtained from all study participants. No personally identifiable information has been collected from the interviewees and clinic records used in quantitative analyses were de-identified before accessing and analyzing.

Locations and Timeline

The study was conducted in several locations in the peninsular states of Penang, Kelantan, Selangor, and Melaka. Selection of study sites was determined by the availability of healthcare and/or non-governmental organizations (NGO) facilities that could be engaged in the study research protocol.

Qualitative interviews collected information from healthcare and service providers, as well as patients with SUD receiving treatment or other services during the MCO/CMCO/RMCO periods from March 18 to August 31, 2020. Quantitative study component evaluated urine toxicology tests results collected before the MCO period (December 2019 to February 2020) and during the RMCO period (June 2020 to August 2020) at the MMT program at SBH in Selangor.

One infectious disease MD physician and two MD general practitioners from the HIV clinic and the methadone maintenance treatment (MMT) clinic, respectively, in SBH, Selangor; one MD physician from MMT clinic in Masjid Tanah, Melaka; and one nurse from Hospital Raja Perempuan Zainab in Kota Bharu, Kelantan were interviewed. A total of nine MMT patients were interviewed: four from

Masjid Tanah, Melaka, and five from Kota Bharu. One programme manager and one programme coordinator at the AIDS Action Research Group (AARG) NGO in Penang; one programme coordinator from the Insaf Murni NGO in Selangor and one programme coordinator from the SAHABAT NGO in Kelantan were also interviewed. Data collection methods.

Qualitative interviews were based on a semi-structured interview guide developed for the current study. The interviews focused on the following domains of interest: (a) programmatic changes in healthcare policies and protocols implemented during MCO/CMCO/RMCO periods; (b) implemented operational changes at the point of care level and at supportive services facilities; (c) effects of the MCO/CMCO/RMCO restrictions and other implemented changes on provision of healthcare and supportive services; (d) effects of MCO/CMCO/RMCO restrictions and other implemented changes on patient access; and (e) effects of MCO/CMCO/RMCO restrictions and other implemented changes on substance use.

One participant was interviewed over the phone, all other interviews were conducted face-to-face. The interviewers wrote down answers to all questions and took additional notes as needed. Study personnel adhered to COVID-19 related regulations implemented by the Malaysian government pertaining to body temperature checks and being interviewed about potential symptoms and health status upon entering healthcare facilities, wearing face masks and maintaining social distancing during the interviews.

Deidentified urine toxicology test results for opiates, benzodiazepines, methamphetamine, amphetamine, and tetrahydrocannabinol collected routinely as part of clinical monitoring at the MMT clinic at SBH in Selangor between December 2019 and August 2020 were also obtained.

Data Analytical Approaches

The analyses focussed on: (a) identifying information on changes in policies, protocols, operating procedures, and implemented practices, and (b) on evaluating potential impact of these changes and of COVID-19 related restrictions on healthcare access, and substance use among PWUDs during the MCO, CMCO, and RMCO in Malaysia.

Collated notes from all qualitative interviews were reviewed by the study research group to identify informational content (i.e., descriptions of changes in policies, protocols, operating procedures, and implemented practices) and analyzed thematically to identify common patterns pertaining to impact, adaptation, and coping both on organizational and individual levels.

Descriptive analyses were conducted using MMT clinic records data. The overall rates of urine toxicology test results positive for any illicit substances during each month of pre-MCO (December 2019 to February 2020) and RMCO (June 2020 to August 2020) were calculated, tabulated, and compared.

RESULTS

Qualitative Interviews With Healthcare Workers

MMT Physicians

The interviewed physicians reported that between January 2020 and August 2020 there were 131 and 78 active patients, respectively, in Masjid Tanah, Melaka and SBH, Selangor MMT clinics. In both clinics, there were no reported COVID-19 infections among their MMT patients.

Prior to the MCO, take-home doses of methadone were provided according to the national guidelines to patients who were considered to be in a stable recovery, as determined by negative urine toxicology tests conducted randomly, at least once a month. Patients with continuous urine tests negative for all tested illicit substances (opioids, amphetamine, methamphetamine, benzodiazepines, THC) for at least 3 months were eligible for take- home methadone doses. The national guidelines for prescribing take home doses, allowed for eligible patients to initially receive 3 to 4 days of take-home doses, and subsequently the number of doses could have been increased for up to 2 weeks maximum, for patients who continued with a stable recovery (11). In both clinics, ∼50 to 60% of the patients were receiving take-home doses before the MCO.

During the MCO, urine testing was suspended until June 2020 at the SBH MMT clinic, but not at Masjid Tanah clinic in Melaka. Methadone take-home dose regulations were relaxed in both clinics participating in this study. Almost all patients in both clinics received take-home doses. Those who previously did not receive take-home doses started receiving a 1-week supply of methadone daily doses, and those previously on weekly take-home regimen, were receiving a 2-week supply of take-home methadone doses. Take home doses for both clinics were dispensed in individual bottles for each day of dosing. Patients were instructed to consume one bottle each day and return the empty bottles when coming to the clinic for their next take-home doses supply. The clinic staff has not collected any self-report on medication adherence, due to the brevity of clinic visit during the MCO.

Only patients who were newly admitted to the MMT program during the MCO were required to come to the clinics daily during their initial dose titration period. However, there were very few new patients enrolling during the MCO. Only one new patient was reported in the Masjid Tanah, Melaka MMT clinic. No new patients were admitted during the MCO, CMCO, and RMCO at the MMT clinic at SBH.

Interviewed MMT personnel indicated that they would prefer to continue with the relaxed rules for the methadone take-home dosing to continue even after the COVID-19 restrictions are ultimately lifted. As of November 2020, The Masjid Tanah MMT clinic in Melaka continues to provide take-home methadone

TABLE 1 | Urine toxicology tests results at the MMT Clinic at SBH during pre- and post-MCO periods.

Pre-movement control order (MCO) months	**Patients with urine tests positive for any illicit substance % (n/N)**	**Number of patients positive for tested substances**
December 2019	23 (17/74)	bzd (6), met (4), amp/mor (2), met/mor (2), met/amp/mor (1), THC (1), met/amp (1)
January 2020	23 (16/74)	bzd (5), met/amp (3), met (2), met/amp/mor (2), mor (1), THC (1), met/mor (1). met/THC/mor (1)
February 2020	18 (13/74)	met (5), bzd (4), met/amp/mor (1), bzd/mor (1), THC (1), met/amp (1)
Movement Control Order (MCO) months March to May 2020	No urine tests conducted	
Recovery Movement Control Order (RMCO) months	Patients with urine tests positive for any illicit substance % (n/N)	Number of patients positive for tested substances
June 2020	24 (18/74)	met (5), met/amp (3), bzd (3), met/amp/mor (2), met/amp/mor/bzd (1), mor (1), bzd/mor (1), THC (1), met/THC/mor/amp (1)
July 2020	19 (14/7)	bzd (4), met/amp (4), met (2), mor (1), met/amp/mor (1), met/THC (1), amp (1)
August 2020	23 (17/74)	bzd (5), met/amp (5), met/amp/mor (3), THC (2), met (1), met/THC/mor/amp (1)

bzd, benzodiazepine; met, methamphetamine; amp, amphetamine; mor, morphine; THC, tetrahydrocannabinol.

doses to the majority of their patients. The MMT clinic at SBH returned to the pre-MCO regulations regarding take-home dosing in July 2020.

Interviewed personnel reported that some patients missed their clinic visits and medication pick up visits during the MCO, CMCO, and RMCO, but beginning in July most of these patients reengaged with their clinics.

Descriptive Data From MMT Clinic

Table 1 shows summaries of urine toxicology results for illicit substance use (opioids, amphetamine, methamphetamine, benzodiazepines, THC) among MMT patients in SBH. The rates of patients testing positive for any of the tested substances during the pre-MCO period (from December 2019 to February 2020) and during the post- MCO or during the RMCO months (from June to August 2020) did not differ substantially and ranged between 18 and 24% in both evaluated periods. In both evaluated periods benzodiazepines and methamphetamine and/or amphetamine were the most commonly detected substances.

HIV Clinics Personnel

Before the MCO has been declared, the SBH in Selangor had the largest HIV treatment programme in Malaysia, with a census of over 9,000 HIV patients. Coinciding with the declaration of the MCO the hospital has been designated as the primary treatment and coordinating center for COVID-19 patients. It has been reported that it had treated approximately 5,000 COVID-19 cases and there was a total of 12 COVID-19 related fatalities reported by the time of the study qualitative interviews. Among all HIV patients at the SBH, only one was reported to become infected with the COVID-19, received the same course of treatment as other COVID-19 patients, and subsequently fully recovered without any COVID-19 related sequalae.

There were significant programmatic, structural/facilities, and organizational changes implemented to decrease concentration/congestion of people on the hospital grounds and to follow newly implemented social distancing rules, as well as to accommodate the new role for the hospital and to facilitate care for the expected influx of COVID-19 patients. The HIV in-patient ward was converted into an inpatient COVID-19 treatment ward. Other wards were also converted or designated to treatment of COVID-19 patients as needed. Existing HIV in-patients were transferred to other wards within the hospital, with some patients transferred to different hospitals or facilities, while some of the HIV outpatients who were assessed to require more vigilant care were admitted as inpatients. The SBH stopped accepting new non-COVID-19 with the exception of any urgent walk-ins. All new cases were referred to other hospitals. The SBH began accepting new non-COVID-19 patients around early to mid-June, after interstate travel was permitted. Patients traveling from other states received letters to certify their travel for important health related reasons. Overall, the interviewed healthcare professionals stated that the greatest challenge in maintaining clinic services was fatigue and COVID-19 case overload due to staffing shortages.

During the MCO, HIV patients who were determined to be clinically stable had their previously scheduled on-site face-to-face medical evaluation appointments with the clinic personnel canceled or postponed by 1 month. Additionally, a telemedicine consultation service offered to clinically stable HIV patients receiving ART operating at the SBH since 2017 continued during the MCO, CMCO, and RMCO periods. This service, called *EZ Clinic*, aimed to ease patient flow through the on-site HIV clinic and to remove some of the challenges of healthcare access, by reducing delays in patient-provider contacts and reducing travel and time burden of an in-person visits for patients who could utilize the telemedicine service. Through the *EZ Clinic* healthcare providers were able to conduct a rudimentary patients evaluation, review laboratory test results, and provide a consultation for their patients.

It was reported that patients registered with the *EZ Clinic* were more likely to maintain regular contact with their treatment providers. On the other hand, patients who were not utilizing the *EZ Clinic* were more likely to miss their evaluation appointments during the MCO, CMCO, and RMCO periods.

For patients scheduled for an in-person visit, the HIV clinic nurse called the patients ahead of their appointment to evaluate their current health status before deciding if they need to come to the clinic. If the patients were clinically stable and generally doing well, they were asked not to come for their scheduled appointment. Patients attending their scheduled appointments in-person were not allowed to be accompanied by family members, which was very common before the MCO. All laboratory tests for stable patients were suspended during the MCO.

Prior to MCO, patients who were receiving Antiretroviral Therapy (ART) were required to come to the on-site pharmacy to receive a monthly supply of ART medications. During the MCO, ART patients were given three options: sending/mailing their medication to their home or to the healthcare facility that was nearest to their residence; or drive through pharmacy pickup service at the hospital; or a walk-in pick up of prepared medication supply at the hospital lobby. No medication shortages were reported during the MCO, CMCO, and RMCO periods.

Staff of NGOs Services

Insaf Murni, an NGO that provides HIV-related services to key populations, operates in two towns within the Selangor state: Klang and Kajang. The AIDS Action Research Group (AARG) operates in Penang, and provides a broad range of services, including needle and syringe services and HIV testing and counseling at sites on the island and at the mainland. SAHABAT NGO operates in Kota Bharu, Kelantan and offers needle and syringe services, HIV testing and counseling and operates a home shelter for PWUDs.

The interviewed NGO staff reported that a day before MCO was implemented, outreach workers from Insaf Murni have distributed a three-week supply of needles and syringes at their community distribution locations frequented by the PWUDs. During the MCO, CMCO, and RMCO, their organizations temporarily stopped providing counseling, community HIV testing, and drop-in services to the clients. All NGOs reported that they increased their needle and syringe package for clients from 1 week to 2 or 3 weeks supply and added face masks and disinfectants/sanitisers to the packages. Clients came to the organization dispensing sites in the community to pick up their packages.

During the MCO period, new clients who were referred by existing clients were registered through phone calls, rather than through in-person visits. An increase in the number of PWUDs interested in being referred to MMT during the MCO has been reported. Insaf Murni NGO also reported an increase in request for HIV and Hepatitis testing among men who have sex with men (MSM) and from the transgender community during the MCO, CMCO, and RMCO periods.

During the MCO, the government begun offering financial assistance to people who lost their jobs and a 6-month property and vehicles loan moratorium was introduced. The NGOs started to help their clients to complete the necessary application documents and assisted them in the application process. One NGO have also reported to provide food to 70 transgender people by delivering the food packages to their homes and to 120 PWUDs by delivering the food to the health clinic.

Starting in May 2020, during CMCO, outreach workers at Insaf Murni restarted to transport clients to a health clinic for Hepatitis C treatment. Their outreach workers were provided with the sets of personal protective equipment (PPE) including a face mask, eye protection, isolation gown, and gloves for their off-site travel and community work. Outreach workers have used this opportunity to restart distribution of needles and syringes at locations frequented by PWUDs, within the 15 km radius of the two towns where this NGO has been operating. During RMCO, outreach workers continued engaging with PWUDs including referrals to MMT treatment and provision of 3-week supply of clean needles and syringes. Counseling sessions and HIV testing for PWUDs resumed in August 2020.

Collection of used needles and syringes, community HIV testing and counseling programs, and narcotic-anonymous meetings were suspended. Collection of used needles and syringes resumed at Insaf Murni during RMCO, but the rates of returned needles and syringes dropped from pre-MCO 75% to ∼30%.

Some of the commonly reported challenges faced by the NGOs during the MCO, CMCO, and RMCO were difficulties reaching out to their clients, especially those who were living further away from the NGOs operating sites. To reach the clients living outside 10–15 km radius from the sites, the outreach workers needed to obtain a permission from the police. NGOs' case workers were also restricted in accompanying clients for their healthcare appointments. Some of the interviewed NGOs' staff remarked that during the initial stages of the MCO they were worried about potential shortages of needles, syringes, and other supplies due to the overall disruption in the supply chains in the country. However, no major shortages of such supplies were reported during the interviews.

MMT Patients

Five of the nine interviewed MMT patients were also receiving ART, and three of these were additionally receiving Hepatitis C treatment during the time of their study participation. All five MMT patients on ART were residing in the SAHABAT NGO shelter home in Kota Bharu, Kelantan. Prior to MCO, residents of the shelter home received weekly counseling. However, this service was suspended when the MCO was declared, as there were local travel restrictions preventing counselors from traveling to the shelter. The on-site staff of the shelter home continued to help the patients to ensure daily ART and Hepatitis C medication adherence and took them for scheduled follow up visits with their HIV clinic treatment providers as their HIV clinic in Kelantan continued to provide in-person services for patients residing in the shelter home.

The interviewed patients confirmed that after the MCO has been implemented take-home doses were given to patients previously on a daily dosing regimen and those already receiving take-home methadone doses became eligible for up-to 2 weeks of methadone take-home dosing. One patient expressed a concern regarding his take-home doses. He said that he did not have a proper place to store the medication as he lived with two younger siblings and nephews and nieces. He was worried that they may accidentally consume his medication even though he kept it in a locked drawer.

Interviewed patients reported that their respective MMT clinics implemented body temperature checks while entering the clinics, and social distancing rules on the clinics' grounds. They were also required to register in the national COVID-19 contact tracing application. Overall, all patients reported that generally they have not had significant problems in getting their supply of medications and their treatment was not interrupted throughout the MCO period.

The interviewed patients expressed mixed views about availability of street drugs during the MCO. Some stated that the price of a packet of street heroin was unchanged while the quantity in each packet was somewhat reduced. Others, stated that the price of heroin increased during the MCO. They also expressed different opinions regarding availability of street drugs: some said that the supply/availability was reduced, while others reported no perceived changes in the supply or availability.

DISCUSSION

This primarily qualitative study evaluated whether the MCOs imposed in Malaysia in March of 2020 in response to the COVID-19 epidemic and the related changes in healthcare and social support services created particularly challenging hindrances for PWUDs. The study collected semi-structured interviews with medical personnel of healthcare services, staff of NGOs, and MMT patients in the peninsular states of Penang, Kelantan, Selangor, and Melaka.

While PWUDs, especially those who use opioids and amphetamine-type-stimulants (ATS), are vulnerable to respiratory and pulmonary health problems and they were feared to be at increased risk of infection and high rates of treatment discontinuation during the COVID-19 pandemic (12), no significant rates of COVID-19 infections among PWUDs, including among those with HIV have been reported at the study sites. Additionally, relatively low rates of treatment disruption or discontinuation during the initial periods of MCOs were reported by the personnel of sites engaged by the study.

Interviewed participants reported significant organizational, programmatic, and treatment protocols related changes implemented within the healthcare and support services in addition to nationally imposed MCOs. The main changes aimed to reduce patient flow and concentration at the on-site services locations, including postponing, or less frequent scheduling of in-person visits, especially for patients determined to be clinically stable. A greater utilization of telemedicine resources and greater reliance on telecommunication methods instead of in-person visits or contacts to maintain therapeutic or service engagements with patients and clients was also commonly reported. Both MMT programs and HIV clinics implemented significant changes in medication dispensing protocols, including relaxed rules for patients to obtain take-home doses, increases in the duration of take-home doses, and delivery of ART medications to patients' homes or locations near their homes. While these changes were meant to be temporary, in some study locations the modified/relaxed medication protocols were still in place after the study completion and may continue to be utilized in the future. In particular, despite the relaxation of the rules for eligibility of methadone take-home dosing, neither healthcare professionals nor patients reported significant challenges resulting from the expansion of methadone take-home regimens at the participating MMT clinics. Urine toxicology data obtained from the MMT clinic at SBH (see **Table 1**) indicates that there were no substantial increases in the rates of patients testing positive for illicit substances after the rules for methadone take-home dosing were relaxed. This data also illustrates that that there were no substantial changes in types of illicit substances used by MMT patients during the pre- and post-MCO periods.

Interviewed staff of NGOs reported challenges in accessing some clients, especially in locations further away from their organizations operation sites, primarily due to travel restrictions. They also reported temporary discontinuation of some of their services, including HIV testing and counseling, and any services necessitating face-to-face or close interaction with the clients. Other services, including needle and syringe distribution continued without major disruptions, due to procedural changes, adjustments, and adaptations. All needle and syringe programs reported providing increased number of needles and syringes in their distribution packets, and providing additional COVID-19 related supplies, such as face masks and disinfectants. Some NGOs also reported initiating additional services that were not typically offered during the pre-MCO period, for example, assistance with applications for new government assistance programs, or food distribution.

Overall, no major or only transient disruptions in provided healthcare and other supportive services were reported by the interviewed healthcare providers, NGOs' staff, as well as MMT patients. Based on the conducted interviews and evaluation of available clinic records, the present study has not obtained any evidence of substantially increased rates of treatment or service discontinuation. Some increases in services demands (e.g., increased number of MMT referral inquiries) were also reported. Interviewed participants reported challenges related to travel/movement restrictions, and concerns about potential adverse effects of the disruptions in the supply chains on availability of medications and service supplies, however the study participants have not reported medication shortages or other significant treatment or supporting services disruption.

LIMITATIONS

Due to COVID-19 response burden on healthcare and other social services, as well as travel restrictions being still in place when the study was conducted, the study was able to engage only a limited number of services, and a relatively small number of healthcare providers, NGO staff, and patients were enrolled. Study findings are based primarily on qualitative interviews with only limited quantitative data obtained and analyzed. Consequently, the study findings represent only a snapshot picture. A broader range of changes and adaptations were likely being implemented in different locations throughout Malaysia in addition to the nationwide imposed MCOs.

Despite these limitations, the study provides an overview of successful changes and adaptations that were implemented in Malaysia in response to the COVID-19 pandemic and outlines their potential impact on provision and access to healthcare and other supportive services for PWUDs in Malaysia. The study findings may inform future responses to potential crises and hindrances concerning provision of healthcare and social support services for PWUDs in Malaysia and other countries in the region.

CONCLUSIONS

The reported changes and adaptations introduced to cope with the COVID-19 pandemic in Malaysia presented new challenges for both service providers and recipients and resulted in some degree of initial disruption. However, generally, all participants reported successful implementation of the changed or newly implemented procedures or protocols and high levels of compliance with the newly introduced restrictions, regulations, and protocols. The reports collected during the study indicate that both the personnel and patients or clients receiving services at the evaluated services were able to adapt well to the changes, resulting in relatively low rates of treatment or service disruption or discontinuation at the study sites.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Ethics Committee of Universiti Sains Malaysia. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NAMS, W-TC, NMZ, and DS were involved in the data collection. BV and MCC conducted the data analysis and drafted the manuscript. All authors contributed to the design, conceptualization of the study, revised and edited the manuscript, contributed to the article, and approved the submitted version.

FUNDING

This study was funded by NIDA DA047789 and 304 /CDADAH /6501001/Y110.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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ORIGINAL RESEARCH
published: 06 April 2021
doi: 10.3389/fpsyt.2021.632519

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The Impact of COVID-19 Pandemic and Lockdown on Alcohol Consumption: A Perspective From Hair Analysis

Eugenio Alladio[1], *Lia Visintin*[1], *Tonia Lombardo*[2], *Roberto Testi*[2], *Alberto Salomone*[1,2]* *and Marco Vincenti*[1,2]

[1] *Dipartimento di Chimica, Università degli Studi di Torino, Torino, Italy,* [2] *Centro Regionale Antidoping e di Tossicologia "A. Bertinaria", Torino, Italy*

Introduction and Aims: The increase in stress levels, social confinement, and addiction's physical consequences play an essential role in the proliferation of drug abuse. In this context, the Covid-19 pandemic produced remarkable effects on those individuals prone to addictions, especially to alcohol. Alcohol is linked to multiple dangerous conditions such as social issues, severe medical conditions, and road accidents. The determination of ethylglucuronide (EtG) in hair is frequently performed to test and monitor chronic excessive alcohol intake conditions, as it allows differentiation among low-risk/moderate drinkers, and excessive/chronic drinkers. Our study aimed to explore hair EtG levels in a controlled population to assess the impact of Covid-19 lockdown on alcohol intake along March-May 2020.

Materials and Methods: EtG levels were measured in all hair samples collected in the months following April 2020 to evaluate the behaviors related to alcohol intake along with the time frame from March to May 2020. The measured concentration distributions for each month were compared with those reported in the same month during the previous 4 years (2016–2019). The dataset was built to highlight possible differences between genders, and the different categories of alcohol consumption, separately.

Results: The samples collected from April to August 2020 ($500<N<1{,}100$ per month) showed an increase in the percentage of subjects classified as abstinent/low-risk drinkers (from 60 up to 79%) and a decrease of subjects classified as moderate and chronic drinkers (−12 and −7%, respectively) when compared to the previous 4 years. A decrease in the overall mean value of EtG in the period April–June 2020 was observed, while the EtG levels of both June and July 2020 provided an increasing trend for chronic/excessive consumers (+27 and +19% for June and July 2020, respectively). A peculiar rise in the EtG levels of moderate and chronic/excessive female consumers was observed along April–June 2020, too.

Discussion and Conclusions: Behavioral and social studies generally report a decrease in alcohol consumption during the Covid-19 lockdown. However, people already suffering from drug or alcohol addictions before Covid-19 pandemic seemingly

Edited by:
*Ornella Corazza,
University of Hertfordshire,
United Kingdom*

Reviewed by:
*Eric Zorrilla,
The Scripps Research Institute,
United States
Sulaf Assi,
Liverpool John Moores University,
United Kingdom*

***Correspondence:**
*Alberto Salomone
alberto.salomone@unito.it*

Specialty section:
*This article was submitted to
Addictive Disorders,
a section of the journal
Frontiers in Psychiatry*

Received: *23 November 2020*
Accepted: *05 March 2021*
Published: *06 April 2021*

Citation:
Alladio E, Visintin L, Lombardo T, Testi R, Salomone A and Vincenti M (2021) The Impact of COVID-19 Pandemic and Lockdown on Alcohol Consumption: A Perspective From Hair Analysis. Front. Psychiatry 12:632519. doi: 10.3389/fpsyt.2021.632519

enhance their harmful behavior. Our data from April to August 2020 are consistent with both suppositions. Our observations confirm once again the utility of EtG to investigate the patterns of alcohol consumption in the population.

Keywords: ethyl glucuronide, hair test, alcohol, COVID-19, addiction

INTRODUCTION AND AIMS

During 2020, the World Health Organization (WHO) and the European section of WHO (1) have published several studies and report (2–5) about alcohol consumption and alcohol addiction dealing with fundamental issues in preventing risks and alcohol-related harm. In the last report published by WHO in 2020 (3), it is stated that alcohol is the primary cause of deterioration in health, disability, and premature death in Europe, which ranks first globally in terms of alcohol consumption. The impact of alcohol is mainly recorded on people of working and productive age. Thus, alcohol is a factor that might hinder economic development and represent an additional financial burden for the society, with consequences for health systems and criminal justice that largely outweigh the benefits of income tax on alcoholic products. Alcohol is not only a significant risk factor for non-communicable diseases (such as cancer and heart disease), but it also contributes to the spread of infectious diseases, and considerable increase in mental health problems, road accidents, injuries, violent accidents, and crimes (1). For these reasons, the National Alcohol Observatory for Italy (ONA) repeatedly expressed concern about the COVID-19 pandemic (https://www.epicentro.iss.it/alcol/epidemiologia-monitoraggio-2020) (6) and its impact on alcohol consumption. The 2020 ONA report states that the growth in the consumption of pure alcohol *per capita* between 2018 and 2019 continues to increase and has reached a level of 7 L/year (7). An increase in the number of consumers between meals, consumers at risk, and binge drinkers (i.e., those who consume large quantities of alcohol in limited periods, for example during the weekend) has been observed, too. 14.2% of men and 6.1% of women reported that they routinely consumed excess alcoholic beverages. In Italy, 6.2 M of male consumers and 2.5 M of female consumers revealed that they did not comply with the public health indications regarding the frequency, the quantity of alcohol, and the alcohol consumption of alcoholic beverages, so that currently a total of 8.7 M individuals have to be considered "at risk" in Italy.

During the Sars-CoV-2 pandemic, WHO Europe has published the document "Frequently asked questions about alcohol and Covid-19" (8) concerning the relationship between the effects of alcohol and the virus spread. The WHO emphasizes that alcohol addiction during an emergency is dangerous from two points of view. First, there is an increased likelihood of being infected by the virus and adverse health outcomes since alcohol compromises the body's immune system. Severe alcohol abuse is actually a risk factor for pneumonia and other lung infections such as the development of acute respiratory distress syndrome (ARDS), which is one of the main complications of Covid-19. Secondly, rising levels of stress, isolation, withdrawal symptoms (i.e., tremors, nausea, and cravings), combined with more difficult access to services and support groups may increase people's risks with alcohol dependence. Several studies have demonstrated the correlation between exposition to catastrophic or stressful events and addiction or increase in alcohol consumption (9–11), even if other studies do not confirm these results (12). Adams et al. (9) investigated the relationship between alcohol consumption and mental health in the context of terrorist attacks. The results showed that binge drinking is related to post-traumatic stress disorder (PTSD) syndromes, while alcohol dependence is related to PTSD, depression, somatization, anxiety, and low quality of life. The same results were confirmed by Lebeaut et al. (11) in a study carried out on firefighters. Boscarino et al. (10) studied alcohol abuse disorder in the period following the 11th September 2001 terroristic attack in New York, highlighting a remarkable aptitude for binge drinking in the immediate aftermath, as well as a long-term increase in alcohol consumption and addiction. However, these findings have been disproved by other studies [for instance, North et al. (12)] that highlighted a 22% increase in PTSD in the population that survived flood disasters, often in comorbidity with depression, but they did not detect any increase or development of dependence on alcohol or other substances. Therefore, the stress arising after a traumatic event is not likely to be the only factor influencing the state of alcohol abuse and substance addiction. For instance, Wu et al. (13) identified the high degree of exposure to a virus and isolation as significant and contributing factors to alcohol abuse and substance addiction when evaluating the data collected during the SARS epidemic emergency over 3 years. Columb et al. (14) hypothesized that another influencing factor is the existence of previous states of dependence by observing an increase in the number of people turning to the help-desks for addictions during the Sars-CoV-2 (Covid-19) emergency. Consequently, the isolation and lack of distractions created by social distancing, possibly in conjunction with increased stress, anxiety, and boredom, may lead to the development of alcohol abuse disorders or relapse into pre-existing alcohol addictions (14). A further study by the University of Padua (15) showed that 66.0% of the people answering to a diet modification questionnaire concerning the quarantine period increased the consumption of "comfort food". 42.7% of them declared that this increase was due to an increase in the anxiety level. Furthermore, it was reported that alcohol consumption decreased by 36.8% and increased by 10.1% of the tested population. It is essential to highlight that 78% of the study's statistical population was under 35 years old, and alcohol consumption preferentially occurs in the form of social drinking for the selected age range.

The present study aims to assess the impact of the Covid-19 emergency on alcohol intake and addiction for the population of North-Western Italy by monitoring ethyl glucuronide (EtG) concentration in hair as a direct biomarker of ethanol consumption. The determination of EtG in the keratin matrices has gained an increasing appreciation since it achieves the highest combination of sensitivity and specificity in the discrimination among alcohol consumers with different drinking habits (16–21). Thus, the determination of EtG in hair is nowadays widely accepted for testing and monitoring chronic excessive alcohol intake, and it is currently employed in different areas of forensic and clinical toxicology, including workplace testing, firearms, driving license re-granting, and post-mortem investigation (17, 22, 23). The data used in the present study have been collected at the Anti-doping and Toxicology Center "A. Bertinaria" of Orbassano (Torino, Italy) (24) from 2016. The hair EtG analytical results arose from samples collected from subjects who underwent medical examination within driving re-granting protocols, alcohol abuse rehabilitation programs, or workplace testing.

MATERIALS AND METHODS

Datasets

This study evaluates the Covid-19 pandemic and lockdown impacts on the population's alcohol intake in the time frame from January 2020 to May 2020 by measuring the EtG level in hair samples collected with the appropriate time-shift. The lockdown protocol started in Italy on March 8th 2020, and it finished at the end of May 2020. Considering that hair grows ∼1 cm/month and, commonly, the proximal head hair segment with a length of 3 cm is analyzed (19, 25–27), only hair samples collected from April 2020 to August 2020 were selected for this study. On average, the effect of a change in the amount of alcohol consumed is observed with a delay of about 2 months.

The hair samples were analyzed at the Anti-doping and Toxicology Center "A. Bertinaria" of Orbassano (Torino, Italy) (https://www.antidoping.piemonte.it/cms/) and refer to a population resident in Northern-Western Italy. More in detail, the selected population includes subjects aiming to regain their driving license temporarily suspended for administrative/legal sanctions, individuals under continuous monitoring due to their ongoing or past alcohol-dependence conditions, and professional workers undergoing workplace testing. No exclusion criteria were applied in the study. Although the Center's database contains reports about the EtG levels in hair that date back to 2011, we decided to assess the impact of the Covid-19 emergency on alcohol consumption by building a dataset containing the EtG values of the last 5 years only, from 2016 to 2020, because the hair sample pre-treatment procedure was modified in the analytical protocol during the Autumn 2015. As a matter of fact, the pulverization of the keratin matrix using a ball mill in place of manual cutting produced an average 38% increase of the detected EtG level (28), as a consequence of an improved extraction yield. The fundamental methodological details of hair analysis are available in published studies (28, 29). To remove the methodological change bias factor from the data, the results before 2016 were not used. The EtG values measured on the samples collected during each month were averaged (April to August, 2020) and compared with the corresponding monthly-averaged values reported in the previous 4 years (i.e., 2016–2019). This approach based on the comparison of data collected in the same month of different years was adopted because the occurrence of a seasonal variation of the average EtG values was observed in a previous study (30).

The collected dataset was split into sub-groups depending on the gender of the tested individuals and their classification into three categories, namely abstinent/low-risk drinkers, social/moderate drinkers, and chronic/excessive drinkers (21) following the Society of Hair Testing (SoHT) guidelines about the use of EtG in hair for supporting the assessment of abstinence and chronic alcohol consumption. The classification is based on the following cut-off values:

- Abstinent/low-risk drinkers (labeled as *Abs*): EtG $<$ 10 pg/mg;
- Social/moderate drinkers (labeled as *SDr*): 10 pg/mg $\leq$ EtG $<$ 30 pg/mg;
- Chronic/excessive drinkers (labeled as *Chr*): EtG $\geq$ 30 pg/mg.

The monthly-averaged EtG values (April–June) for the different years (2016–2020) were compared for the different categories of gender and alcohol consumption, to highlight the effects of the Covid-19 emergency. Since the original database reported a "lower than 10 pg/mg" output for *Abs*-labeled samples, for statistical purposes, a random value between 1 and 9 pg/mg was arbitrarily assigned to them. A comprehensive table reporting the numbers of samples involved in the study is available in the **Supplementary Table 1** with details about the number of male and female individuals in the different alcohol consumption categories.

Statistics and Data Interpretation

The first phase of data interpretation evaluated the absolute values, percentage frequencies, and percentage differences for the various categories of alcohol consumption and gender. In the second step, the variations of EtG levels for each month over the years was studied by plotting their EtG mean values, together with 95% confidence intervals and the number of individuals involved. Lastly, analysis of variance (ANOVA) (31) and Kruskal–Wallis test (32) were used to determine whether the differences found in the previous phases had statistical significance or, conversely, had to be ascribed to random statistical fluctuation in the collected data.

Statistical Tests

In ANOVA (31) and Kruskal–Wallis tests, the continuous dependent variable was the concentration of ethyl glucuronate in the keratin matrix, while the investigated factors included the individuals gender and the time of sample collection (months or years). Consequently, the levels are male/female for the gender factor and the years (2016, 2017, 2018, 2019, and 2020) or the months (April, May, June, July, and August) for the time. With this analysis, it is possible to compare different distributions or groups of data and, according to their variance, confirm the existence of dissimilar distributions, trends, or anomalous results. Assumptions involving the probability distribution of the data, their independence and absence or outliers were tested before performing ANOVA and Kruskal–Wallis tests, as follows: (i) normality was tested using QQ-plots, (ii) the homogeneity of the variance within the groups (i.e., homoscedasticity) was tested via Bartlett's test (32, 33).

Once ANOVA identified a significant statistical difference, additional evaluations involving Tukey's HSD (honestly significant difference) (32, 33) tests were performed to determine which group significantly differed from the others [thus performing a multiple comparison procedure (MCP)]. Finally, the results obtained after applying ANOVA were confirmed using the non-parametric Kruskal–Wallis test, since the available data contained many outliers for chronic/excessive drinkers (*Chr*), corresponding to very high levels of EtG (observed in both genders). The results obtained by Tukey's HSD test were verified also by the Wilcoxon–Mann–Whitney rank-sum (non-parametric) test (32).

Software

Data processing was carried out using R software (version 4.0.2) (34) and R Studio (version 1.3.959) (35). The following packages were used for various representations and statistical analysis: ggplot2 (36), gplots (37), and dplyr (38).

RESULTS

Data Structure and Summary

The total number of samples, the absolute and relative percentage frequencies were calculated for each year and month by considering the different genders and categories of alcohol consumption. **Figure 1** shows the number of analyzed hair samples for May (**Figure 1A**) and July (**Figure 1B**) 2016–2020. The stacked barplot reports the counts and the relative percentage frequencies of subjects belonging to the three categories [i.e., abstinent/low-risk drinkers (*Abs*), social/moderate drinkers (*SDr*), and chronic/excessive drinkers (*Chr*)]. The number of May 2020 samples (nr. = 992) is significantly lower (∼ −36%) than in the same month for the years 2016–2019 (nr. = ∼1,546, on average). The months of April, June, and August 2020 showed the same decreasing trend (−53, −18, and −21%, respectively), while July 2020 provided a total number of specimens quite close to the past 4 years (−9%). All the stacked barplots are available in **Supplementary Figure 1**. **Figure 1** also reports the same data in terms of relative percentages for the various classes of alcohol consumers. May 2020 (**Figure 1A**) shows a distinct increase of the *Abs* subjects (+19%) with respect to the average percentage observed in 2016–2019 (i.e., 79 vs. 60%). Accordingly, lower percentages of *SDr* (−12%) and *Chr* (−7%) individuals are observed. Similar trends are evident from April and June data. In July 2020 (**Figure 1B**), a slightly higher percentage of *Abs* (and a lower percentage of *SDr*) is still observed with respect to the previous years, while the percentage of *Chr* individuals is approximately the same. In August 2020, the percentage distribution turned back similar to the one observed in the previous 4 years.

Women represent only a small percentage (11%) of the overall dataset; approximately the same percentage was recorded for the entire period 2016–2020. The number of women providing EtG values higher than 10 pg/mg is relatively low (23% of the women, against 41% for the men), as well as the number of chronic/excessive drinkers (7% of the women, against 15% for the men). Further evaluations were made to evaluate potential bias in the sampling of the subjects under evaluation. The individuals were divided into the following three categories: (i) DRL: those seeking driver license reinstatement, (ii) TAA: those tracked for alcohol abuse, and (iii) WT: those seeking workplace testing. The frequencies and percentages of the three types of visitors were calculated for the year 2020 and then monthly-compared with 2016–2019. The results in terms of pie charts and chi-squared tests are available in the **Supplementary Figures 2A–K** and **Supplementary Table 2**.

Evaluation of Mean Values

Since the number of samples collected from women represents a small fraction of the overall dataset, no differences were made in terms of gender when plotting the mean values of EtG for the different categories of alcohol consumption, together with their 95% confidence intervals (**Figures 2**, **3**). However, a brief focus on the EtG levels of the female population will be brought into at the end of this section. The mean EtG values measured in each month of 2020 were compared with values reported in the same month during the previous 4 years (2016–2019). All the results in terms of total numbers and percentages are reported in **Supplementary Tables 1, 2**.

Figure 2 shows the mean values for EtG calculated for all the months (April–August) and years (2016–2020). A consistent decrease in the mean EtG values was recorded in the year 2020 for the months of April 2020 (**Figure 2A**), May (**Figure 2B**), and June 2020 (**Figure 2C**). In contrast, the EtG mean value for July 2020 (**Figure 2D**) and August 2020 (**Figure 2E**) show comparable results with the previous years.

When the mean EtG values were calculated only from the samples with measurable Etg levels (i.e., higher than 10 pg/mg; the specimens belonging to the *Abs* population were excluded), no significant changes were detected in the year 2020, because the population shift from upper to lower categories of alcohol consumers observed in 2020 gets undetected in single category values (see **Supplementary Figure 2**). Lastly, **Figure 3** depicts the boxplots and the mean EtG values (red circles in **Figure 3**) calculated from the samples with Etg levels exceeding 30 pg/mg (i.e., the hair specimens belonging to *Chr* populations). In this case, June 2020 (**Figure 3B**) and July 2020 (**Figure 3C**) data show a detectable increase in the mean EtG values, while April, May (**Figure 3A**), and August 2020 provided no change with respect to the previous years.

With respect to the women data showing measurable EtG levels (i.e., higher than 10 pg/mg), the combined April–June 2020 period was considered in order to put together a statistically significant population. The results reported in **Figure 4** show a peculiar increase of the mean EtG value in the 2020 hair samples

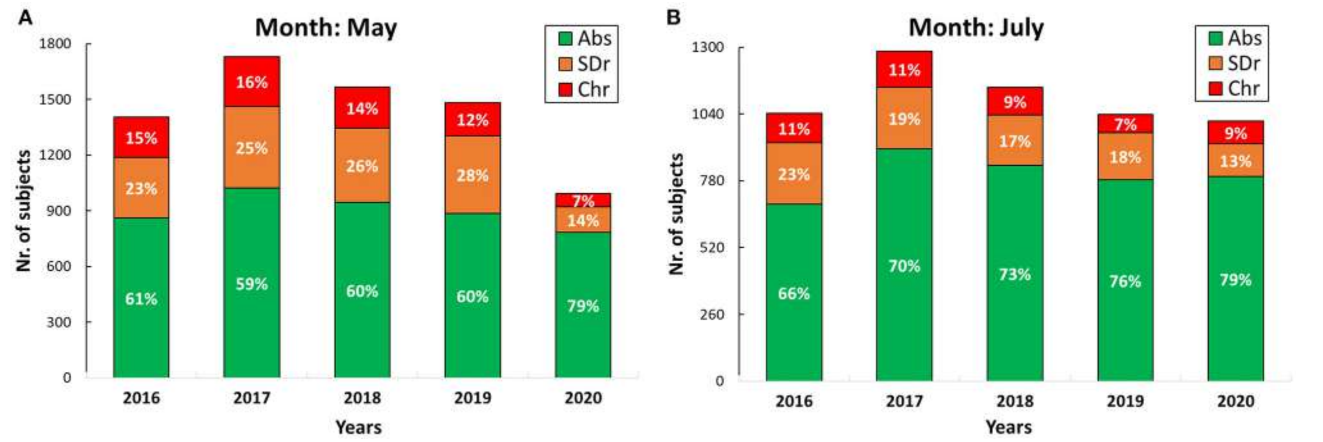

FIGURE 1 | Stacked barplots showing the number and the relative percentages of *Abs* (green), *SDr* (orange), and *Chr* (red) individuals in May **(A)** and July **(B)** 2016–2020.

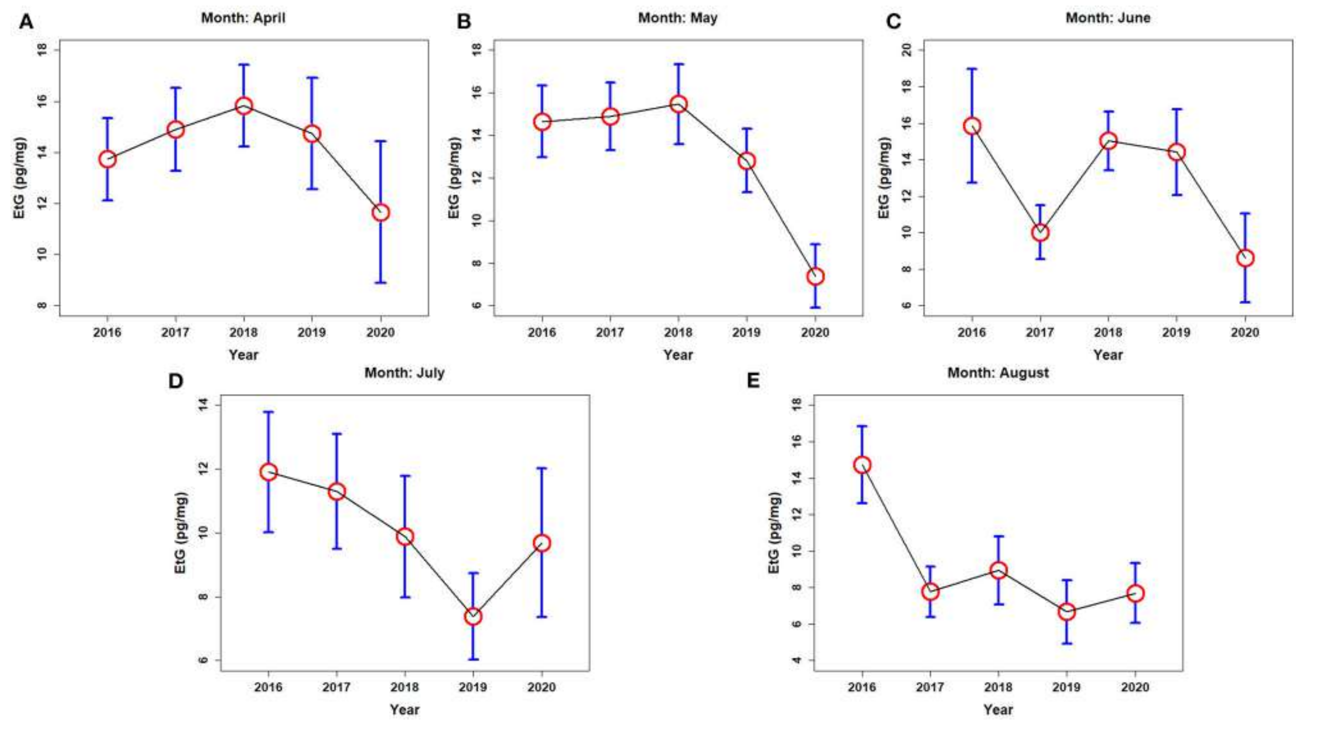

FIGURE 2 | Mean Etg values (red circles) and 95% confidence intervals (blue bars) for all the analyzed hair samples relative to the months of **(A)** April, **(B)** May, **(C)** June, **(D)** July, and **(E)** August 2016–2020.

with respect to the previous years. In contrast, the mean EtG values recorded in July and August 2020 provided results similar to the 2016–2019 time range (data not shown).

The results plotted in **Figure 2** showed wide 95% confidence intervals, especially for the 2020 data, possibly because the Covid-19 emergency reduced the total number of samples collected and simultaneously amplified the inter-individual variability of the results. For these reasons, the use of statistical significance tests turned out necessary to support the observed trends.

Significance Tests

Parametric tests including ANOVA and Tukey HSD tests were performed to verify the statistical significance of the variations observed in the EtG result distributions during the lockdown period with respect to the corresponding periods of the preceding years.

It was preliminarily checked if the EtG distributions for the different periods April–June 2016–2020 fulfilled the ANOVA application conditions: normality, independence

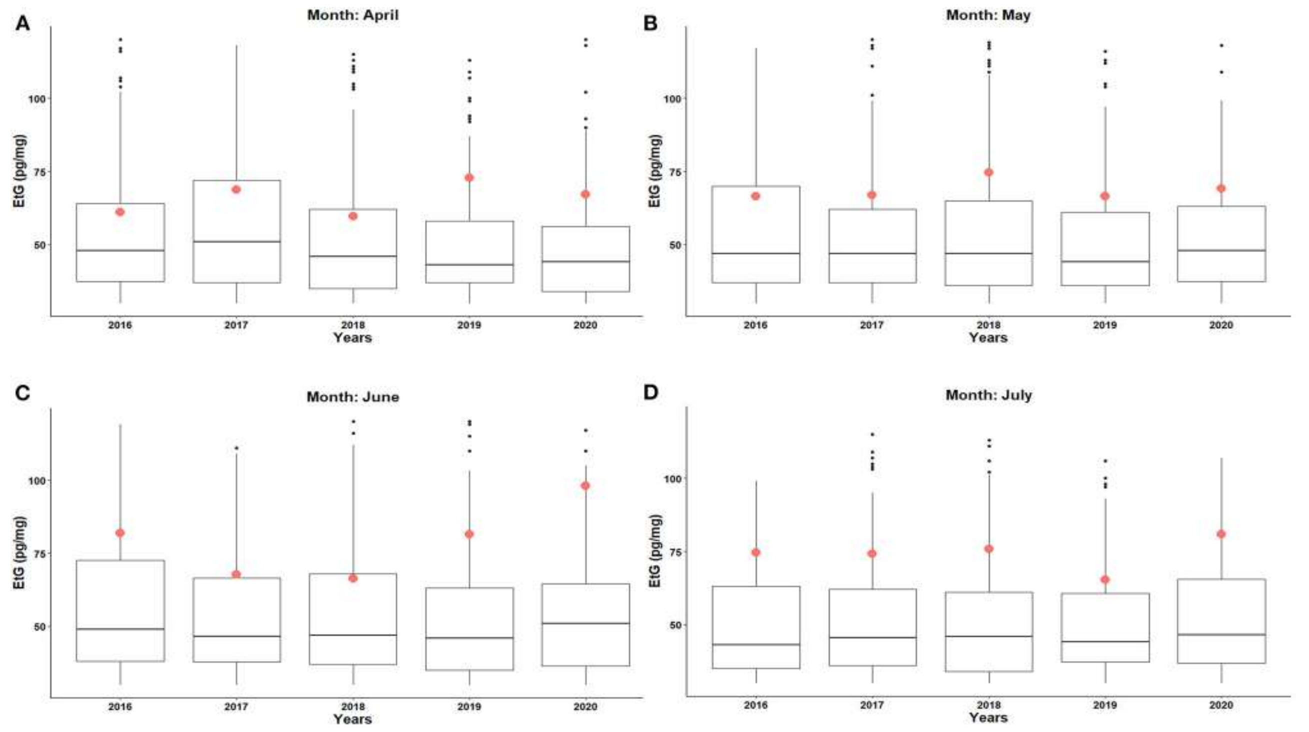

FIGURE 3 | Boxplots and mean Etg values (red circles) for the individuals showing higher EtG levels than 30 pg/mg (i.e., Chr population) concerning the months of **(A)** April, **(B)** May, **(C)** June, and **(D)** July 2016–2020. Black points are the outliers.

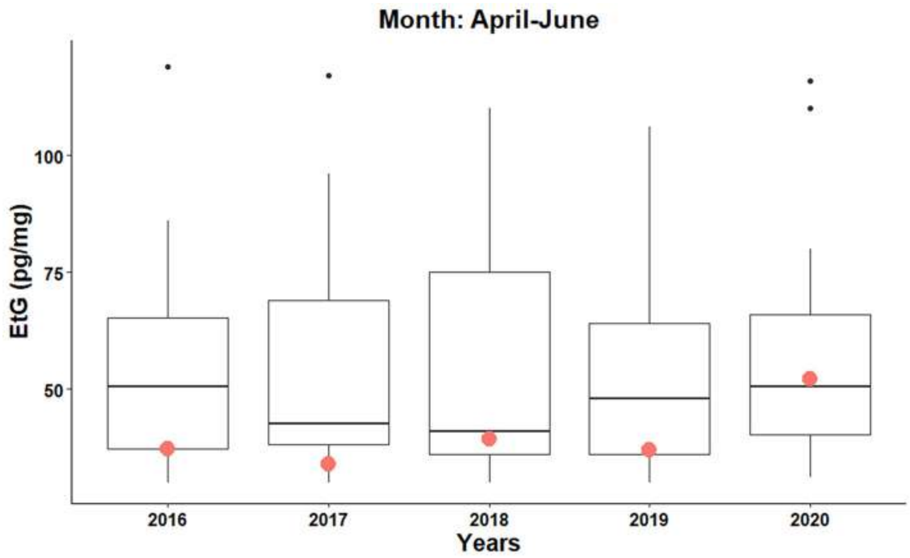

FIGURE 4 | Boxplots and mean Etg values (red circles) for the women showing EtG levels higher than 10 pg/mg in the combined period April–June 2016–2020. Black points are the outliers.

and homogeneous variance. Q–Q plots and Bartlett's test confirmed the subsistence of ANOVA applicability. The presence of scattered outliers in the data distribution, relative to samples with very high EtG values induced us to verify ANOVA and Tukey HSD results with alternative non-parametric approaches (Kruskal–Wallis and Wilcoxon–Mann–Whitney tests). The most important results are listed below:

The EtG distributions relative to May and June 2020 that included all categories of consumers (**Figure 2**) proved different, with statistically significant p-values lower than 0.05 for both the parametric (May: df = 4, $F_{calc} = 11.76$, $p = 1.61\text{e-}09$; June: df = 4, $F_{calc} = 7.74$, and $p = 3.23\text{e-}06$) and non-parametric tests (May: $df_1 = 992$, $df_2 = 6{,}186$, $W = 2{,}475{,}055$, $p = 1.70\text{e-}29$; June: $df_1 = 1{,}073$, $df_2 = 5{,}232$, $W = 2{,}362{,}794$, $p = 1.65\text{e-}22$), with respect to the corresponding month of each year along the period 2016–2019, with the only exception of June 2020 vs. June 2017. Mean EtG levels resulted significantly lower in both May and June 2020, but also in April 2020 according to non-parametric tests only.

Considering only the EtG values higher than 10 pg/mg (relative to moderate consumers and chronic/excessive drinkers; **Supplementary Figure 2**), the differences observed in the global set of data disappears or becomes not statistically significant. Only July 2020 data show increased EtG results with respect to July 2016–2019 corroborated by significant p-values (ANOVA: df = 1, $F_{calc} = 20.42$, $p = 6.39\text{e-}06$; Wilcoxon–Mann–Whitney: $df_1 = 800$, $df_2 = 3{,}683$, $W = 1{,}363{,}260$, $p = 3.13\text{e-}06$). The loss of significance observed on the upper portion of the data is somehow expected, because the fixed cut-off erases the lower tail of the distributions, leveling off the remaining results.

The limited population involved in the comparison of *Chr* subjects together with the large spread of the experimental EtG values prevent any rational application of rigorous statistical tests. On the whole, the mean EtG levels recorded on both June and July 2020 show an increasing trend in comparison with the mean EtG values recorded in 2016–2019. In detail, June 2020 data correspond to an average EtG value of 94 pg/mg, corresponding to a +27% increase with respect to the average value recorded in June for the years 2016–2019 (74 pg/mg). Similarly, the mean EtG value of July 2020 is 85 pg/mg, showing a +19% difference from July 2016 to 2019 (71 pg/mg). All the percent differences are available in **Supplementary Table 3**.

Taking into account the moderate and excessive female drinkers (**Figure 4**), Wilcoxon–Mann–Whitney test provided a significant p-value equal to 0.030 ($df_1 = 48$, $df_2 = 352$, $W = 10{,}082$) was obtained by comparing the higher EtG levels of April–June 2020 with respect to April–June 2016–2019. In this scenario, the data of April–June 2020 correspond to a mean EtG of 52 pg/mg, showing a + 40% increase with respect to April–June 2016–2019 (37 pg/mg).

DISCUSSION AND CONCLUSIONS

Several studies reported significant worsening in the behavior of people already addicted to alcohol, gambling, or drugs after the occurrence of catastrophic or stressful events (2, 9–11, 14). People who suffered from alcohol addiction before the Covid-19 pandemic might relapse into it or aggravate their harmful behavior. On the other hand, Scarmozzino and Visioli (15) described a self-reported decrease in alcohol consumption during Covid-19 lockdown; despite the self-reported results may be underestimated when dealing with alcohol consumption (39), it is plausible that this shift is related to the "social" category of drinkers, whose alcohol consumption commonly takes place outside their households.

Our results are consistent with these evaluations. The comparison of the relative frequencies along 2016–2020 showed a noteworthy increase in the number of abstinent/low-risk drinkers in April (+10.6%), May (+19.0%), and July (+15.2%) 2020. Accordingly, the number of moderate and chronic/excessive drinkers dropped, thus revealing an immediate influence on the drinking habits due to the Covid-19 lockdown of March–May 2020. Moreover, the mean EtG values showed decreasing trends in April, May, and June 2020, indicating a variation in alcohol consumption during the first months of the Covid-19 pandemic. Notably, a change in the drinking habits of the controlled population is expected to show its maximum effect after about 2–3 months, as is actually observed, due to the average rate of hair growth (1 cm/month) and the proximal 3-cm segment undergoing analysis. These results fit with the conclusions available in the literature about low-risk and social categories of drinkers (13, 40), which consume alcohol for its socializing and pleasuring effects.

The interpretation of chronic/excessive consumers showed a reduction in the number of samples and the relative percentage frequencies in 2020 and, simultaneously, a severe intra-variability of the EtG values for this category (**Supplementary Figure 3**, **Figures 3**, **4**). The chronic/excessive drinkers showed higher mean EtG values in June and July 2020 (+27 and +19%, respectively). This phenomenon is not perceived by evaluating the whole population since the overall dataset contains a large percentage of abstinent and low-risk consumers. Our results corroborate the conclusions reported in several other studies stating that emergencies and trauma may worsen the mid/long-term addiction of high-risk consumers. These people had to face their addiction in a moment of vulnerability caused by anxiety, depression, stress, social isolation, and inability to access any welfare service (12, 14).

The COVID-19 pandemic has been associated with stress-associated and post-infection dermatologic conditions, including hair loss and altered hair growth (41–43). While we can reasonably believe that most of subjects undergoing hair collection were not Covid-positive or been in contact with Covid-positive (otherwise they would have been quarantined), it is impossible to estimate if any bias related to altered hair growth occurred in our population.

Lastly, moderate and chronic/excessive female drinkers showed the highest mean EtG level when the data collected from April to June 2020 are merged. According to our data, they seemed to worsen their drinking habits during the lockdown, while the male excessive drinkers showed the highest mean EtG values in correspondence with the re-opening of bars and restaurants (i.e., June and July 2020). However, it has to be noted that female drinkers represent a small percentage of the study samples.

In conclusion, this study supports the proposition that the Covid-19 emergency and the consequent lockdown condition affected the drinking habits of the different categories of alcohol consumers in several peculiar ways. While the average alcohol intake of social consumers was observed to decrease, on the other hand the consumption from chronic/excessive drinkers showed an alarming increment. Noteworthy, the alcoholic drinks were largely accessible during the lockdown, since supermarkets and liquor stores remained open, and delivering from on-line stores was always possible. On the other hand, bar and restaurants were shut down, thus significantly limiting the opportunities for "social drinking" (44). The cogency of hair EtG as a biomarker for monitoring and retrospective analysis of average alcohol consumption has been proved once again, particularly when large population datasets are available. Future developments of this study will be addressed to the monitoring of the second surge of the Covid-19 infection and particularly concern the long-term influence of the Covid-19 emergency on alcohol addicted patients.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

EA: data elaboration and manuscript draft. LV: experimental and data elaboration. TL: sample analyses. AS: rationale and manuscript draft. MV: manuscript supervision. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.632519/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

MINI REVIEW
published: 16 April 2021
doi: 10.3389/fpsyt.2021.653674

Substance Use Disorders and Behavioral Addictions During the COVID-19 Pandemic and COVID-19-Related Restrictions

Nicole M. Avena[1,2]*, *Julia Simkus*[2], *Anne Lewandowski*[3], *Mark S. Gold*[4] and *Marc N. Potenza*[5,6,7,8]

[1] Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2] Princeton University, Department of Psychology, Princeton, NJ, United States, [3] Columbia College, Columbia University, New York, NY, United States, [4] Department of Psychiatry and National Council, School of Medicine, Institute for Public Health, Washington University in St Louis, Missouri, TX, United States, [5] Department of Psychiatry and the Child Study Center, Yale School of Medicine, New Haven, CT, United States, [6] Connecticut Council on Problem Gambling, Wethersfield, CT, United States, [7] Connecticut Mental Health Center, New Haven, CT, United States, [8] Department of Neuroscience, Yale University, New Haven, CT, United States

OPEN ACCESS

Edited by:
Giuseppe Bersani, Sapienza University of Rome, Italy

Reviewed by:
Ruben David Baler, National Institutes of Health (NIH), United States
Domenico De Berardis, Azienda Usl Teramo, Italy

***Correspondence:**
Nicole M. Avena
nicole.avena@mssm.edu

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 15 January 2021
Accepted: 11 March 2021
Published: 16 April 2021

Citation:
Avena NM, Simkus J, Lewandowski A, Gold MS and Potenza MN (2021) Substance Use Disorders and Behavioral Addictions During the COVID-19 Pandemic and COVID-19-Related Restrictions. Front. Psychiatry 12:653674. doi: 10.3389/fpsyt.2021.653674

COVID-19 was first identified in Wuhan, China in December of 2019 and appeared in the United States 1 month later. Between the onset of the pandemic and January 13, 2021, over 92 million people have tested positive for the virus and over 1.9 million people have died globally. Virtually every country in the world has been impacted by this virus. Beginning in March 2020, many U.S. state governments enforced a "quarantine" to respond to the growing health crisis. Citizens were required to remain at home; schools, restaurants, and non-essential businesses were forced to close, and large gatherings were prohibited. Americans' lives were transformed in a span of days as daily routines were interrupted and people were shuttered indoors. Mounting fear and unpredictability coupled with widespread unemployment and social isolation escalated anxiety and impacted the mental health of millions across the globe. Most (53%) U.S. adults reported that the coronavirus outbreak has had a negative impact on their mental health, including inducing or exacerbating use of alcohol, drugs, gambling and overeating as coping mechanisms. In this paper, we will examine substance use and addictive behaviors that have been used to manage the stress and uncertainty wrought by the COVID-19 pandemic. We review the changing treatment landscape as therapy pivoted online and telemedicine became the norm.

Keywords: COVID-19 pandemic, food addiction, gambling, mental health services, substance-related disorders, addictive behaviors

INTRODUCTION

COVID-19 appeared on January 15th, 2020 in the United States as a novel coronavirus about which scientists and doctors knew very little (1). In efforts to mitigate the spread of the virus and not tax healthcare resources, a "quarantine" began in March. Most state governments imposed stay-at home orders, requiring schools, restaurants, and non-essential businesses to close, forbidding large gatherings, prohibiting travel and enforcing spatial distancing. Nationwide restrictions did not start to ease until May, and as of this writing, many of these restrictions remain in place in certain regions of the country (2).

The COVID-19 pandemic and subsequent quarantine and lockdown restrictions have negatively impacted virtually every segment of the U.S. population. The healthcare system has been strained due to mounting COVID-19 cases[1]. Hospitals have suffered economic losses from reductions in elective procedures, limitations on routine medical services and the high cost of personal protective equipment (PPE) (3). Individually, people were faced seemingly overnight with fears over contracting this virus with unknown outcomes, altered life responsibilities including juggling home-schooling of children, worries about the health of their families and friends, and, in some cases, experiences of food insecurity, isolation and job loss.

It is important to note, while COVID-19 has often been referred to as a pandemic, and it is from a purely scientific standpoint, the term syndemic, coined first by anthropologist Merrill Singer in the 1990s has been used to describe this outbreak as well. The specificity of a syndemic is that it involves biological and social interactions and takes into account socioeconomic disparities that cause certain communities to be more heavily affected by the virus than others. These communities usually lack access to healthcare and tend to be low-income communities. They often have higher occurrences of comorbidities that make them more susceptible to the novel coronavirus. It is important to take this social aspect into account when tallying the effects of COVID-19 on the US population (4).

One of these tragic effects is the impact COVID-19 has had on the mental health of millions of Americans. Many individuals were already experiencing depression and anxiety "pre-pandemic," with an estimated 9.5 percent of Americans utilizing mental health services in 2019. The pandemic likely exacerbated these conditions. Studies of the psychological impacts of quarantines during the SARS (severe acute respiratory syndrome) (2003) and Ebola (2014) epidemics demonstrated that individuals under government-imposed quarantines exhibited greater psychological distress (5), including higher levels of depression, stress, irritability, fear, exhaustion and insomnia (6). According to a study that assessed the psychological effects of quarantine measures in response to the SARS epidemic in Toronto, 31.2% of participants exhibited signs of depression and 28.9% exhibited signs of posttraumatic stress disorder. The study also showed that family and friends connected to infected individuals experienced heightened feelings of distress and depression (7). SARS was considered a serious epidemic that infected over 8,000 people worldwide and took 774 lives (8). In comparison, there have been over 22 million COVID-19 cases and over 379,000 deaths in the United States alone (9). It is also important to note, while not the main focus of this article, there has been evidence that shows that SARS-CoV2 can actually disrupt the central nervous system and create "acquired vulnerability" which can make an individual who is recovering from the virus more susceptible to developing psychiatric conditions after they have had COVID-19 (10). This is another element to consider when cataloging the impacts of COVID-19 on mental health.

When people experience increased psychological distress, they may rely on maladaptive coping mechanisms, including using alcohol and drugs, gambling and overeating. Over half of U.S. adults reported that the coronavirus outbreak has had a negative impact on their mental health. Of those adults, 12% reported an increase in alcohol or drug use (11). Gambling has also increased considerably between March and August of 2020 with Global Poker, a gambling research firm, reporting a 43% growth in the poker industry (12). Along with drugs, alcohol and gambling, Americans have turned to food to alleviate stress. A WebMD poll in May 2020 reported that 44% of women and 22% of men had already experienced weight gain just 2 months into government-imposed shutdowns. The "Quarantine 15" and #quarantineweightgain have been trending on social media since the early days of the pandemic (13).

This article will address the various ways in which the past months' quarantine has impacted the mental health of many and led to detrimental behaviors including substance, gambling and food addictions. Although others have already written about the challenges (and opportunities) emerging from these interacting phenomena (14–17), this article will add to this discussion and also address how access to treatment for mental health has changed in this new, more virtual world. The research for this publication was conducted using PubMed (Medline) and United States government resources. The keywords used to find the sources that are cited include: COVID-19, lockdown, substance use disorder, alcohol use disorder, food addiction, mental health, depression.

SUBSTANCE USE BEHAVIORS AND DISORDERS

Pandemic-related stress, anxiety and isolation, in addition to disrupted treatment and recovery programs, can increase the likelihood of substance misuse, addiction and relapse. Unemployment tends to contribute to increased spikes in substance abuse (18). As of May 2020, 39% of Americans lost their jobs or had their work hours curtailed due to the pandemic (19). The stress of financial uncertainty along with an increase in free time and the absence of employment repercussions can lead people to seek ongoing solace from illicit drugs. Data from the first quarter of 2020 demonstrate the effects of COVID-19 on substance abuse among Americans. From January to March of 2020, 19,146 people died from drug overdoses, compared to 16,682 people in the same quarter of 2019. The CDC estimated a record number of US drug-related deaths in 2020 (20).

A survey of 1,079 individuals with substance use disorders (SUDs) and SUD-impacted individuals was conducted by the Addiction Policy Forum (21). This study, which examined the impact of COVID-19 on individuals with SUDs, found that 74% of respondents said they had noticed changes in their emotions since the pandemic began (21). Twenty percent of respondents reported an increase in substance use, and 1% reported being impacted by experiencing a fatal overdose since

[1]Worldometer. *Coronavirus Cases*. (2021). Available online at: https://www.worldometers.info/coronavirus/ (accessed January 13, 2021).

the onset of the pandemic (21). Close to 5% (4.2%) of respondents reported an overdose. Other challenges that were identified included COVID-19 impacting treatment services and difficulties accessing specific services like naloxone and needle exchanges (22). The Addiction Policy Forum cited some perspectives from individuals in recovery or those with an active SUD. Some examples include: "During the last months I have felt more at risk of relapse than I ever have," and "I have never felt true depression like I have in the past month. I know alcohol makes it worse, but I feel like I just want to make it through this time by staying comfortably numb" (21).

To make matters worse, seeking treatment for SUDs during quarantine has been extremely difficult for many. In-person treatment for opioid use disorder (OUD) and other SUDs has been offered virtually, but many who need these services do not have regular access to a computer or the internet. Unfortunately, the amount of attention healthcare providers can give to those in recovery, especially in the first few months of the pandemic, has been severely limited by the demand of attending to COVID-19 patients. PPE and hospital space are often difficult to spare for anyone not gravely ill with the virus (23).

ALCOHOL USE

Amid isolation, financial difficulties and lockdowns, many have turned to alcohol to cope with anxiety and uncertainties during the pandemic. There are positive correlations between exposure to stress and alcohol and SUDs. For example, in the months following the September 11 terrorist attacks, around 30% of surveyed New York City residents reported significant increases in their consumption of cigarettes, alcohol or marijuana (24). Although bars, restaurants, and liquor stores were closed at the peak of the pandemic in March and April, studies reveal a 54% increase in national sales of alcohol during the week ending March 15, compared to this same week 1 year prior, with online alcohol sales increasing 234%. Consumers are ordering alcohol in bulk to limit their purchase frequency and buying mostly brands that they trust, increasing the number of favorable alcoholic beverages in people's households (25). While working from home, people may have access to alcohol during all hours of the day, which may contribute to drinking in the morning or during lunch breaks. One study reported that on average, alcohol was consumed 1 more day per month by 75% of adults. The frequency of alcohol consumption among adults in this study increased by 14% from 2019 to 2020 (26). Heavy-drinking episodes increased by 41% in women since the COVID-19 lockdown (27). Additionally, many states have changed their policies on carry-out purchases of liquor to help restaurants cope with the impact on restaurant business during the pandemic. According to the New York State Liquor Authority, as of March 16th 2020, businesses that sold alcoholic beverages on premise were allowed to begin selling for off-premise consumption as long as the beverages were in closed containers (28).

While many people turn to alcohol to relieve their stress and worries, the relief is typically only temporary. Instead, alcohol generally increases the symptoms of anxiety and depression, often leading to binge drinking. Those who use alcohol as a coping mechanism are more likely to develop SUDs (29). Alcohol can have serious neurological impacts, especially when used heavily and for prolonged periods of time. Alcohol interacts with several neurotransmitter receptor sites in the brain including GABA, glutamate and dopamine. Alcohol temporarily stimulates brain reward regions thus promoting drinking, but over time alcohol tends to act as a depressant (30). A common result of long-term alcohol use is the development or exacerbation of depression (31).

FAMILY STRESS

The stress of the pandemic is taking a particular toll on parents with children at home. By the middle of March 2020, public and private elementary and secondary schools closed across the country and students were forced to transition to online learning. An August 2020 report by the U.S. Census Bureau stated that nearly 93% of households with school-age children reported some form of distance learning during the pandemic (32). Parents were often forced to facilitate online learning throughout the school day while juggling their own employment and attending to basic household needs. Over 70% of parents reported that managing distance learning for their children during the pandemic was a significant source of stress (33).

The American Psychological Association surveyed 3,000 adults between April 24 and May 4, 2020. The survey showed that the average stress level reported by parents of children under 18 was 6.7 out of 10 compared with 5.5 out of 10 for adults with no children living at home. Additionally, 46% of adults with children under 18 stated that their stress level was "high" (between 8 and 10) compared with 28% of adults without children reporting the same level of stress (33).

GAMING AND GAMBLING

Physical distancing, lockdowns and self-quarantines amid the coronavirus outbreak have been associated with increases in online gaming and gambling, which in turn have placed people at risk for gaming and gambling disorders. In addition, financial difficulties and unemployment may encourage gambling as people are encouraged to gamble to win money. Global Poker reported that the number of first-time online poker players increased by 255% since stay-at-home orders began (12).

College students may be particularly vulnerable to stress during the pandemic due to changes in their social lives, uncertainties regarding career prospects and shifts to online learning. In a study involving about 400 college students, 50.8% reported that their gaming had increased during the COVID-19 lockdown (34). These students acknowledged that gaming helped manage their stress related to the pandemic. General and specific practices to promote healthy gaming and internet use more generally have been suggested (35).

FOOD ADDICTION

The term "freshman 15" is an expression that refers to the arbitrary weight that a student gains during his/her first year of college. Since the onset of the pandemic, the term "quarantine 15" has been used to refer to a 15-pound weight gain during self-isolation. Eating as a result of stress, specifically the stress during the outbreak of an infectious disease, is not uncommon among Americans (37). According to a 2013 study conducted by the American Psychological Association, 38% of adults reported overeating or eating more unhealthy foods due to stress, with 33% of these adults saying they do so because it helps distract them (36). Emotional eating tends to occur because when people are stressed, the stress hormone cortisol increases, which in turn, increases our appetite and motivations to eat (38). Eating may serve as a distraction or respite from pandemic isolation. Some highly palatable foods may trigger an addictive-like process in some individuals, activating reward-processing brain regions like drugs of abuse. Parallels exist between clinical and behavioral features of binge eating and substance use disorders (39, 40). Similar to how individuals become dependent on drugs or alcohol to manage depression and anxiety, the reliance on highly palatable foods for comfort and stress reduction may be considered as aspects of a "food addiction" (39, 41). Food addictions or eating disorders may include abnormal eating behaviors, such as excessive food intake or restriction and binging and purging, to cope with one's negative emotions. The National Eating Disorders Association reported a 78 percent increase in calls to their hotline and online chats in March and April this year compared to the same period in 2019 (42).

Among 602 Italians surveyed online between April and May 2020, almost half reported feeling anxious due to their eating habits and admitted to increasing their consumption of comfort foods to feel better. In addition, 86% of respondents reported that they felt unable to sufficiently control their diet (43). While emotional eating is not necessarily considered disordered, these habits may become problematic and unhealthy if one is routinely turning to food to manage stress and anxiety.

HOW THE PANDEMIC HAS CHANGED THE TREATMENT LANDSCAPE

For individuals with SUDs, the COVID-19 pandemic has resulted in changes in treatment including access to therapy, physician availability and adjustments to medication schedules. Moreover, fears associated with contracting the virus combined with rigid screening of patients resulted in a sharp decrease in psychiatric emergency room visits early in the pandemic (44). Inpatients traditionally shared bedrooms and common spaces. COVID-19 has put this system in jeopardy and strict admission criteria – including vigorous COVID-19 testing – has in part led to a reduced number of voluntary admissions to psychiatric facilities (45). Disruptions in treatment and difficulties obtaining treatment have intensified emotional distress associated with the pandemic. On March 17, 2020, the US federal government waived regulations pertaining to telemedicine and loosened restrictions to enable physicians to cross state lines for treatment (46). The last week of March saw a 154% increase in telehealth visits compared to the same period in 2019 (47). While these unprecedented changes arguably increased access to treatment for many individuals, even slight adjustments to traditional mental health care can be traumatizing and magnify the risk for an exacerbation or a recurrence of symptoms (48).

Relative to in-person treatment, online therapy may result in poorer communication and lower quality for some. Online therapy is often not ideal for people who are homeless, lack regular cell phone access or work outside of the home. Individuals in recovery may be enduring particular hardships as support group meetings such as Alcoholics Anonymous are being held virtually instead of in-person (21). Data from communication science and telemedicine group therapy show that online recovery and support services are not as beneficial as in-person services (48). A survey by the Addiction Policy Forum on 1,079 individuals with or impacted by SUDs was conducted between April 27 and May 8. The findings revealed that 34% of respondents reported changes or disruptions in their treatment or recovery support services since the onset of the COVID-19 pandemic, with 14% reporting that they have been unable to receive their needed services (21). Individuals with poly-substance use may have been particularly impacted (49). Other drawbacks of online recovery-related services include the absence of in-person activities, a lack of peer-to-peer social and emotional connections, and online distractions interfering with patients' engagement (48).

Arguably, there have been advantages to switching to online therapy. According to the American Psychological Association, online therapy can be more accessible to people living in areas where psychologists and psychiatrists are scarce (50). Teletherapy can provide more flexibility for people who previously found it difficult to visit an office, a greater sense of anonymity than in-person services, and 24/7 access to social support (48). In addition, research by Simpson and Reid (2014) discussing the therapeutic alliance in videoconference psychotherapy suggests that the relationship between therapist and patient is generally as good for telemedicine as it is for in-person therapy (48). Teletherapy may be more flexible for people who previously found it difficult to visit an office (50). A recent study found evidence that supports the importance of teletherapy by documenting the changes in mental health of a sample demographic after the beginning of the pandemic. The results from this study concluded that there was an increase in stress, fear, and other states of poor mental well-being that began after quarantine in March 2020. The fact that a survey of this type was able to be conducted in a fully virtual format bodes well for the future of telemedicine during and after the pandemic (51). In short, mental health treatment has been significantly altered by the COVID-19 pandemic, and while online therapy may present some drawbacks, new opportunities also exist.

While the COVID-19 pandemic has negatively impacted essentially every corner of the U.S. population, there is a distinctly disproportionate effect on disadvantaged, vulnerable populations. Reports from state and city health departments have revealed that Black, Latinx, and Native Americans

TABLE 1 | Highlights and relevant sources.

Substance use disorders	Coping mechanisms, increased stress, predispositions: https://www.drugabuse.gov/publications/drugfacts/treatment-approaches-drug-addiction, https://www.niaaa.nih.gov/publications/brochures-and-fact-sheets/treatment-alcohol-problems-finding-and-getting-help
Disordered eating	Dealing with emotional eating, food addiction, and other forms of disordered eating: https://www.nationaleatingdisorders.org/where-do-i-start-0
Gambling	Financial struggles, willingness to take risks, boredom, online access: https://americanaddictioncenters.org/gambling-addiction
Depression	Isolation, too much worrying, world crises: https://www.psychiatry.org/patients-families/depression
Expansion of telehealth	Increased access, more flexibility, remoteness: https://www.apa.org/monitor/2017/02/online-therapy

test positive for and die of COVID-19 at a higher rate than other racial and ethnic groups. For example, while black Americans represent only 13% of the U.S. population, about 30% of all COVID-19 cases occurred in this racial group. Or, Latinx Americans, who constitute 18% of the U.S. population, accounted for 34% of total COVID-19 cases (52).

The unequal access to health care, greater dependency on low-wage or hourly paid employment, heightened psychological distress, and less access to treatment among racial minorities in the United States became undoubtedly evident this past year. There were noticeable racial and ethnic disparities in outpatient visits for substance use disorders during the surge of COVID-19. In Massachusetts, for example, a state with an early and considerable COVID-19 outbreak, outpatient visits for mental health and/or substance use disorders decreased by Hispanics (−33.0%) and non-Hispanic Blacks (−24.6%) while visits by non-Hispanic Whites increased by 10.5%. This decrease in mental health and/or substance use disorder visits among certain ethnic minority groups is likely due to lower access to employer-sponsored commercial insurance as well as a lack of access to digital technology (53).

CONCLUSIONS

Nationwide closures and reduced mental health services have been detrimental to peoples, well-being. Many individuals will encounter repercussions from the COVID-19 pandemic for years to come. The U.S. will need to reevaluate how mental health treatment is provided during these times and when faced with future crises. The COVID-19 pandemic has demonstrated that many Americans may turn to maladaptive coping mechanisms when faced with significant disruptions to their daily lives. Future research should focus on creating adequate delivery of mental health resources and implementing strategies and methods to respond better when other crises occur (**Table 1**).

AUTHOR CONTRIBUTIONS

NA: drafted outline and sections of the paper and edited paper. JS: collected research and drafted sections of the paper and edited paper. AL: collected research and drafted sections of the paper. MG: drafted and edited sections of paper. MP: drafted and edited sections of paper. All authors contributed to the article and approved the submitted version.

FUNDING

MP was supported by the Connecticut Council on Problem Gambling. Beyond funding, the funding agencies had no further role in the writing of the report or in the decision to submit the paper for publication.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 21 April 2021
doi: 10.3389/fpsyt.2021.599859

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Is Watching TV Series an Adaptive Coping Strategy During the COVID-19 Pandemic? Insights From an Italian Community Sample

Valentina Boursier[1*], *Alessandro Musetti*[2], *Francesca Gioia*[1], *Maèva Flayelle*[3], *Joël Billieux*[3] and *Adriano Schimmenti*[4]

[1] Department of Humanities, University of Naples Federico II, Naples, Italy, [2] Department of Humanities, Social Sciences and Cultural Industries, University of Parma, Parma, Italy, [3] Institute of Psychology, Faculty of Social and Political Sciences, University of Lausanne, Lausanne, Switzerland, [4] Faculty of Human and Society Sciences, Kore University of Enna, Enna, Italy

OPEN ACCESS

Edited by:
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***Correspondence:**
Valentina Boursier
valentina.boursier@unina.it

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *28 August 2020*
Accepted: *29 March 2021*
Published: *21 April 2021*

Citation:
Boursier V, Musetti A, Gioia F, Flayelle M, Billieux J and Schimmenti A (2021) Is Watching TV Series an Adaptive Coping Strategy During the COVID-19 Pandemic? Insights From an Italian Community Sample. Front. Psychiatry 12:599859. doi: 10.3389/fpsyt.2021.599859

Social distancing and lockdown due to the COVID-19 pandemic substantially impacted individuals' daily habits and well-being. Within such a context, digital technology may provide a welcome source of alternative forms of connection and entertainment. Indeed, streaming services showed a remarkable increase in membership subscriptions throughout the period considered. However, excessive involvement in watching TV series has recently become a subject of scholarly concern as it may represent an emerging form of addictive behavior with the features of what has been labeled as "binge-watching" (i.e., watching multiple episodes of TV series in a single session). The current study aimed to assess TV series watching behaviors and related motivations, as well as their relationships with depression, stress and anxiety, in a sample of Italian adults during the COVID-19 lockdown. Specifically, we aimed to explore which patterns of motivations and emotional states influenced either a high but healthy engagement in watching TV series, or promoted problematic and uncontrolled watching behavior under such circumstances. A total of 715 adults ($M = 31.70$, $SD = 10.81$; 71.5% female) from all over Italy were recruited (from 1st to 30th April 2020) through advertisements *via* social media platforms of Italian university communities and other online groups. Two multiple hierarchical regression analyses were performed with non-problematic and problematic TV series watching set as dependent variables. Results showed that people spent more time watching TV series during the pandemic lockdown, especially women who also reported higher levels of anxiety and stress than men. Moreover, both non-problematic ($R^2 = 0.56$; $p < 0.001$) and problematic ($R^2 = 0.33$; $p < 0.001$) TV series watching behaviors were equally induced by anxiety symptoms and escapism motivation, thereby suggesting that watching TV series during the COVID-19 lockdown probably served as a recovery strategy to face such a stressful situation. Finally, our findings also suggest that enrichment motives may protect from uncontrolled and potentially addictive watching behaviors. These findings, therefore, hold important implications, particularly for avoiding the over-pathologization of excessive involvement in online activities emerging as a result of specific distressing situations.

Keywords: anxiety, binge-watching, watching TV series motives, COVID-19, coping strategies

INTRODUCTION

The recent COVID-19 pandemic has caused worldwide derangement. Governments imposed lockdown and measures of social distancing, ruling restrictions that highly affected individuals' daily routine and impacted on people's behaviors and psychological well-being (1–5). A wide body of international literature has thus investigated how the outbreak emergency has affected mental health (2, 6–10), forcing individuals to cope with uncertainty, fears, isolation and feelings of stress, anxiety and depression (3, 11, 12). A recent meta-analytic study indeed provided evidence of increased rates of depression (24%), anxiety (26%), post-traumatic stress symptoms (15%), and poor sleep quality (34%) in the general population following the Covid-19 outbreak (13). More specifically, Italy was the first European country to face the pandemic emergency, and recent studies involving Italian samples suggested that lonely as well as depressive individuals have been more likely to perceive the COVID-19 outbreak and related containment measures as distressful (14–17).

Notably, the use of digital technology has been recommended, as it provides alternative forms of connection and entertainment in an unprecedented period of social distancing and lockdown even though the effects of social media consumption in this specific circumstance need to be carefully addressed (18, 19), as recently showed (14, 20). From the 1st weeks of pandemic, media companies reported an exponential growth in media consumption by different types of users among generations, especially highlighting an increasing search for updated information among young and middle-aged individuals (21). More particularly, streaming service trends revealed a definite impact of COVID-19 quarantining with a sharp increase in membership subscriptions—for example, a 104% increase in Netflix subscribers and 633% in Disney Plus subscribers were observed between January and April 2020 at the worldwide level (22, 23). As regards Italy specifically, since March 2020, Netflix and the newcomer Disney Plus have recorded an increase of accesses of 332 and 290%, respectively (24).

Over the last decade, the concept of watching television has undergone a transition. Video-on-demand (VoD) services (e.g., Netflix, Amazon Prime, Rakuten) revolutionized viewing practices impacting on consumers' engagement (25). Indeed, these online streaming platforms offer permanently available programs (26), which implies that, unlike traditional TV viewers, VoD subscribers can watch TV series at their own convenience [i.e., *what, when, where* and *how* they want; (27)]. In this regard, watching multiple episodes of a TV series all in one go has become a very popular viewing pattern (28–30). Consequently, the implications of these changes in viewing practices are increasingly fueling the scientific debate (31–37) on the potential harmfulness of what has been labeled "binge-watching" (i.e., watching multiple episodes of TV series in a single session).

Binge-watching became better known in 2013, when the Oxford Dictionaries placed it in the Word of the Year shortlist (38). Rapidly, binge-watching has become a daily and widespread habit among TV series viewers as a part of a trend (27) reflecting a taste for immediate gratification (39) and/or a social tool to share opinions with friends, thereby reinforcing a sense of belongingness (40).

Previous research assessing binge-watching behaviors highlighted higher engagement among women (33, 41, 42) and young people (27, 43, 44). Moreover, scholars analyzed the relationships between psychopathological symptoms and binge-watching behaviors, pointing out a positive association between binge-watching and depression (27, 45) as well as anxiety (46). Thus, individuals experiencing negative affect and emotions might be more prone to engage in problematic binge-watching as a coping strategy (33, 47, 48). However, it was recently proposed that binge-watching induced by escapist motivations (i.e., motives related to coping with adverse life events or negative affect by immersing oneself in a TV series) can paradoxically contribute to recovery from stress (49).

In this regard, excessive involvement in watching TV series has recently become a matter of concern, leading scholars to debate on the differences between what reflects a non-problematic recreational activity (a healthy engagement or a "passion") and what constitutes an excessive and uncontrolled form of behavior associated with negative consequences, functional impairment, and distress (34, 36, 47). Initial evidence indeed suggests that binge-watching may represent an emerging addictive behavior (50–52), which is reflected in individuals' loss of control over watching time (31, 50, 52, 53), impairment of day-to-day functioning (53), sleep quality (54, 55), and social relationships (53, 56).

Undoubtedly, the functionally impairing nature of the engagement has been evidenced as a critical dimension when considering problematic involvement in a specific behavior (57–59), and a key element that prevents from the risk of over-pathologizing everyday life activities (60). In this regard, particular attention should be paid to the motivations underlying binge-watching and its potential consequences (44, 48). Indeed, previous studies stated a wide range of motivations for engaging in watching TV series [e.g., social interaction, relaxation, escapism from reality, coping with stressful circumstances; (32, 42, 44, 47, 49, 61)]. Accordingly, relationships between various motives for watching TV series and unproblematic/problematic viewing behaviors (i.e., different levels of engagement or loss of control in binge-watching) is a key issue which needs to be considered (32). More specifically, individuals' engagement in watching TV series during the current pandemic deserves particular attention, as different motivations related to different levels of involvement in such activity might reflect adaptive or maladaptive responses to this unprecedented context.

The current study thus aimed to assess TV series viewing behaviors and related motivations, as well as their relationships with depression, stress and anxiety in a sample of Italian adults during the COVID-19 lockdown. Within this context, our particular aim was to explore which patterns of motivations and emotional states specifically influenced either a high but healthy involvement in watching TV series, or promoted a problematic and uncontrolled viewing behavior.

We not only hypothesized that psychopathological symptoms would affect TV series watching behaviors, but also that viewing motivations would particularly discriminate between healthy and problematic involvement in this activity. In particular, we predicted that coping/escapism motive could be related to both healthy and problematic involvement, whereas differences could be found concerning other motivations to watch TV series, such as those related to emotional enhancement, personal enrichment, and the fostering of social connection.

METHODS

Participants and Procedure

A cross-sectional design was adopted during the COVID-19 pandemic emergency, covering the lockdown period in Italy that was declared on 9th March and was implemented across the entire country till 3rd May. A total of 715 adults from all over Italy participated in this study through an online survey system. Participants ranged in age from 18 to 72 ($M = 31.70$, $SD = 10.81$) and 71.5% of the sample were female ($n = 511$). Participants were recruited (from 1st to 30th April 2020) through advertisements in Italian university Web communities and other online groups (*via* social media platforms), which asked for dissemination among their members. There were no specific inclusion criteria, except being of legal age which, according to Italian law, is 18 years of age. The call for participation in the online study contained a website link for participants to click on to complete the questionnaire. Participation was voluntary, and confidentiality and anonymity were ensured. No course credits or remunerative rewards were given. Before filling out the survey, all of the participants were informed about the research aims and its scope, and the measures to be used in generating the data. The participants could withdraw from the study at any time. There were no missing responses because all of the questions were set as mandatory. The current study was approved by the University Federico II (Naples, Italy) Research Ethics Committee and was conducted according to the ethical guidelines for psychological research established by the Italian Psychological Association (AIP). Additional scales assessing individuals' social media use during the COVID-19 pandemic were also administered to this sample. Further findings of this broader research that are not directly relevant for the current study have been discussed elsewhere (14).

Measures

Sociodemographic Information and Time Spent Watching TV Series

In this section, information was collected about gender, age, number of family members at home during the COVID-19 lockdown, and hours spent watching TV series per day before and during forced isolation due to COVID-19. A Δ score was calculated to reflect the difference between hours spent watching TV series during and before the COVID-19 lockdown.

Watching TV Series Engagement and Loss of Control

The extent of TV series watching involvement and problematic binge-watching was assessed using the Italian version of the 40-item Binge-Watching Engagement and Symptoms Questionnaire [BWESQ – (32); Italian version by (62)]. Relevant to the present research, only two subscales of the questionnaire were used in this study as reflecting adaptive vs. maladaptive TV series watching: *engagement* (e.g., "Watching TV series is one of my favorite hobbies.") and *loss of control* (e.g., "I sometimes try not to spend so much time watching TV series, but I fail every time."). Items are scored on a 4-point Likert scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher average score on each subscale indicates greater involvement or problematic binge-watching, respectively. The Cronbach's α values obtained in this study were 0.87 (*engagement*) and 0.82 (*loss of control*).

Psychopathological Symptoms

The Depression Anxiety Stress Scale [DASS-21 – (63); Italian version by (64)] was used to measure psychopathological symptoms. The DASS-21 is a 21-item self-report tool using a 4-point Likert scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*), assessing depressive symptoms (e.g., "In the last 7 days, I felt no positive feelings"), anxiety symptoms (e.g., "In the last 7 days, I have had problems breathing"), and stress (e.g., "I found it hard to wind down"). Higher scores correspond to greater severity of psychopathological symptoms. The Cronbach's α values in this study were 0.90 (*depression*), 0.86 (*anxiety*), and 0.90 (*stress*).

Watching TV Series Motives

The Italian version of the Watching TV Series Motives Questionnaire [WTSMQ – (32); Italian version by (62)] was used to assess TV series watching motivations. It is a 22-item scale with four core dimensions: *coping/escapism* (e.g., "I watch TV series to escape reality and seek shelter in fictional worlds."), *emotional enhancement* (e.g., "I watch TV series to be captivated and experience extraordinary adventures by proxy."), *enrichment* (e.g., "I watch TV series to develop my personality and broaden my views."), and *social* (e.g., "I watch TV series to relate to others more easily, because TV series give me something to talk about."). Items are evaluated on a 4-point Likert scale ranging from 1 (*not at all*) to 4 (*to a great extent*), with a higher average score on each subscale indicating higher motivation for watching TV series. Cronbach's α values in this study were 0.87 (*coping/escapism*), 0.88 (*emotional enhancement*), 0.85 (*enrichment*), and 0.71 (*social*).

Statistical Analyses

Descriptive statistics were computed for all of the study variables. Gender differences were examined through t-test and the magnitude of the differences was evaluated with effect sizes (Cohen's d). Pearson's r correlations were used to explore the associations between the variables. Finally, two multiple hierarchical regression analyses were performed. First, adaptive engagement in watching TV series (i.e., *engagement*) was set as the dependent variable, with sociodemographic characteristics (age, gender, and the number of family members at home during COVID-19 restrictions) and increased time spent watching TV series during COVID-19 restrictions (step 1), anxiety, depression, and stress symptom scores (step 2), as well as WTSMQ domain scores (step 3), set as predictors. Second, maladaptive engagement in watching TV series (i.e., *loss of control*) was set as

TABLE 1 | Descriptive statistics and gender differences for all investigated variables.

	Full sample (N = 715)			Males (n = 204)	Females (n = 511)	$t_{(713)}$	d	95% CI
	M (SD)	Observed range	Possible range	M (SD)	M (SD)			
Δ h/day watching TV series during and before the COVID-19	0.84 (1.16)	−4 – 5	−24 – 24	0.70 (0.97)	0.89 (1.22)	−1.97*	0.17	[−0.38, 0.00]
BWESQ-Engagement	1.89 (0.67)	1 – 3.88	1 – 4	1.81 (0.59)	1.91 (0.70)	−2.03*	0.15	[−0.21, 0.00]
BWESQ-Loss of control	1.48 (0.53)	1 – 4	1 – 4	1.48 (0.50)	1.49 (0.53)	0.81	0.02	[−0.10, 0.07]
WTSMQ-Coping/Escapism	2.02 (0.68)	1 – 4	1 – 4	1.98 (0.62)	2.04 (0.71)	−1.17	0.09	[−0.17, 0.04]
WTSMQ-Enrichment	2.22 (0.83)	1 – 4	1 – 4	2.18 (0.79)	2.24 (0.84)	−0.83	0.07	[−0.19, 0.08]
WTSMQ-Emotional-enhancement	2.15 (0.81)	1 – 4	1 – 4	2.20 (0.79)	2.13 (0.83)	0.98	0.09	[−0.07, 0.20]
WTSMQ-Social	1.33 (0.49)	1 – 4	1 – 4	1.42 (0.56)	1.29 (0.46)	2.84**	0.25	[0.04, 0.21]
Depression	0.99 (0.75)	0 – 3	0 – 3	0.91 (0.70)	1.02 (0.77)	−1.86	0.15	[−0.24, 0.01]
Anxiety	0.69 (0.67)	0 – 3	0 – 3	0.59 (0.60)	0.73 (0.68)	−2.72**	0.22	[−0.24, −0.3]
Stress	1.36 (0.74)	0 – 3	0 – 3	1.23 (0.71)	1.41 (0.75)	−2.79**	0.25	[−0.29, −0.05]

*p < 0.05; **p < 0.01.

TABLE 2 | Pearson's r correlations between the variables.

	2	3	4	5	6	7	8	9	10	11	12	13
1. Gender	−0.01	0.06	−0.16**	−0.07	−0.01	−0.04	−0.03	0.04	0.11**	−0.07	−0.10**	−0.10**
2. Age	–	−0.25**	−0.22**	−0.33**	−0.25**	−0.37**	−0.43**	−0.34**	−0.20**	−0.25**	−0.18**	−0.21**
3. Number of family members at home		–	−0.01	0.04	0.07	0.03	0.03	0.00	0.10**	0.06	0.05	0.06
4. Hour per day spent watching TV series during COVID-19 pandemic			–	0.57**	0.33**	0.40**	0.35**	0.33**	0.09*	0.14**	0.13**	0.07
5. BWESQ-Engagement				–	0.61**	0.66**	0.61**	0.69**	0.37**	0.28**	0.24**	0.22**
6. BWESQ-Loss of control					–	0.52**	0.35**	0.47**	0.40**	0.31**	0.27**	0.24**
7. WTSMQ-Coping/Escapism						–	0.62**	0.74**	0.47**	0.48**	0.34**	0.39**
8. WTSMQ-Enrichment							–	0.69**	0.45**	0.32**	0.27**	0.27**
9. WTSMQ-Emotional-enhancement								–	0.45**	0.34**	0.22**	0.28**
10. WTSMQ-Social									–	0.26**	0.23**	0.19**
11. Depression										–	0.70**	0.74**
12. Anxiety											–	0.70**
13. Stress												–

*p <0.05; **p <0.01.

the dependent variable, using the same set of predictors. A level of $p < 0.05$ was set as the level for statistical significance.

RESULTS

Descriptive Statistics

Descriptive statistics are reported in **Table 1** for both the full sample and differentiated by gender, along with the level of significance for gender differences. Participants reported 2.81 h/day spent watching TV series during the pandemic, with an increase of about one episode per day (0.84 h in average) in respect to their pre-COVID-19 watching habits. Females showed a higher increased amount of time watching TV series during the COVID-19 pandemic than males. Females also reported a higher extent of engagement in watching TV series, and higher levels of anxiety and stress symptoms. Males reported a higher motivation in bonding with others through watching TV series.

Subsequently, the intercorrelations between the investigated variables were examined (see **Table 2**). More time spent watching TV series during the COVID-19 pandemic was significantly and positively associated with engagement in watching TV series scores and, to a lesser extent, also with loss of control over TV series watching, coping/escapism, enrichment, and emotional enhancement motives for watching TV series. No further associations were found between increased amount of time spent watching TV series during the COVID-19 pandemic and psychopathological symptoms domain scores.

As reported in **Table 3**, the first hierarchical regression analysis revealed that younger age ($\beta = 0.33$, $p < 0.001$), and increased amount of time spent watching TV series during the COVID-19 pandemic ($\beta = 0.15$, $p < 0.001$) positively predicted adaptive engagement in watching TV series (i.e., *engagement*) at Step 1. These control variables accounted for 14% of the variance. With the inclusion of psychopathological symptoms as

TABLE 3 | Regression: predictors of engagement in watching TV series during the COVID-19 pandemic.

	F	R^2	ΔR^2	*B*	SE	*t*	*P*
Step 1	28.87 ($p < 0.001$)	0.14	0.14				
Age				−0.21	0.00	−9.20	< 0.001
Gender*				−0.09	0.05	−1.79	0.07
Number of family members at home				−0.02	0.02	−0.87	0.38
Δ h/day watching TV series during and before the COVID-19 pandemic				0.09	0.02	4.36	< 0.001
Step 2	22.69 ($p < 0.001$)	0.18	0.04				
Age				−0.02	0.00	−7.68	< 0.001
Gender				−0.07	0.05	−1.29	0.20
Number of family members at home				−0.02	0.02	−0.90	0.37
Δ h/day watching TV series during and before the COVID-19 pandemic				0.09	0.02	4.40	< 0.001
Depression				0.15	0.05	3.04	< 0.01
Anxiety				0.07	0.05	1.36	0.17
Stress				−0.01	0.05	−0.18	0.86
Step 3	80.70 ($p < 0.001$)	0.56	0.38				
Age				0.00	0.00	−0.93	0.35
Gender				−0.10	0.04	−2.63	< 0.01
Number of family members at home				0.02	0.01	1.25	0.21
Δ h/day watching TV series during and before the COVID-19 pandemic				0.05	0.01	3.24	0.01
Depression				−0.04	0.04	−1.06	0.29
Anxiety				0.09	0.04	2.26	0.02
Stress				−0.07	0.04	−1.84	0.07
WTSMQ-Coping/Escapism				0.26	0.04	6.21	< 0.001
WTSMQ- Enrichment				0.15	0.03	4.80	< 0.001
WTSMQ- Emotional-enhancement				0.30	0.03	8.71	< 0.001
WTSMQ- Social				0.01	0.04	0.38	0.71

** Male coded as 1; female coded as 0.*

predictors at Step 2, younger age ($\beta = 0.28$, $p < 0.001$), increased amount of time spent watching TV series during the COVID-19 pandemic ($\beta = 0.15$, $p < 0.001$), and depression symptoms ($\beta = 0.17$, $p < 0.01$) were positively associated with adaptive engagement in watching TV series. Finally, with the inclusion of motives for TV series watching at Step 3, the explained variance increased from 18 to 56%. Female gender ($\beta = 0.07$ $p < 0.01$), increased amount of time spent watching TV series during the COVID-19 pandemic ($\beta = 0.08$, $p = 0.01$), anxiety symptoms ($\beta = 0.09$, $p = 0.02$), and both coping/escapism ($\beta = 0.26$, $p < 0.001$), enrichment ($\beta = 0.18$, $p < 0.001$), and emotional enhancement ($\beta = 0.37$, $p < 0.001$) motivations for watching TV series had a significant positively predictive effect on non-problematic watching engagement.

As reported in **Table 4**, the second hierarchical regression analysis revealed that younger age ($\beta = 0.24$, $p < 0.001$) and increased amount of time spent watching TV series during the COVID-19 pandemic ($\beta = 0.08$, $p = 0.02$) positively predicted maladaptive engagement over TV series watching (i.e., *loss of control*) at Step 1. These control variables accounted for 7% of the variance. At Step 2, younger age ($\beta = 0.18$, $p < 0.001$), increased amount of time spent watching TV series during the COVID-19 pandemic ($\beta = 0.08$, $p = 0.02$), depression symptoms ($\beta = 0.22$, $p < 0.001$), and anxiety symptoms ($\beta = 0.11$, $p = 0.04$) were positively related to loss of control over TV series watching during the COVID-19 pandemic. Finally, with the inclusion of motives for TV series watching at Step 3, the explained variance increased from 14 to 33%. Loss of control over TV series watching was positively predicted by anxiety symptoms ($\beta = 0.12$, $p = 0.01$), coping/escapism ($\beta = 0.29$, $p < 0.001$), emotional enhancement ($\beta = 0.20$, $p < 0.001$), and social ($\beta = 0.17$, $p < 0.001$) motivations for watching TV series, and negatively predicted by the enrichment motive for watching TV series ($\beta = -0.10$, $p < 0.03$).

DISCUSSION

Recent literature has evidenced that the COVID-19 outbreak and related protective measures involved many risks to individuals' mental health (1–3, 5–8, 10, 12). In order to contribute to the ongoing debate on the psychological consequences of forced isolation due to the current pandemic, where the functionally impairing nature of one's engagement in web-related activities is an important issue to consider (65), the purpose of this study was to explore TV series watching behaviors (both from an adaptive and maladaptive perspective) and their underlying motivations, as well as their relationships with psychopathological symptoms during the COVID-19 lockdown in a sample of self-selected Italian adults.

TABLE 4 | Regression: predictors of loss of control over TV series watching during the COVID-19 pandemic.

	F	R^2	ΔR^2	*B*	SE	*t*	*P*
Step 1	13.46 ($p < 0.001$)	0.07	0.07				
Age				−0.01	0.00	−6.52	< 0.001
Gender				−0.01	0.04	−0.20	0.84
Number of family members at home				0.00	0.01	0.34	0.73
Δ h/day watching TV series during and before the COVID-19 pandemic				0.04	0.02	2.29	0.02
Step 2	16.83 ($p < 0.001$)	0.14	0.07				
Age				−0.01	0.00	−4.76	< 0.001
Gender				0.02	0.04	0.44	0.66
Number of family members at home				0.00	0.01	0.35	0.73
Δ h/day watching TV series during and before the COVID-19 pandemic				0.04	0.02	2.28	0.02
Depression				0.15	0.04	3.83	< 0.001
Anxiety				0.09	0.04	2.06	0.04
Stress				−0.02	0.04	−0.61	0.54
Step 3	31.72 ($p < 0.001$)	0.33	0.19				
Age				0.00	0.00	−1.47	0.14
Gender				−0.02	0.04	−0.65	0.52
Number of family members at home				0.01	0.01	0.99	0.32
Δ h/day watching TV series during and before the COVID-19 pandemic				0.02	0.01	1.10	0.27
Depression				0.03	0.04	0.81	0.42
Anxiety				0.09	0.04	2.45	0.01
Stress				−0.05	0.04	−1.35	0.18
WTSMQ-Coping/Escapism				0.23	0.04	5.71	< 0.001
WTSMQ- Enrichment				0.06	0.03	−2.12	0.03
WTSMQ- Emotional-enhancement				0.13	0.03	3.95	< 0.001
WTSMQ- Social				0.19	0.04	4.73	< 0.001

**Male coded as 1; female coded as 0.*

The present findings firstly show that people spent more time watching TV series during the pandemic lockdown. In particular, consistent with the existing literature on binge-watching [e.g., (33, 41, 42)], women still proved more engaged in watching TV series during the COVID-19 emergency, while also showing higher levels of anxiety and stress than men. These results thus enter in resonance with previous data showing women's higher propensity to experience negative affect and low sense of mastery in negative circumstances, thus engaging in abstract and dysfunctional ruminative coping (66), and that female gender constitutes a risk factor for anxiety during the COVID-19 pandemic (67). Conversely, men were found to be more interested in bonding with others through watching TV series in such life circumstances. These findings can also be interpreted according to recent studies that showed gender inequality in experiencing the consequences of the COVID-19 restrictions, which differently impacted men's and women's lives as well as gender-role attitudes (e.g. work-family balance) (68–70).

As previously reported (46), the positive association between TV series watching involvement and anxiety—as also evidenced in the current sample—supports the idea that individuals experiencing unpleasant affect are more prone to use binge-watching as a coping strategy to get recovery from undesirable emotions, thus facing and regulating their negative moods (33, 47–49). Indeed, individuals' adaptive reaction to negative life circumstances might be facilitated by web-related activities, which can positively contribute to alleviate negative feelings, even though sometimes paving the way for problematic online engagement (71). It has also been demonstrated that while emotional enhancement and enrichment motivation for watching TV series is more strongly related to non-problematic watching behavior, coping-escapism motive is usually more strongly associated with problematic patterns of TV series watching (32, 62).

Interestingly, in the current sample loss of control over TV series watching was positively predicted by anxiety symptoms and coping/escapism motivation for watching TV series, but also by emotional enhancement and social drivers. It appears, therefore, that both "positive" and "negative" reinforcement motivations for watching behavior played a role in predicting the possibility of losing control while immersing oneself in TV series during the COVID-19 lockdown. In line with current neuroscientific research, it could be hypothesized that the pleasure deriving from the alleviation of pain combines with the pleasure deriving from positive emotions and relationships, thereby generating a complex rewarding process that may lead in some cases to a loss of control over the behavior (72). However, it is noteworthy that the enrichment motive was negatively associated with a maladaptive engagement in TV series watching. This might suggest that watching TV series for exploring new ideas, increasing knowledge, and enriching one's own perspective on contexts and situations may protect from uncontrolled and potentially addictive watching behaviors.

Non-problematic engagement in TV series watching was positively predicted by anxiety symptoms, coping/escapism, enrichment and emotional enhancement motivations for watching TV series, as well as by the increased amount of time spent watching TV series during the COVID-19 pandemic, and this especially for women. Therefore, besides the opposite effect of the enrichment motive, the results of both regression analyses do not highlight a clear distinction between non-problematic and problematic patterns of TV series watching behaviors, which were likely less dissociated from each other in the unprecedented context of the COVID-19 lockdown.

Be that as it may, the fact that both non-problematic and problematic TV series watching behaviors appear to be equally induced by anxiety and coping/escapism motivation — as hypothesized — centrally strengthens the notion that watching TV series during the COVID-19 lockdown probably served as a recovery strategy to face such a stressful situation. Furthermore, the current pattern of predictors once again reinforces that TV series watching activity, despite a high involvement, should not be considered as problematic *per se* as it might actually represent an effective coping strategy to deal with emotional distress by allowing viewers to find temporary shelter in the fictional world of a TV series, while experiencing pleasure, and fulfilling self-development and social needs during those times of isolation due to the COVID-19 pandemic.

We may reasonably assume, then, that TV series watching seemed to fuel viewers' minds with a different world, thereby distracting individuals from the pandemic distress. In this context, the possibility to watch TV series for personal enrichment might be key to prevent excessive watching behavior becoming a compulsive and uncontrollable habit (59), rather than a temporary and adequate coping strategy.

Limitations of this study need to be acknowledged. First, the current cross-sectional design limited the ability to formally test causative effects. Second, the well-known risk of biases due to the use of self-reported measures is also prevailing. Third, despite the representation of the entire Italian peninsula in our sample, the different geographic areas of Italy have been differently affected by the COVID-19-related health crisis, thereby limiting the generalizability of the present results. Finally, if these watching TV series behaviors and related motivations should be regarded as resulting from such specific circumstances, it would be worthwhile considering analyzing the lasting effects of the pandemic on individuals' viewing behaviors through longitudinal study designs. Moreover, differences and similarities between different cultural contexts might be also explored.

Despite these limitations, the present findings hold important implications, not only for binge-watching research, but also for avoiding the over-pathologization and stigmatization of excessive online behaviors that may emerge as a result of specific distressing situations and that, as recently showed (14, 20, 73), might instead be effective although attentively addressed in some limited periods for sustaining temporary recovery from psychological distress.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Committee of Psychological Research of the Department of Humanities of the University of Naples Federico II. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

VB was responsible for preparing the first draft of the article. AM analyzed the data. FG edited the manuscript. MF conceptually contributed to the development of the work. JB and AS critically revised the whole work for important intellectual content. All authors contributed to the study design, article, and approved the final version of the paper.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 23 April 2021
doi: 10.3389/fpsyt.2021.623099

Perceived Strain Due to COVID-19-Related Restrictions Mediates the Effect of Social Needs and Fear of Missing Out on the Risk of a Problematic Use of Social Networks

Elisa Wegmann[1]*, *Annika Brandtner*[1] and *Matthias Brand*[1,2]

[1] General Psychology: Cognition and Center for Behavioral Addiction Research (CeBAR), University of Duisburg-Essen, Duisburg, Germany, [2] Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany

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Edited by:
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Reviewed by:
Marianna Mazza, Catholic University of the Sacred Heart, Italy
Ilaria Cataldo, University of Trento, Italy

***Correspondence:**
Elisa Wegmann
elisa.wegmann@uni-due.de

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *29 October 2020*
Accepted: *25 March 2021*
Published: *23 April 2021*

Citation:
Wegmann E, Brandtner A and Brand M (2021) Perceived Strain Due to COVID-19-Related Restrictions Mediates the Effect of Social Needs and Fear of Missing Out on the Risk of a Problematic Use of Social Networks. Front. Psychiatry 12:623099. doi: 10.3389/fpsyt.2021.623099

The occurrence of the COVID-19-virus led to drastic short-term measures to reduce its spread and influence. Regulations such as "physical distancing," mentioned as "social distancing," and the closure of public facilities during the lockdown could be perceived as burdensome especially by individuals who feel a strong need for social exchange and belonging. These components such as need to belong and the fear of missing out also play a major role in the development and maintenance of a problematic use of social networks. Researchers have argued recently that an increase of addictive (online) behaviors may be a likely consequence of subjectively experienced restrictions in the context of the COVID-19 pandemic. The current study investigates the interplay of perceived strain due to COVID-19-related restrictions and the fear of missing out (FoMO) as well as of symptoms of problematic social-networks use. We hypothesized that perceived strain due to COVID-19-related restrictions mediates the effect of specific predisposing variables related to social needs on the symptom severity of a problematic use. To assess the perceived strain due to COVID-19-related restrictions, we developed a specific questionnaire asking for perceived COVID-19-related strain in several domains of everyday-life. An exploratory factor analysis identified five factors: perceived strain related to restrictions of (1) social contacts, (2) travel, (3) childcare, (4) work, and (5) own health. In a sample of 719 German participants and data collection during the first COVID-19 lockdown (March 30th until April 3rd 2020), a structural equation model was calculated showing that higher levels of need to belong and FoMO increase perceived COVID-19-related strain, which is related to symptoms of a problematic social-networks use. The effect of need to belong on problematic social-networks use is mediated by experienced COVID-19-related strain and FoMO-online. Even if the use of social networks is not pathological *per se*, it may be associated with suffering for a vulnerable part of users. We conclude that specific needs and fear-associated predisposing variables contribute to experiencing physical distance and other pandemic-related restrictions as more stressful, which may increase problematic social-networks use and potentially other addictive behaviors as well in the context of the COVID-19-related lockdown.

Keywords: COVID-19, coronavirus, social media addiction, internet addiction, addictive disorders, fear of missing out, need to belong, coping

INTRODUCTION

In 2020, the coronavirus disease, (COVID-19) an infection leading to acute respiratory syndromes, has emerged. In December 2019, the first outbreak of this disease was reported in Wuhan, China, and due to the massive spread across the entire globe, on March 11, 2020, the World Health Organization (WHO) declared the pandemic due to the coronavirus. In order to prohibit the spread and prevent further infections and deaths, governments of many countries imposed unexpectedly drastic changes in societal, cultural, professional, and social life domains. These restrictions include, among others, the temporary closure of public faculties such as schools and kindergartens, the closure of shops, restaurants, and museums, the cancellation of cultural and sporting events, the short-term closure of borders and the issuing of travel warnings as well as the request to cover mouth and nose in public. One of the most important restrictions is the strategy of "social distancing," often also mentioned as "spatial distancing" or "physical distancing," which—in addition to create safe, physical distance between people—mainly includes the restrictions of social contacts in real life and to stay at home. This form of self-isolation and contact restrictions seems to be a massive burden, especially for individuals with a strong need for social exchange and belonging. In this context, the WHO as well as several scientists have declared that the usage of digital communication and information technologies could be a good way to stay in touch with family members, friends, and colleagues, and that it may help to maintain a form of social exchange and connectedness with others (1, 2). The use of social networks and other digital online communication applications such as WhatsApp and Facebook therefore play an important role since they allow the exchange and communication with others, the sharing of information, pictures, and videos, and provide further entertainment opportunities during a time when staying at home is the most effective way to break chains of infection (3, 4). Accordingly, Dong et al. (5) and Nimrod (6) illustrate that there was an increase of Internet use in general as well as of social networks, even in the elder generations during the COVID-19 pandemic. Reasons for this increase in Internet use, social networks, and online games could, besides the effect of staying socially connected and feeling entertained, lie in the reductions of stress and unpleasant feelings that could have emerged as a result of physical isolation. Hence, the use of the Internet might be a welcome and functional coping strategy to escape pandemic-associated problems and difficult thoughts for some (1, 7–9).

However, researchers also warn of possible risks regarding social networks and Internet usage not only, but especially during the pandemic (1, 8). While an increase in psychopathological symptoms can generally be observed during the COVID-19 pandemic (5, 10), studies show that the frequent use of the Internet and social networks in particular seems to be associated with mental health problems (11, 12). Rolland et al. (13) as well as Sun et al. (14) demonstrate that addiction-related habits such as eating high caloric food, alcohol consumption, tobacco use, and screen time related to an addictive Internet use have risen. This illustrates the association between mental health issues and the problematic use of the Internet during the COVID-19 pandemic and gives reason to investigate the psychological mechanisms that might make individuals prone to suffer from problematic social-networks use during this time. Researching this question, it is particularly important to take situational circumstances and the perceived strain due to the COVID-19 related restrictions into account.

Problematic Use of Social Networks and Theoretical Framework Models

As already mentioned, even if the use of social networks and online communication applications offers many advantages and positive aspects, especially for staying in contact with others during the COVID-19 pandemic, there are also individuals reporting negative consequences due to the excessive use of social networks. These reports are part of an ongoing debate regarding the problematic use of social networks which is often defined as "being overly concerned about social networking sites, to be driven by a strong motivation to log on or to use social networking sites and to devote so much time and effort" [(15), p. 4045], whereby individuals experience a diminished control, negative consequences, and impairments in daily life due to the use of these applications (16, 17). The problematic use of social networks has been described as addictive use of social networks or social-networks-use disorder based on the definition of the already classified gaming disorder as disorder due to addictive behaviors in the ICD-11 (18, 19). In addition, researchers discuss whether the problematic use of social networks could be considered as "other specified disorders due to addictive behaviors (coded as 6C5Y) in the ICD-11. Here, Brand et al. (16) argue that three meta-level criteria have to be fulfilled which should be considered as guidelines and which include (1) the scientific evidence for clinical relevance, (2) the theoretical embedding, and (3) the empirical evidence for underlying mechanisms. In the current study, theoretical frameworks of addiction research have been used as basis for deriving the research questions, which will now be described.

The I-PACE model by Brand et al. (20) and its updated version (21) summarizes different theoretical assumptions of addiction research, for example the dual-process approach of addiction (22) and incentive neural sensitization processes (23). Basing on this, the I-PACE model provides a theoretical approach to understand and investigate the process of the development and maintenance of an addictive behavior. One key assumption of this model is the interaction of predisposing factors and affective and cognitive components leading to the continued use of specific online applications or showing a specific behavior. It has been outlined that motives, psychopathological characteristics, personality aspects, and temporal features affect the perception of specific situational features (e.g., mood, stress perception, environmental components). These factors may interact with affective processes (e.g., cue reactivity, craving), internet-related cognitive biases as well as impairments in (specific) inhibitory control and executive functions. Based on conditioned learning processes and reinforcement mechanisms, this may result in the experience of gratification and/or compensation. The constant cycle as part of the addiction process thus forms the basis for the repeated execution of the behavior, but also for the experience of limited control or even a loss of control [for a more detailed description, see (21)]. The overview by Wegmann and Brand (18) picks up key assumptions of the I-PACE model and specifies it for the problematic use of social networks. The authors argue that the use of social networks is mainly associated with psychosocial characteristics that determine either a fear-driven/compensation-seeking approach or a reward-driven approach to use social networks excessively (18). As such, a high need to belong, need for social exchange, perceived social support, and social anxiety depict main motivators that drive behavior in order to experience gratification or compensatory effects due to the usage. As online applications mainly focus on the exchange with other users by creating feelings of social connectedness, psychosocial characteristics and social needs are especially important factors which could *per se* result in a higher risk of an uncontrolled social-networks use. An interaction with specific reinforcement mechanisms such as reductions of fear of missing out and social isolation, or the satisfaction of social needs, could further accelerate the tendency to develop problematic social-networks use. Moreover, Tonioni et al. (24) highlight that a problematic use is also associated with communicative insecurity and a higher need of social support, wherefore it could be argued that on the one hand this is not experienced in real life or on the other hand it is the result of a dysfunctional coping strategy that is related with a higher risk of a problematic use as well [e.g., (25)]. Empirical evidence already illustrates the association of need to belong, social anxiety, and perceived social support related to the problematic use of social networks [e.g., (18, 26–30)].

In addition, research also highlights that the fear that others have more rewarding experiences without oneself, referred to as fear of missing out (FoMO), is an additional key component of a problematic use [e.g., (31–34)]. More precisely, Wegmann et al. (35) differentiate between a general trait-FoMO as a predisposing factor and online-specific state-FoMO as an internet-related cognitive bias where the latter mediates the effect of trait-FoMO on the symptom severity of a problematic social-networks use. To our best knowledge, further studies investigating the mediation effect on social needs such as need to belong and trait-FoMO on the symptom severity have been missing. In addition to the specific predisposing factors and reinforcing mechanisms such as state-FoMO, the I-PACE model by Brand et al. (21) also explores that besides affective and cognitive components, situational aspects play an important role in the understanding of an addictive behavior. It could be argued that the experienced strain due to the social restrictions during the COVID-19 pandemic are such situational aspects which affect the relationship between predisposing factors on the risk of a problematic social-networks use. Therefore, it seems to be important to better understand the interplay of these components in the development and maintenance of a problematic social-networks use.

Aim of the Current Study

In the current study, we investigated the relevance of subjectively perceived strain due to COVID-19-related restrictions for the development and maintenance of a problematic use of social networks. Several researchers argue that the increase of addiction-related habits such as the increase of the symptom severity of a problematic social-networks use may be a likely consequence of the experienced restrictions in the context of the COVID-19 pandemic. Therefore, we developed a specific questionnaire asking for perceived COVID-19-related strain in several domains of daily life.

Based on the aforementioned theoretical considerations, we argue that social needs such as need to belong and trait-FoMO are important predisposing factors contributing to the symptom severity of a problematic use of social networks, and that this relationship is mediated by internet-related cognitive biases such as state-FoMO. Considering the situation of the COVID-19-related lockdown, we hypothesized that individuals with high social needs are somewhat deprived in the fulfillment of these needs and therefore experience higher strains due to the COVID-19-related restrictions such as "social distancing" and self-isolation. Experiencing the COVID-19-related restrictions as more burdensome might lead to higher state-FoMO, because the missing opportunity to satisfy social needs by the physical contact to beloved ones might evoke the fear to miss out what they do online. This might cause a more intense use of social networks which could result in a problematic behavior. Therefore, we investigated the interplay of perceived strain due to Covid-19-related restrictions and the fear of missing out in the online world as well as of symptoms of problematic use of social networks. We hypothesized that perceived strain due to Covid-19-related restrictions mediates the effect of specific predisposing variables related to social exchange and social needs on the symptom severity of a problematic use of social networks. The theoretically argued relationships and mediating effects are illustrated in **Figure 1**.

METHODS

Participants and Recruitment

Data was collected using a comprehensive online survey which was hosted at University of Duisburg-Essen using the

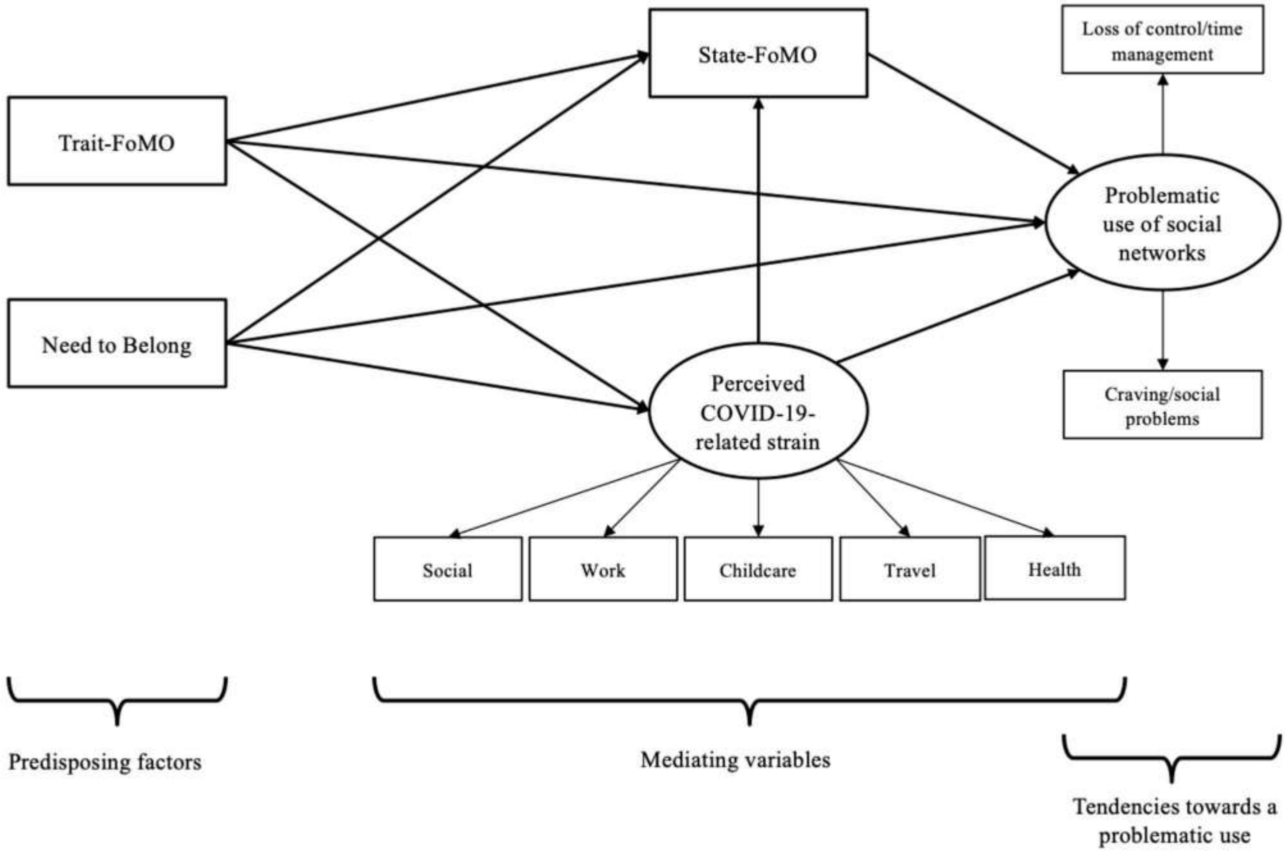

FIGURE 1 | The hypothesized model for analyzing the suggested direct and indirect effects including the latent dimensions of perceived strain due to COVID-19 related restrictions and problematic use of social networks. The figure shows the predisposing factors, the mediator variables, and the dependent variable. The directions of the hypothesized effects are illustrated by the arrows, which also symbolize the direct effects. The rectangles represent the manifest variables, depicted by the subscales of the questionnaires used. The ellipses illustrate the latent dimensions, which are created by the specific manifest variables.

survey software LimeSurvey®. Study participants were recruited and incentivized by an access panel in Germany. Two first screen out questions ensured that participants regularly used a smartphone and that they used communication applications such as Facebook, Twitter, Instagram, or messengers such as WhatsApp. If these queries were answered in the negative, participants were informed that they were not eligible for the study. The survey was online March 30th until April 3rd 2020, right after the "Law to protect the population in the event of an epidemic situation of national importance" came into force in Germany on March 27, 2020. After this survey, participants have been invited to take part in a second survey 4 weeks later, however, this was not part of the current research question. The study was approved by an ethics committee of University Duisburg-Essen.

After careless responder analysis using long-string method, even-odd method, and the investigation of irrational responding times, the final sample consisted of 719 participants (347 females, 48.3%), with a mean age of 50.11 ($SD = 12.29$), ranging from 18 to 79 years. 57.2% of the sample were employees, 19.3% pensioners, 7.5% officials, 6.0% self-employed, and the rest indicated being students, looking for work or other. Participants reported to have used their smartphones averagely 115.72 min ($SD = 127.03$) during the past seven days and to have utilized social networks and messengers for 9.82 years ($SD = 4.95$). Additionally, participants were asked how many minutes they used specific applications per day in February 2020 and during the last 7 days in order to investigate if using times differed. For descriptive results including paired t-tests, see **Table 1**. Gender differences in using times during the last 7 days were identified for Instagram, Smartphone usage, Telephony, and WhatsApp. In all cases, female participants reported significantly higher usage times ($p \leq 0.037$). In February 2020, only Instagram and WhatsApp were used significantly longer by females ($p \leq 0.031$).

Instruments

Need to Belong

To assess a general need to belong, the 10-item Need to Belong Scale (36) was used. As there is no validated German version so far, the questionnaire was translated into German and re-translated into English by four independent research assistants. Exemplary items are "I don't like being alone." or "It bothers me a lot when I am not involved in the planning of others."

TABLE 1 | Means *(M)* and standard deviations *(SD)* of using times per different social networks and online communication applications as well as the smartphone and Internet use in general.

Application	N	February 2020		Last 7 days		t-test
		M	SD	M	SD	
Internet	719	189.71	165.32	200.70	157.75	0.003
Smartphone	719	105.09	125.95	115.72	127.03	0.002
Telephony	719	27.62	64.47	35.00	70.88	<0.001
WhatsApp	684	38.26	75.22	42.70	71.47	0.010
Facebook	290	45.48	85.32	50.39	78.32	0.172
Facebook Messenger	215	22.79	108.42	15.03	27.64	0.228
Instagram	162	39.41	106.71	35.25	44.87	0.523
Skype	80	22.81	60.18	29.62	53.28	0.218
Twitter	62	43.85	91.62	43.15	83.05	0.844
Threema	37	24.11	56.80	21.78	47.21	0.718
iMessage	36	22.69	82.68	15.33	34.04	0.385
Snapchat	24	51.75	181.29	46.21	140.10	0.522

All using times are indicated in minutes per day. M = mean, SD = standard deviation.

which are answered on a five-point Likert scale (1 = *completely disagree* to 5 = *completely agree*). The internal consistency of the questionnaire in this sample reached Cronbach's α = 0.798.

Fear of Missing Out

To measure FoMO as trait- and state-variable, we utilized the scale introduced by Wegmann et al. (35). This version was modified and extended with online-specific items basing on the original 10-item Fear of Missing Out Scale (37). Wegmann et al. (35) detected a two-factor structure of their 12-item version with one factor depicting *trait-FoMO* (five items; e.g., "I feel insecure when I do not know what my friends are up to.") and the other factor representing *state (online) FoMO* (seven items; e.g., "I am continually online, to not miss out on anything."). Items are answered on a five-point Likert scale (1 = *completely disagree* to 5 = *completely agree*). The internal consistency of the questionnaire in this sample reached Cronbach's α = 0.812 for trait-FoMO and Cronbach's α = 0.848 for state-FoMO.

Problematic Use of Social Networks

Tendencies toward symptoms of problematic use of social networks were assessed using a modified version of the short Internet Addiction Test (s-IAT-com) for online-communication applications (38) which bases on the s-IAT as introduced by Pawlikowski et al. (39). The two factors of the 12-item questionnaire are represented by six items each. Items of the factor *loss of control/time management* (e.g., "How often do you find that you have used online communication applications for longer than you intended?") and the factor *craving/social problems* (e.g., "How often do you react evasively or defensively when someone asks you what you do online?") were answered on a five-point Likert scale (1 = *never* to 5 = *very often*). The internal consistency of the questionnaire in this sample reached Cronbach's α = 0.911.

Perceived COVID-19-Related Strain

To operationalize the perceived strain during the Covid-19-associated restrictions, a total of 16 items were developed on the basis of consideration. These items asked for how much several restrictions that were initiated to prohibit the spread of the pandemic were perceived as burdensome. Among the restrictions and consequences due to the lockdown were the recommendation to work from home, the cancellation of orders, or the closure of public places and borders. Each of the restrictions and consequences were rated on a 5-point Likert scale (1 = *not at all burdensome* to 5 = *very burdensome*).

To explore the factorial structure of these 16 items, an exploratory factor analysis (EFA) with principal axis factoring, promax rotation, and parallel analysis by Horn (40) was conducted with the data of the current sample. During this procedure, items were discarded on the basis of poor combinations of primary and secondary factor loadings. This procedure resulted in a stable twelve-item and five-factor solution. The factors that were extracted could thematically be classified as experienced strain due to social contact restrictions (three items), restrictions in the working context (three items), childcare restrictions (two items), travel restrictions (two items) and health issues (two items), see **Table 2**.

Statistical Analysis

The statistical analyses were carried out with SPSS 26.0 for Mac. There were no missing data. We calculated Pearson correlations testing the bivariate correlations between two manifest variables. The structural equation model analyses were computed with Mplus 8 (41). For evaluating the model fit of the model, standard criteria were used: standardized root mean square residual (SRMR; values < 0.08 indicate a good fit with the data), comparative fit indices (CFI/TLI; values > 0.90 indicate an acceptable and values > 0.95 indicate a good fit with the data), and root mean square error of approximation (RMSEA; values between 0.08 and 0.10 indicate an acceptable and values < 0.08

TABLE 2 | Item factor loadings, means, standard deviations, and Cronbach's α of the subscales of the questionnaire assessing perceived strain due to COVID-19-related restrictions.

Items	*M (SD)*	Factor 1	2	3	4	5
Social						
Avoidance of social contacts	3.21 (1.23)	**0.983**	−0.023	−0.028	−0.098	−0.013
Restrictions in public life	3.07 (1.14)	**0.797**	0.024	−0.009	0.062	0.028
Prohibition of contact to others than family	3.26 (1.37)	**0.675**	0.008	0.059	0.081	−0.017
Reliability α = 0.860						
Work						
Initiation of short-term working	1.81 (1.29)	−0.014	**0.783**	0.036	−0.046	−0.069
Cancellation of orders	1.95 (1.24)	0.007	**0.760**	−0.058	0.051	−0.087
Existential livelihood/unemployment	1.87 (1.18)	0.015	**0.659**	0.024	−0.010	0.190
Reliability α = 0.774						
Childcare						
Closure of playgrounds	1.72 (1.19)	−0.019	−0.017	**0.899**	0.002	0.027
Closure of schools and childcare facilities	2.04 (1.42)	0.031	0.016	**0.791**	−0.006	−0.044
Reliability α = 0.825						
Travel						
Closure of borders	2.24 (1.41)	0.030	−0.021	0.008	**0.815**	0.082
Travel warnings/cancellations of holiday trips	2.80 (1.48)	−0.013	0.016	−0.011	**0.796**	−0.085
Reliability α = 0.784						
Health						
Own illness	1.79 (1.11)	−0.027	0.035	0.011	0.015	**0.815**
Own previous illness	1.98 (1.22)	0.022	−0.052	−0.025	−0.023	**0.738**
Reliability α = 0.745						

M = mean, SD = standard deviation.
The primary factor loadings are highlighted in bold.

indicate a good fit with the data) (42, 43). All variables for the structural equation model were required to correlate with each other (44).

RESULTS

Descriptive Values and Correlation Analysis

The descriptive values of the s-IAT and the scores of the questionnaires as well as the bivariate correlations are shown in **Table 3**. The results illustrated significant correlations between all variables applied. We found no significant relationship between factor *Health* of the COVID-19 related strain and the symptom severity of problematic social-networks use. Therefore, we excluded the factor in the structural equation model. In addition, based on the reported cut-off scores by Pawlikowski et al. (39), 52 participants (7.23% of the sample) indicated a problematic use of social networks (cut-off score $\geq$ 31), and 22 participants (3.01% of the sample) a pathological use (cut-off score $\geq$ 38).

Structural Equation Modeling

The proposed model on latent dimension with symptom severity of problematic social-networks use showed a good fit with the data (RMSEA = 0.069, p = 0.018; CFI = 0.962; TLI = 0.933; SRMR = 0.040). Overall, 37.8% of the variance of the symptom severity could be explained by the proposed direct and indirect effects. The latent dimensions *problematic use of social networks* and *perceived COVID-19-related strain* were well-represented by the manifest variables. The results illustrate that the perceived COVID-19-related strain as well as trait-FoMO and state-FoMO showed a direct effect on the symptom severity. The COVID-19-related strain, trait-FoMO, and need to belong also had a direct effect on state-FoMO, and in addition, trait-FoMO and need to belong showed a direct effect on COVID-19-related strain as well. We found significant indirect effects; the effect of trait-FoMO on symptom severity was mediated by state-FoMO (β = 0.199, SE = 0.025, $p \leq$ 0.001) and by COVID-19-related strain (β = 0.029, SE = 0.013, p = 0.027), but not the path of both (β = 0.004, SE = 0.003, p = 0.106). The effect of COVID-19-related strain on symptom severity was also mediated by state-FoMO (β = 0.026, SE = 0.017, p = 0.036). Even if we could not illustrate a direct effect of need to belong on the symptom severity, we found that the effect was mediated by state-FoMO (β = 0.035, *SE* = 0.016, p = 0.026), COVID-19-related strain (β = 0.124, SE = 0.029, $p \leq$ 0.001), and by both, COVID-19-related strain, and state-FoMO indicating a full-mediation effect (β = 0.018, SE = 0.009, p = 0.040). The structural equation model with factor loadings and β-weights are represented in **Figure 2**. For an overview, all coefficients for direct and indirect effects of the SEM are also summarized in **Table 4**.

TABLE 3 | Descriptive statistics and bivariate correlations between the symptom severity of a problematic use of social networks and the applied scales.

	M (SD)	2	3	4	5	6	7	8	9	10	11	12
1. s-IAT-com sum score	20.18 (7.14)	0.948**	0.934**	0.276**	0.427**	0.510**	0.219**	0.261**	0.253**	0.192**	0.079*	0.339**
2. s-IAT-com loss of control	10.88 (4.02)		0.772**	0.287**	0.387**	0.480**	0.238**	0.256**	0.261**	0.198**	0.051	0.342**
3. s-IAT-com craving/social problems	9.30 (3.56)			0.229**	0.420**	0.479**	0.171**	0.235**	0.213**	0.162**	0.101**	0.294**
4. Need to Belong	3.17 (0.65)				0.382**	0.343**	0.458**	0.143**	0.233**	0.191**	0.065	0.382**
5. Trait-FoMO	1.98 (0.79)					0.587**	0.228**	0.162**	0.168**	0.094**	0.025	0.236**
6. State-FoMO	1.86 (0.75)						0.219**	0.148**	0.149**	0.145**	0.008	0.234**
7. COVID-19-related strain *Social*	3.18 (1.11)							0.234**	0.349**	0.405**	0.042	0.729**
8. COVID-19-related strain *Work*	1.88 (1.01)								0.276**	0.237**	0.140**	0.653**
9. COVID-19–related strain *Childcare*	1.88 (1.21)									0.268**	0.005	0.620**
10. COVID-19-related strain *Travel*	2.52 (1.31)										0.002	0.646**
11. COVID-19-related strain *Health*	1.89 (1.04)											0.322**
12. COVID-19-related strain *Overall*	2.31 (0.69)											

*M = mean, SD = standard deviation, *p ≤ 0.050, **p ≤ 0.010.*

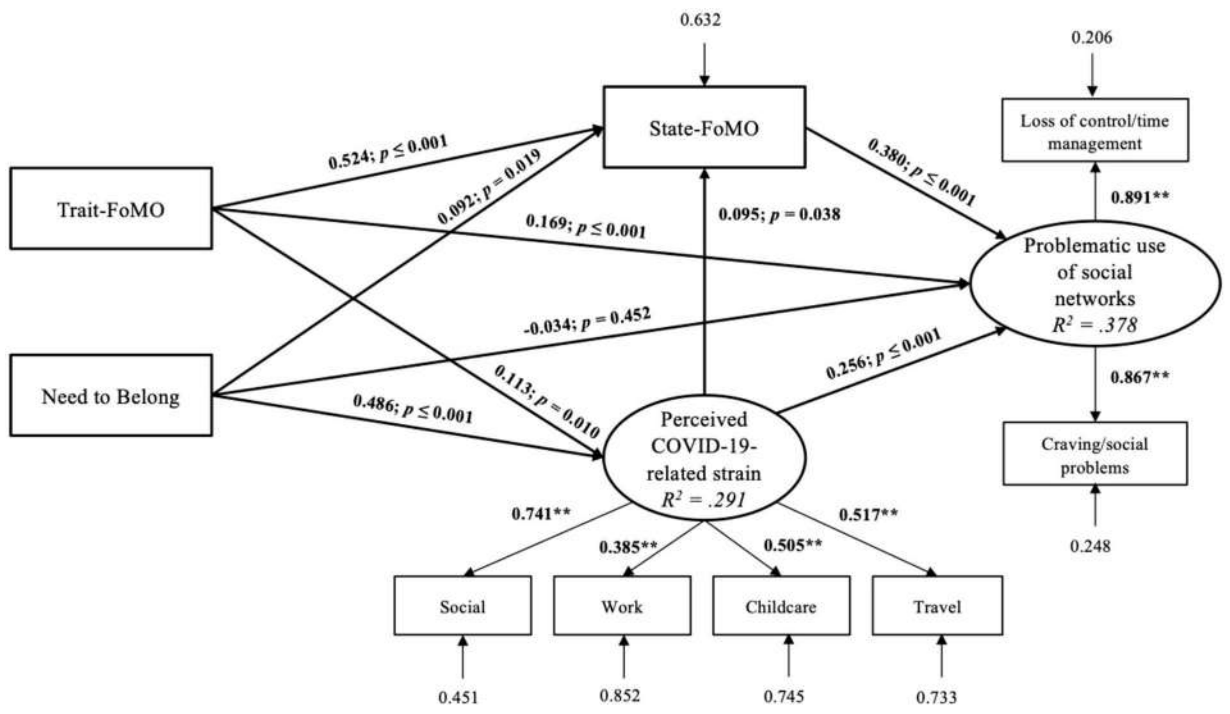

FIGURE 2 | Results of the structural equation model with problematic use of social networks as dependent variable including factor loadings on the described latent dimensions and the accompanying β-weights, *p*-values, and residuals. The directions of the hypothesized effects are illustrated by the arrows. The rectangles represent the manifest variables, depicted by the subscales of the questionnaires used. The ellipses illustrate the latent dimensions, which are created by the specific manifest variables.

TABLE 4 | Overview of the standardized coefficients illustrating the direct and indirect effects in the SEM.

	Effects	β	SE	*p*
Direct effects	Trait-FoMO—State-FoMO	0.524	0.029	<0.001
	Trait-FoMO—Strain	0.113	0.044	0.010
	Trait-FoMO—Problematic Use	0.169	0.043	<0.001
	Need to Belong—State-FoMO	0.092	0.039	0.019
	Need to Belong—Strain	0.486	0.041	<0.001
	Need to Belong—Problematic Use	−0.034	0.045	0.452
	Strain—State-FoMO	0.095	0.046	0.038
	Strain—Problematic Use	0.256	0.054	<0.001
	State-FoMO—Problematic Use	0.380	0.041	<0.001
Indirect effects	Trait-FoMO—State-FoMO—Problematic Use	0.199	0.025	<0.001
	Trait-FoMO—Strain—Problematic Use	0.029	0.013	0.027
	Trait-FoMO—Strain—State-FoMO—Problematic Use	0.004	0.003	0.106
	Need to Belong—State-FoMO—Problematic Use	0.035	0.016	0.026
	Need to Belong—Strain—Problematic Use	0.124	0.029	<0.001
	Need to Belong—Strain—State-FoMO—Problematic Use	0.018	0.009	0.040
	Strain—State-FoMO—Problematic Use	0.036	0.017	0.036

DISCUSSION

General Discussion of the Results

In the current study, the effect of subjectively perceived strain due to COVID-19-related restrictions on the symptom severity of a problematic use of social networks has been investigated. We also examined if the perceived strain as well as state-FoMO mediate the effect of social characteristics needs such as trait-FoMO and need to belong on the development and maintenance of the problematic behavior. We therefore developed a specific questionnaire assessing perceived COVID-19-related strain in several domains of everyday life. The results of an exploratory factor analysis identified a five-factor solution illustrating strain related to social contact restrictions, restrictions in the working context, childcare restrictions, travel restrictions, and health issues. Pearson correlation analyses showed that the strain due to COVID-19-related restrictions was associated with the tendency of a problematic use of social networks as well as with need to belong, trait-FoMO, and state-FoMO with small to medium effect sizes. As the only factor, the strain related to health issues showed no consistent correlations with the symptom severity and some of the other constructs. Rather than measuring perceived strain due to own health issues, it could be assumed that this factor is more related to a general fear or anxiety due to or of the COVID-19 virus itself [cf., (45)].

The structural equation model also outlines that the perceived strain could be identified as potential accelerating factor of the problematic social-networks use. The analysis demonstrates that trait-FoMO had a direct effect on the symptom severity, but that there had been a partial mediation effect by the COVID-19-related strain as well. There was no direct effect of need to belong on problematic use of social networks which indicates that higher social needs do not lead automatically to habitually using social networks and developing problematic behaviors. Rather, the results showed a full mediation effect of need to belong on symptom severity due to, among other, the perceived strain. These results highlight that individual characteristics and social needs such as the necessity for social connectedness and an alongside fear to miss out what friends and acquaintances experience, do not *per se* and isolated predict the problematic use of social networks. Instead, these findings assign a prominent role to the perceived strain or stress due to situational circumstances when investigating determining factors for an enhanced risk for a problematic use. In the I-PACE model, Brand et al. (20) also stress out that the subjective perception of situational factors, which are related to perceived stress and abnormal mood, could result in a higher risk of using the Internet dysfunctionally, or as a strategy to cope with stress. This is in line with the model of Compensatory Internet Use by Kardefelt-Winther (46) reflecting that using the Internet or social networks as for compensation and particularly as coping strategy could result in a problematic behavior. The author emphasizes the importance of considering environmental factors as complementary components that might trigger coping mechanisms or a problematic behavior. Referring to this theory, the COVID-19-related restrictions could be such environmental factors, especially since research already outlines that the Internet in general and social networks in specific represent coping strategies during the COVID-19 pandemic (1, 9, 14). Accordingly, individual differences in responding to situational circumstances and restrictions could trigger subjectively perceived strain or stress, affecting the relationship between personality aspects, and social needs, which does not determine, but may enhance the risk to use social networks problematically.

Besides the situational factors, the findings also show that internet-related cognitive biases as proposed in the I-PACE model (20, 21) are additional reinforcing factors leading to a higher risk of a problematic use of social networks. The effect of need to belong and trait-FoMO on the symptom severity was mediated by state-FoMO. It highlights that it is worth not investigating persons' core characteristics solely, but also specific cognitions and further reinforcing processes. Nevertheless, the results are in line with previous studies showing that social needs, psychosocial characteristics and emotional impairments (e.g., need for exchange, need to belong, perceived social support) are related to a problematic social-networks use in general [e.g., (18, 24, 26, 28, 29, 47)]. It has also been demonstrated that FoMO is a risk factor and in addition mediates the effect of psychopathological symptoms on symptom severity [e.g., (48–50)]. Comparable with Wegmann et al. (35), we would like to make this association even more precisely by differentiating between the general fear that others have rewarding experiences while being absent and the online specific state. Therefore, the current findings expand the empirical evidence since they highlight the outstanding position of online-specific FoMO as reinforcing mechanism of the relationship between predisposing factors and a problematic behavior. This process is part of the fear-driven/compensation-seeking hypothesis by Wegmann and Brand (18). The hypothesis outlines that high social needs and the expectancies to reduce feelings of social isolation and FoMO by using social networks may drive problematic behavior. The additional mediation effects of the structural equation model in this study indeed show that the effect of social needs on the symptom severity was mediated by the perceived COVID-19-related strain which was mediated by state-FoMO as well. The considerations of the fear-driven hypothesis can thus be expanded by that additional external strain may result in higher fear of missing out online, which could enhance the risk of a problematic use. This path is also postulated by the I-PACE model (20, 21) showing that a person's core characteristics (i.e., a tendency for social needs) impact on the situational perception of external triggers (i.e., COVID-19-related strain), which affect specific cognitions such as internet-related cognitive biases (i.e., state-FoMO), and then enhance the chance to experience a diminished control over the behavior.

The result that social needs may not automatically be associated with the problematic use of social networks impact the derivation of prevention and practical implications. It means that specific cognitions, but in particular fears, coping strategies, expectancies, the experience of gratification and compensation, as well as emotion regulation should be focused. Individuals who do not expect to experience gratification and compensation, to feel better or experience pleasure, and to deal with stress, negative emotions and fear exclusively online have a lower risk of developing a problematic use. Therefore, it is crucial to learn, posses, and be able to apply functional coping strategies and emotion regulation skills. The environmental and situational factors may facilitate these processes or—as it is the case of the restriction during the COVID-19 pandemic—complicate them. The gratification of social needs such as feelings of belonging or physical as well as real-life social contact are extremely limited by the strategy of social distancing. In a situation that may already be perceived as very stressful, further restrictions such as the closure of sport or leisure facilities makes it even more difficult to apply further coping strategies. The use of social networks or playing online games is an approach to deal with individual needs and fears, but since they carry the risk to be used dysfunctionally, the establishment of further strategies is of great importance. With regard to our results, we think that it could be of particular interest to address the perception of strain and stress as preventive mechanisms. The functional handling of perceived strain and stress may reduce the risk of an addictive behavior. Concurrently, it also includes the consideration which alternative coping strategies can be used to satisfy needs for connectedness and belonging while maintaining the strategy of social distancing, and to use social networks in this context functionally without using it as the only strategy for social well-being. Central aspects in cultivating resilience to distress admit the COVID-19 pandemic refer to the creation of meaning, for example by taking goal- and value-oriented activities (51) such as pursuing hobbies, physical activity, and a daily routine (1, 52, 53). Going outdoors, but also just looking outside has a potential to reduce, for example, depressive symptoms (52). Other possible indoor-activities that have an individual stress-reducing effect and help to handle one's emotions might include reading, writing, meditation and mindfulness exercises, and openly communicating arising emotions to family members or close friends (1). Further, some authors argue that strengthening a feeling of human interconnectedness and positive reappraisal/reframing of the current situation might soothe a feeling of social desertion (51, 53). Respective strategies that have been proposed include acceptance-based coping and loving-kindness practices (51). More specific propositions that directly target the use of social networks address the reductions of screen time per day, including the regulation of one's own as well of children's usage (1).

Finally, there are some limitations to be mentioned. In the current study, we developed a new questionnaire assessing perceived strain due to COVID-19-related restrictions. This self-report needs further validations, especially because it was constructed during a time period which was very dynamic and contained a high uncertainty in Germany. We highly recommend to apply this questionnaire in further studies during the COVID-19 pandemic and additionally to investigate convergent and divergent validity such as general fear and stress perception related to COVID-19 [see also (45, 54, 55)]. We also consider it important to discuss the sample of the current study in relation to previous findings. The average age represents a middle age about 50 years, which differs significantly from previous research mainly investigating student samples with an average age of 30 years. Since empirical studies already outlined that the problematic use of social networks could mainly be found in younger age or even in middle age (56–58), the lower symptom severity is not unexpected. However, it has to be considered that an increase of social-networks use and the Internet in general could be observed in elderly generations during the COVID-19 pandemic as well (6). Lastly, in the current study, we used cross-sectional data which is another important aspect to bear in mind. Even if this snapshot makes an important contribution to gaining knowledge of the potential development and maintenance of a problematic use of social networks during the COVID-19 pandemic, longitudinal studies are particularly important in this context. This would allow assessing the effect of long-term consequences of the perceived restrictions and the pandemic circumstances on individual well-being in general as well as on the social-networks use specifically.

CONCLUSION

Investigating the psychological effects on individual well-being during the COVID-19 pandemic is an important task in psychological research. This includes the question of how certain behaviors such as the use of social networks, but also potential addictive tendencies may change. The present study contributes to this question by examining the subjectively perceived strain due to the COVID-19-related restrictions in several life domains in relation to the problematic use of social networks and social needs. The results showed that for the development and maintenance of a problematic use, the effect of social needs should not be investigated in isolation, since internet-related cognitive biases and situational factors such as perceived strain may represent additional accelerating mechanisms. We conclude that social needs and fear-associated predisposing variables contribute to experiencing physical distance and other pandemic-related restrictions as more stressful, which may then increase problematic social-networks use in the context of the COVID-19-related lockdown. Reducing the subjectively experienced strains related to the COVID-19-related restrictions by clarification of facts and the importance of such restrictions and by considering stress-reduction techniques and mindfulness may be helpful for both dealing with the restrictions and preventing problematic use of social networks.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethics committee of the division of Computer Science and Applied Cognitive Sciences at the Faculty of Engineering, University of Duisburg-Essen. The ethics committee waived the requirement of written informed consent for participation.

AUTHOR CONTRIBUTIONS

EW, AB, and MB contributed to conception and design of the study as well as performed and interpreted the statistical analysis. EW and AB organized the database. EW wrote the first draft of the manuscript. AB and MB wrote sections, edited, and revised the manuscript critically. All authors read and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 23 April 2021
doi: 10.3389/fpsyt.2021.648273

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Availability of Illegal Drugs During the COVID-19 Pandemic in Western Germany

Norbert Scherbaum [1]*, *Udo Bonnet* [1,2], *Henning Hafermann* [1], *Fabrizio Schifano* [3], *Stefan Bender* [4], *Torsten Grigoleit* [5], *Jens Kuhn* [6,7], *Peter Nyhuis* [8], *Ulrich W. Preuss* [9], *Gerhard Reymann* [10], *Udo Schneider* [11], *Jo Shibata* [12] *and Michael Specka* [1]

[1] Department of Psychiatry and Psychotherapy, Medical Faculty, LVR-Hospital Essen, University of Duisburg-Essen, Essen, Germany, [2] Klinik für Psychiatrie, Psychotherapie und Psychosomatische Medizin, Evangelisches Krankenhaus Castrop-Rauxel, Castrop-Rauxel, Germany, [3] Psychopharmacology, Substance Misuse and Novel Psychoactive Substances Research Unit, University of Hertfordshire, Hatfield, United Kingdom, [4] Klinik für Psychiatrie und Psychotherapie, LWL-Klinik Marsberg, Marsberg, Germany, [5] Abteilung für Abhängigkeitserkrankungen, LVR-Klinik Langenfeld, Langenfeld, Germany, [6] Klinik für Psychiatrie, Psychotherapie und Psychosomatik, Johanniter Krankenhaus Oberhausen, Oberhausen, Germany, [7] Department of Psychiatry and Psychotherapy, University of Cologne, Cologne, Germany, [8] Klinik für Psychiatrie, Psychotherapie und Psychosomatik, St. Marien Hospital Eickel, Herne, Germany, [9] Vitos-Klinik für Psychiatrie und Psychotherapie, Herborn, Germany, [10] Suchtmedizin, LWL-Klinik Dortmund, Dortmund, Germany, [11] Medizinisches Zentrum für Seelische Gesundheit, Krankenhaus Lübbecke-Rahden, Lübbecke, Germany, [12] Substitution Outpatient Clinic, Health Department of the City of Cologne, Cologne, Germany

OPEN ACCESS

Edited by:
Hironobu Fujiwara,
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University of Hertfordshire,
United Kingdom

***Correspondence:**
Norbert Scherbaum
norbert.scherbaum@uni-due.de

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *31 December 2020*
Accepted: *04 March 2021*
Published: *23 April 2021*

Citation:
Scherbaum N, Bonnet U, Hafermann H, Schifano F, Bender S, Grigoleit T, Kuhn J, Nyhuis P, Preuss UW, Reymann G, Schneider U, Shibata J and Specka M (2021) Availability of Illegal Drugs During the COVID-19 Pandemic in Western Germany. Front. Psychiatry 12:648273. doi: 10.3389/fpsyt.2021.648273

Background: In response to the COVID-19-pandemic, a lockdown was established in the middle of March 2020 by the German Federal Government resulting in drastic reduction of private and professional traveling in and out of Germany with a reduction of social contacts in public areas.

Research Questions: We seek evidence on whether the lockdown has led to a reduced availability of illegal drugs and whether subjects with substance-related problems tried to cope with possible drug availability issues by increasingly obtaining drugs via the internet, replacing their preferred illegal drug with novel psychoactive substances, including new synthetic opioids (NSO), and/or by seeking drug treatment.

Methods: A questionnaire was anonymously filled in by subjects with substance-related disorders, typically attending low-threshold settings, drug consumption facilities, and inpatient detoxification wards from a range of locations in the Western part of Germany. Participants had to both identify their main drug of abuse and to answer questions regarding its availability, price, quality, and routes of acquisition.

Results: Data were obtained from 362 participants. The most frequent main substances of abuse were cannabis (n = 109), heroin (n = 103), and cocaine (n = 75). A minority of participants reported decreased availability (8.4%), increased price (14.4%), or decreased quality (28.3%) of their main drug. About 81% reported no change in their drug consumption due to the COVID-19 pandemic and the lockdown. A shift to the use of novel psychoactive substances including NSO were reported only by single subjects. Only 1–2% of the participants obtained their main drug via the web.

Discussion: Present findings may suggest that recent pandemic-related imposed restrictions may have not been able to substantially influence either acquisition or consumption of drugs within the context of polydrug users (including opiates) attending a range of addiction services in Germany.

Keywords: COVID-19, drug availability, cocaine, heroin, cannabis, novel synthetic opioids, novel psychotropic substances, pregabalin

INTRODUCTION

In March 2020 the Federal Republic of Germany, in line with other states, put a lockdown strategy into effect as a response to the threat of the COVID-19 pandemic. The aim of this was to prevent new infections and to reduce stress on the health care system, especially the intensive care units (1). The lockdown included a drastic reduction of personal traffic by aircraft, car, or train across international borders, while the transport of commercial goods, e.g., by trucks and ships, within Germany and internationally was largely unaffected by these restrictions. From July 1, 2020, the restrictions regarding traveling were partially reduced both in Germany and in the European Union.

Given these restrictions within public and private life, one could argue whether the availability of illegal drugs was reduced in parallel with the COVID-19 pandemic. For example, cocaine and heroin available in Germany typically arrive from South America and Afghanistan, respectively. Within the context of a general reduction of international traveling, one could expect decreased trafficking of these drugs to Europe and to Germany in particular. As possible consequences of the reduced availability of certain drugs, higher prices, increased levels of contamination, and increased levels of risk/criminal behavior in order to obtain drugs were assumed (2). Moreover, it was expected that a higher number of drug addicts would claim access to therapeutic care and/or that they would increasingly utilize online sources of illicit drug delivery in order to compensate for decreased availability of illegal drugs on the street market (3). Within the context of online drug acquisition, a shift to novel psychotropic drugs (NPS) (4) as a substitute for common illicit drugs [e.g., synthetic cannabinoids as a substitute for cannabis, cathinones as a substitute for cocaine or amphetamines, and new synthetic opioids (NSO) such as fentanyl analogues as substitutes for heroin (5, 6)] could also be anticipated as a possibility.

Soon after the first lockdown measures had been introduced in most European countries, several studies were conducted on their impact on legal and illegal drug use. This included wastewater analyses in several large cities, which for example found decreased use of MDMA, amphetamines, and cocaine (7, 8). Other studies, for example, documented increased cannabis consumption by cannabis users (9), local shortages of heroin supply, or an increase in alcohol consumption (7). It is important to note that some results were heterogeneous and variable between places, drug types, and types of users investigated.

The principal aim of the present study was to collect data from users of illicit drugs, regarding the availability of their preferred substances within the context of the COVID-19 pandemic; in addition, we tried to ascertain participants' strategies for coping with the anticipated reduced drug availability; it was hypothesized here that these strategies included self-referral to addiction services, online purchase of drugs, and a shift to the use of remaining drugs, especially NPS and NSO. In order to investigate these issues, a survey was carried out on clients in contact with the drug addiction health care system, with a special focus on those clients currently using illegal drugs (e.g., those attending low-threshold services such as drug consumption facilities and detoxification units).

METHODS AND MATERIALS

For this multicenter investigation, 14 institutions were included, and 12 agreed to participate; most of these institutions had already collaborated in previous clinical addiction research projects (10). These 12 facilities included a drug consumption facility with an associated meeting point for clients ("crisis café") ($n = 1$), a heroin prescription clinic ($n = 1$), inpatient detoxification wards ($n = 10$). In some of these institutions, the survey was also carried out in associated outpatient addiction services, e.g., opioid maintenance clinics (whose patients could be included if they concomitantly used illicit drugs). All facilities were situated in the Federal state North Rhine Westphalia: seven of them in the Ruhrgebiet, a metropolitan region; one in the large city of Cologne; and four (which recruited about one fifth of the sample analyzed) from smaller towns in rural areas.

For this survey a self-administered questionnaire with 37 items was designed. The questionnaire included questions regarding basic sociodemographic variables (age, sex), and presented a list of 15 legal or illegal psychotropic substances for which subjects should indicate the number of consumption days during the previous 30 days. The drugs presented were those identified as those used most frequently by drug users, in a comprehensive survey carried out recently (10). Subjects were then asked to identify their main drug (open question); regarding that main drug, they were then asked whether (a) its availability, price, or quality had changed after lockdown; (b) its use (with regard to frequency of use; shift to legal substances, including alcohol; shift to illegally acquired medications, such as benzodiazepines and pregabalin; shift to NPS and NSO) had changed; (c) a formal drug-related treatment (opioid maintenance or detoxification treatment) had been initiated, due to lockdown-related drug acquisition issues; and (d) drugs had been purchased online (ever purchased online, frequency of purchases, purchase for the first time during the lockdown). All these questions went with predefined answering options. To fill in the survey, subjects needed 10–15 min.

The survey was carried out between April 20 and September 9, 2020. The survey was developed by the addiction research team, partially based on the German version of the European Addiction Severity Index [EuropASI (11)] and discussed with single patients. A formal pilot phase was not carried out.

Participation was strictly anonymous and on a voluntary basis; no financial compensation for study participation was provided. In order to further guarantee respondents' anonymity regarding a survey presenting with drug acquisition/trafficking activities as a relevant topic, neither was a consent agreement signature requested, nor were participation rates or participants systematically recorded. The inclusion criterion was current (e.g., last 30 days) use of an illegal drug according to the German narcotics law; clients with no sufficient command of German or presenting with a manifest psychotic disorder were excluded. Ethical approval was granted by the ethics' committee of the University Hospital Essen (20-9350-BO).

Statistical analyses were carried out using descriptive statistics, in terms of absolute frequencies and percentages.

RESULTS

The total number of participants was 362. Out of these, 25 were excluded from data analysis, because the questionnaire was only partially filled in ($n = 2$), no main drug was indicated ($n = 5$), alcohol was indicated as the main psychoactive substance ($n = 11$), or a maintenance drug within maintenance treatment was identified as the main drug ($n = 7$).

The mean age of the 337 remaining clients was 38.5 (standard deviation [SD] 10.3); 262 (77.8%) were male. Most participants were multiple drug users (including illicit drugs, alcohol, and benzodiazepines, but excluding nicotine) with an average of 3.8 (SD 2.1; median 2) different substances used during the previous 30 days. Participants indicated as their main drug cannabis ($n = 109$), heroin ($n = 103$), cocaine ($n = 75$), amphetamines ($n = 34$), benzodiazepines ($n = 8$), pregabalin ($n = 3$), NPS ($n = 3$), Kratom ($n = 1$), or MDMA ($n = 1$). The largest proportion of participants was from in-patient drug detoxification facilities ($n = 178$; 52.8 %), followed by low-threshold facilities (drug consumption facility, associated counseling café, or heroin prescription clinic; $n = 127$, 37.7%), the remaining ($n = 32$, 9.5%) were from different settings, for example, maintenance clinics or out-patient services for the treatment of cannabis addiction.

Data from the three largest groups with respect to their main drug (heroin, cannabis, and cocaine) were further analyzed. The first set of statements concerned the availability of the main drug, its quality, and its price during the present COVID-19 pandemic (see **Table 1**). For all three main drugs, more than 80% of the subjects evaluated the availability of their main drug as unchanged compared with the situation before the lockdown. Conversely, only a small minority (heroin 10.8%, cannabis 8.3%, and cocaine 5.4%) reported that the availability of their main drug was reduced. About a third of the participants evaluated the quality of heroin (36.3%) and cocaine (34.2%) as having been reduced. Conversely, only 16.7% of the subjects reported a reduction in the quality of cannabis. About 75% in total (heroin 75.7%, cannabis 77.6%, and cocaine 74.3%) indicated that the price of their main drug was unchanged as compared to the pre-lockdown period, while <20% (for heroin and cannabis) and 10% (for cocaine) evaluated the price as having increased.

The second set of statements related with changes in the pattern of drug use associated with the COVID-19 pandemic (see **Table 2**). Most subjects (e.g., heroin users, 83%; cannabis users, 84.1%; and cocaine users, 73%) evaluated the frequency of the use of their main drug as unchanged compared with the period before the lockdown. Some 27% of clients for whom cocaine was the main drug reported a reduced frequency of drug use. Only some 10% of clients reported a shift to an increased use of legal substances, mainly alcohol. About 5% ($n = 14$) reported a shift toward illegally acquired medications such as benzodiazepines, pregabalin, or opioid maintenance drugs. Only a very small number of participants reported a shift to the use of NPS: one client shifted from cannabis as the main drug to synthetic cannabinoids and another shifted from the main drug heroin to NSOs. None of the participants reporting cocaine as their main drug shifted to the use of novel synthetic stimulants, such as cathinones, or "bath salts," etc.

A third set of statements concerned the initiation of treatment in the context of the COVID-19 pandemic as a consequence of changed availability or price in the context of the lockdown. In total, 8% of participants reported that they had started detoxification and/or had initiated maintenance treatment due to the COVID-19 situation.

The fourth set of items concerned the possible shift from street trafficking of drugs to an increase of drug ordering via smartphone or personal computer (see **Table 3**). Some 50–65% of participants reported having internet access, but only a minority of <10% reported having ever purchased drugs online. About five participants had acquired illicit drugs online more than five times, and one of them reported having carried out such online purchase activities more than 100 times in his/her lifetime. Conversely, online acquisition of illicit drugs during the pandemic was only carried out by single individuals, i.e., one subject reporting cannabis as the main drug and one subject reporting cocaine.

DISCUSSION

The federal state of North Rhine Westphalia, in which the present study was conducted, is a densely populated region in the Western part of Germany. About 10% of its 11 million residents aged 18–64 years show risky alcohol consumption (>12 g alcohol daily in women, >24 g in men) (12). The total 12 month prevalence of illegal drugs is 7.9%, most frequently cannabis (6.5%) but also amphetamines and methamphetamine (1.1%), MDMA/ecstasy (0.8%), novel psychoactive substances (NPS, including synthetic

TABLE 1 | Availability, price, and quality of the main drug.

			Main drug			
			Heroin (*n* = 103)	**Cannabis (*n* = 109)**	**Cocaine (*n* = 75)**	**Total (*n* = 287)**
Availability	Unchanged	*n*	84	90	61	235
		%	82.4%	82.6%	82.4%	82.5%
	Drug more accessible than before	*n*	1	0	2	3
		%	1.0%	0.0%	2.7%	1.1%
	Drug less accessible than before	*n*	11	9	4	24
		%	10.8%	8.3%	5.4%	8.4%
	Fluctuating levels of access	*n*	6	10	7	23
		%	5.9%	9.2%	9.5%	8.1%
Price	Unchanged	*n*	78	83	55	216
		%	75.7%	77.6%	74.3%	76.1%
	Decreased	*n*	3	5	4	12
		%	2.9%	4.7%	5.4%	4.2%
	Increased	*n*	20	15	6	41
		%	19.4%	14.0%	8.1%	14.4%
	Fluctuating	*n*	2	4	9	15
		%	1.9%	3.7%	12.2%	5.3%
Quality	Unchanged	*n*	65	90	48	203
		%	63.7%	83.3%	65.8%	71.7%
	Worse	*n*	37	18	25	80
		%	36.3%	16.7%	34.2%	28.3%

Note that some responses were missing for some questions.

TABLE 2 | Shift to other substances and initiation of a formal drug treatment because of problems with availability of the main drug during the COVID-19 pandemic.

		Main drug			
		Heroin (*n* = 103)	**Cannabis (*n* = 109)**	**Cocaine (*n* = 75)**	**Total (*n* = 287)**
No change in consumption of main drug	*n*	83	90	54	227
	%	83.0%	84.1%	73.0%	80.8%
Shift to legal substances (alcohol)	*n*	12	8	6	26
	%	12.0%	7.5%	8.1%	9.30%
Shift to illegally acquired medications, maintenance drugs	*n*	8	2	3	13
	%	8.0%	1.0%	4.1%	4.6%
Shift to synthetic cannabinoids	*n*	0	1	1	2
	%	0.0%	0.9%	1.4%	0.7%
Shift to synthetic stimulants	*n*	0	2	0	2
	%	0.0%	1.9%	0.0%	0.7%
Shift to new synthetic opioids	*n*	1	0	0	1
	%	1.0%	0.0%	0.0%	0.4%
Started a new episode of opioid maintenance treatment because of COVID-19 pandemic	*n*	7	4	0	11
	%	7.0%	3.7%	0.0%	3.9%
Started detoxification treatment because of COVID-19 pandemic	*n*	6	5	5	16
	%	6.0%	4.7%	6.8%	5.7%

Note that some responses were missing for some questions.

opioids), heroin (0.4%), or cocaine (1.0%). It was estimated that 1.2% of the population aged 18–64 years show a dependency [according to DSM-IV (13)] on one or more illicit drugs during a year, including 1.1% for cannabis, and 0.4% show substance misuse. Besides cultivation within the state, cannabis is supplied mainly through importation from the neighboring Netherlands, where a considerable share of the consumed amphetamine, methamphetamine, and MDMA is also produced; important

TABLE 3 | Online acquisition of illicit drugs.

			Main drug			
			Heroin (*n* = 103)	**Cannabis (*n* = 109)**	**Cocaine (*n* = 75)**	**Total (*n* = 287)**
Internet connection available to the subject		*n*	64	72	39	175
		%	64.0%	67.3%	53.4%	62.5%
Ever purchased drugs over the internet		*n*	10	6	5	21
		%	10.0%	5.6%	6.8%	7.5%
Purchase of main drug over the internet during the pandemic	No	*n*	98	105	72	275
		%	99.0%	97.2%	98.6%	98.2%
	Yes, for the first time	*n*	0	1	1	2
		%	0.0%	0.9%	1.4%	0.7%
	Yes, same frequency as before	*n*	1	1	0	2
		%	1.0%	0.9%	0.0%	0.7%
	Yes, more frequently	*n*	0	1	0	1
		%	0.0%	0.9%	0.0%	0.4%

Note that some responses were missing for some questions.

routes for the supply of heroin and cocaine from outside of Europe are via the large ports and airports of Belgium and the Netherlands (14). It was anticipated that lockdown measures and closing of borders would influence the quantity and quality of illicit drugs for users in contact with the drug treatment and low-threshhold services for drug addicts.

Summary of the Findings

In the present study, about 80% of the subjects did not report a reduced availability or an increased price of the illegal drugs heroin, cocaine, or cannabis. The quality of these drugs was evaluated as worse by 28.3% as compared with the period before the lockdown. Furthermore, only a small minority switched from their main drug to legal drugs, especially alcohol, or to illegally acquired medications such as benzodiazepines or gabapentinoids. Only one subject whose main drug was cannabis switched to synthetic cannabinoids, one heroin addict switched to NSOs, and only a few subjects initiated treatment due to a reduced availability of their main drug. In our sample, the lifetime experience of ordering illegal drugs online was low, e.g., <10%, and only two subjects ordered their main drugs for the first time during the COVID-pandemic.

Basic sociodemographic and clinical data (e.g., age around 40; mostly males; and typically polydrug users) of the present sample are consistent with the description of samples of illegal drug-using clients attending German drug services (10); in two recently published investigations carried out in Western parts of Germany addiction clients confirmed that heroin, cocaine, and cannabis were their main illegal drugs (10, 15), with very limited numbers of clients reporting NPS and NSO intake. Typical low-threshold addiction facilities' clients polydrug, including opiates, users. However, drug addicts might define cocaine or cannabis as their main (illegal) drug, especially in the case of maintenance treatment. However, consistent with recent inpatient detoxification treatment data from Western Germany (10), a growing problem of gabapentinoid misuse, predominantly among opioid addicts (16–18), with three participants having identified pregabalin as their main drug, was highlighted here.

Comparison With Previous Covid-19-Related Findings

Current results are not fully consistent with recent findings about drug abuse during the COVID-19 pandemic (7, 19). In April and May 2020, EMCDDA carried out the "European Web Survey on Drugs: COVID-19" (EWSD-COVID), in which more than 10,000 subjects of at least 18 years of age were asked about their use of illicit drugs (7). Some 46% of respondents reported a reduced use or no drug use during the lockdown. In particular, 20% of cocaine or MDMA users reported to have stopped the use of one of these drugs during the pandemic. In contrast, among current users of illegal drugs (defined as drug consumption during the last 12 months) some 25% reported an increased drug use, especially of cannabis (about 15%) and of alcohol (about 15%). Conversely, the EMCDDA expert opinions regarding availability and price of drugs, albeit not supported by empirical evidence, yielded a heterogeneous picture, with different situations in the different EU countries. Indeed, the price of cannabis was suggested to have increased in several EU member states, in parallel with a decrease in its availability. However, the European Web Survey focused on users of illicit drugs, not only on subjects with a clear drug addiction status.

A further document, elaborated by the EMCDDA in cooperation with Europol (19), concluded that the European drug supply scenario had not significantly reduced during the Covid-19 pandemic. In fact, while air trafficking was vastly reduced, the transport of commercial goods by ship, air freight, and so on had somehow continued during the pandemic, and this may have facilitated the transportation of drugs such as cocaine and heroin. In addition, the domestic production of cannabis in some European countries was not restricted by the COVID-19 pandemic (19). These issues may explain the lack of an overall significant reduction of drug supply during the pandemic, although there may have been illegal drug acquisition issues in some places. In Germany, this overall scenario was confirmed by the Federal Criminal Police Office (Ms. B. Hübner, spokeswoman for the Federal Criminal Police Office). In addition, even during the lockdown, several important drug seizures were successfully carried out in EU countries (18).

Lockdown measures made it more difficult to meet with dealers and friends and this may have led to a breakdown of the local street market for drugs. This could have facilitated the occurrence of other forms of drug trafficking, especially buying of illegal drugs online and delivery of drugs by post and parcel services. According to the EMCDDA (19), however, there was only a small increase in drug buying from the darknet during the pandemic. In our sample of polydrug addicts, including users of opiates, only 2/3 of respondents had internet access at all. Consistently with this, online drug acquisition activities during the pandemic were carried out here only by single individuals. Difficulties handling the web and especially the darknet (20, 21) with the related money transfer issues may have limited the availability of the online acquisition option in the current population of marginalized polydrug drug addicts with minimal resources. Conversely, the online option, which may well-include access to messenger services facilitating drug orders and deliveries, may be an easier option for those with a regular income and a routine use of the web. It must be stressed, though, that during lockdown, the internet and the world wide web also offered opportunities for continued "telehealth" care for patients with mental health issues, including those with substance use problems. This extends to online individual or group therapy (22, 23).

A significant reduction of the clients' main drug availability level was not here reported and this may have arguably reduced the need for a shift to NPS/NSO use. Consistent with this, recent data (10, 15) suggested that while about 40% of drug addicts open to addiction services had a lifetime experience with NPSs—and especially with synthetic cannabinoids—this use was sporadic, due to the often severe side effects experienced, which are a strong argument against repeated levels of use even for experienced drug addicts. As for NSOs, only one heroin user shifted here to the use of these substances; this is fully consistent with recent German data (15), but it contrasts with reports from the USA, where an opioid epidemic is occurring (5). There was also only a small shift toward more alcohol use. Previous studies in the general population in the United States or elsewhere found no sustained increase of alcohol use (24) or even decreases due to the discontinuation of social drinking events (8), and on the individual level, large proportions of subjects either increased or decreased their alcohol use during the pandemic. It must be stressed that in the present study increased alcohol use *per se* was not investigated, but rather the COVID-19-related shifts away from the main drug.

Finally, although long-term follow-up German studies have suggested that on and off treatment episodes alternate in the life of opiate addicts (25), the substantially unchanged levels of drug availability did prompt the need for the initiation of a new treatment (e.g., maintenance or detoxification treatment) episode in only <10% of interviewees.

Limitations

Only a minority of subjects from the participating inpatient detoxification wards and some 50% of those attending drug consumption/low-threshold facilities participated in the survey, and this may limit the generalizability of current finding. According to the study design, questionnaires were handed out to those subjects who satisfied the study inclusion criteria; however, to respect anonymity, there were no specific checks to assess whether questionnaires were *de facto* filled in by the individuals themselves. No measures were taken here to increase the response rate. In addition, the main drug was self-reported by the interviewees, not by the clinician. However, current sociodemographic and clinical data were here fully consistent with those characterizing samples taken from addiction services in Germany (10).

CONCLUSIONS

Current findings may support the idea that at least in the first part of 2020 the pandemic-related imposed restrictions may not have been able to substantially influence the demand, acquisition, and consumption of drugs within a context of polydrug users, including users of opiates, attending a range of addiction services in Germany. Further studies, focusing on the issues relating to the persistence of the current pandemic, should be carried out to assess the impact of confinement on these vulnerable clients drug intake.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethikkommission des Universitätsklinikums Essen, Robert-Koch-Str. 9-11, 45147 Essen, Germany ethikkommission@uk-essen.de. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

NS, MS, and HH planned and designed the empirical study. NS, UB, HH, SB, TG, JK, PN, UP, GR, and JS planned the data collection and participated in defining and accessing the study population. NS, UB, FS, and MS wrote the manuscript. SB, TG, JK, PN, UP, GR, and JS reviewed the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

This study was conducted as part of the project JUSTSO, funded by the European Union's Justice Programme—Drugs Policy Initiatives (number 806996—JUSTSO—JUST-2017-AG-DRUG).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.648273/full#supplementary-material

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Conflict of Interest: NS received honoraria for several activities (advisory boards, lectures, manuscripts) from the factories AbbVie, Camurus, Hexal, Janssen-Cilag, MSD, Medice, Mundipharma, Reckitt-Benckiser/Indivior, and Sanofi-Aventis. During the last three years he participated in clinical trials financed by the pharmaceutical industry.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer SC declared a shared affiliation with one of the authors, FS to the handling editor at time of review.

frontiers in Psychiatry

PERSPECTIVE
published: 30 April 2021
doi: 10.3389/fpsyt.2021.618508

Cyberchondria Amidst COVID-19 Pandemic: Challenges and Management Strategies

*Rahul Varma, Sreeja Das and Tushar Singh**

Department of Psychology, Banaras Hindu University, Varanasi, India

The corona-virus disease 2019 (COVID-19), first found in Wuhan, China in December 2019, has posed an inexplicable threat to the global community. After its inception, the virus proliferated rapidly, which led to the cause of millions of deaths, and having a detrimental effect on physical health, social lives, economic uncertainty, and mental health of people. The World Health Organization has reported that there are 111 million confirmed cases of COVID-19 and 2.45 million deaths due to COVID-19 worldwide. Indisputably, the present pandemic has contributed to the extensive psychological and environmental distress together with clinical depression, anxiety and post-traumatic stress disorder (PTSD), domestic violence, and unemployment. Due to the ambiguous nature of the pandemic, educational organizations, and outdoor activities are closed, thus burdening the mental health of younger populations. Children as well as youths are more glued to the Internet for their studies, online gaming, shopping, watching movies, and searching health-related information. Despite the advantages of using the Internet, it has some severe consequences too. Some people are repeatedly searching for physical and mental well-being related information without verifying credible sources, which, in turn, causes distress and anxiety. In such situations, individuals may end up contributing to an illness known as cyberchondria. In this paper, we have tried to highlight the problematic use of Internet for health-related searches and have outlined the management of such illness. We suggest two strategies: firstly, to reduce repeated online searches of health information and, secondly, to manage anxiety-augmenting thoughts that are triggered due to the maladaptive thoughts caused by the abstruse information.

Keywords: cyberchondria, COVID-19, health, health related internet searches, Covid anxiety

OPEN ACCESS

Edited by:
Ornella Corazza,
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Reviewed by:
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Sapienza University of Rome, Italy
Jucier Gonçalves Júnior,
University of São Paulo, Brazil

****Correspondence:***
Tushar Singh
tusharsinghalld@gmail.com

Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *19 October 2020*
Accepted: *08 March 2021*
Published: *30 April 2021*

Citation:
Varma R, Das S and Singh T (2021) Cyberchondria Amidst COVID-19 Pandemic: Challenges and Management Strategies. Front. Psychiatry 12:618508. doi: 10.3389/fpsyt.2021.618508

INTRODUCTION

The global trudge of COVID-19 is beginning to look inexorable. The WHO reported cases of pneumonia due to an unknown cause in the Wuhan city of China on December 31, 2019. On further probing, Chinese authorities identified the novel virus as coronavirus on 7th January and was provisionally named as "2019-nCoV." As the year 2020 progressed, numerous cases of the novel coronavirus proliferated in most cities of China, and due to its highly permeable nature, the virus transmitted rapidly to other countries; therefore, the WHO declared it as a pandemic on March 11, 2020. As of February 22, 2021, there have been 111,114,777 confirmed cases of COVID-19 and 2,461,436 deaths (1) due to this pandemic. In the interim, recent research projects have focused on new symptoms, diagnosis, management, and development of vaccine and drugs (2).

Pulla (3) reported that India observed its first COVID-19 positive patient on January 31 and the nationwide lockdown in India was initiated from March 24, 2020 and was extended until May 31, 2020. Although the unlocking phase was initiated in June 2020, many schools, colleges, and universities are still not functional. This extended quarantine period and the control measures associated with COVID-19 have their enormous effects on masses (4, 5). The Indian Express (6) outlined the guidelines of unlock of 5.0 by stating that the Indian government has allowed to open schools, theaters, and swimming pools in many states of the country in mid-October while maintaining social distancing norms, wearing masks, and thermal scanning at every entry point. In India, it was the first time that such a restrictive course of action was taken to restrain the contamination. These measures, thus, have greatly affected the lifestyle (e.g., education, working, and social interactions) of the people.

Recent reviews propounded that the psychological repercussions of social distancing and isolation are substantial, are broad ranging, and can be enduring, comprising mood disorder and anxiety, PTSD and psychological distress, and other psychopathological conditions (7, 8). Some studies have revealed that availing the Internet and social networking forums for reduction of stress, fear of illness, and anxiety has elevated amid the COVID-19 pandemic, and for individuals, problematic Internet use (PIU) may fall along with the reduction of stress and anxiety (9, 10). Searching health information on the Internet can also be problematic; if individuals are using the Internet as a diagnostic tool for their illness, with less or no medical literacy, it will probably heighten their anxiety (11).

People diagnosed with hypochondriasis are prone to look for medical information because of their fear of illness (12, 13). When individuals with their somatic symptoms, health anxiety, and distress use social media and the Internet to get the information associated with their health, they are embodied as having cyberchondria (14). Cyberchondria has not been included so far as a distinct diagnosis in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (15), but it is a kind of anxiety disorder in which individuals conduct an Internet search and, based on the search result, they conclude that they have an illness (16). Mostly, they discern the illness in perilous form, which shoots up their anxiety and fear (14).

PSYCHOSOCIAL IMPACT OF COVID-19 PANDEMIC

The present pandemic has globally impacted not only the health but also the economic status of individuals (17). The pandemic and the resulted lockdowns imposed by the Governments to stop the spread of the disease have resulted in various psychological issues including, but not limited to, clinical depression, anxiety, post-traumatic stress disorder (PTSD), Suicidal ideation and suicide (18), domestic violence (19, 20), Stigma, discrimination (21) and unemployment. Not only the general population but also the frontline healthcare professionals have been reported to experience psychological distress, anxiety, depression, delusion, Suicidal thoughts and death (22–24). Besides, the global health distress, the COVID-19 pandemic has a detrimental upshot on the world economy as well, which has resulted in the depreciation in the overall GDP (25). The inescapable nature of the pandemic has malformed the Indian economy leaving the country shattered and directionless (26). Chaudhary et al. (26) highlighted the catastrophic condition of daily wagers, migrant workers, and MSMEs (micro, small, and medium enterprises), which resulted in a major threat to the economy of the country. In the current situation, after 9 months of being unlocked, the MSMEs are on a spree of opening shops in the most vulnerable locations to meet their basic needs.

With the continuous rise of the infection, there is an increasing rate of health-related issues among people (27). Shadmi et al. (28) reported that frontline professionals and workers, who are comparatively more exposed to public, are more vulnerable to this infection. They also stated that the people who belong to lower economic strata and migrant workers are more susceptible to infection and fail to seek help due to unavailability of finance and poor access to healthcare facilities. This leads to poor prognosis, which may result into death. According to Arumugam et al. (29), patients with comorbid diseases such as hypertension, diabetes, and heart disease have a higher mortality rate. Adding to the problems, due to the infectious nature of the pandemic, some necessary treatments and surgeries have been delayed for patients who are diagnosed with cancer or other major illnesses (30) and the delay of such surgeries for tumors has resulted in the advancement of the tumors from treatable to untreatable (31). According to The Lancet Rheumatology (32), there are also delays in elective surgery, i.e., surgery that people choose to have a better quality of life but not for a life-threatening condition, e.g., hernia surgery, cataract surgery, cardiovascular surgery, etc., and also some orthopedic surgeries such as for osteoarthritis. These diseases often cause debilitating discomfort that interrupts mobility and obstructs with daily routine. Living with chronic pain induced by an illness or a disease may result in substance abuse and impaired mental health.

The pandemic has stemmed to limit face-to-face contact. Zero physical contact has led to disrupted social lives contributing to antagonistic psychological upshots including loneliness, clinical depression, trauma, domestic violence, and health anxiety (33). Adverse cases of obsessive-compulsive disorder are also observed, which are caused by decreased belief in healthcare structure and people are donned with fear of contracting the infection (34). Recent studies have also suggested prevalent symptoms of PTSD also due to the aftermath of this current pandemic (35).

It can, therefore, be concluded that the current COVID-19 pandemic is giving considerable rise to physical and psychological stress and high morbidity and mortality rates all over the world since its upsurge in December 2019 (36, 37). Jalloh et al. (38) found in their research that up to 50% of the respondents in their studies reported anxiety or worries during virus-induced pandemics or epidemics. Also, in a few recent studies conducted in China among general population and adults, it was found that about 25–35% of respondents experienced psychological stress or anxiety symptoms during the COVID-19 pandemic (36, 39).

CYBERCHONDRIA LINKED TO PSYCHOLOGICAL HEALTH, ANXIETY, AND STRESS

The Internet has crawled into people's lives and has gradually become an umbilical to the peripheral world. Individuals are dependent on Internet connection for majority of reasons as it has replaced schools, jobs, and face-to-face communication with family and friends. Although online health-related information search has some latent benefits that help to enlighten people about ailments, their remedies and treatment (11), some people are repeatedly searching physical and mental well-being-related information to quench their thirst of queries, which, in turn, causes distress and anxiety (40).

The abnormal practice of searching health information on the Internet to alleviate stress and anxiety but instead worsening the condition is called cyberchondria (41). It refers to the unfounded increase in concerns about general symptomatology, which is based on Internet search results (11). Cyberchondria has been inextricably linked to escalated health anxiety, stress, and depression and is also associated with obsessive-compulsive disorder (OCD) (14, 42–44). Sarkar (45) reported that the detrimental effect is mainly pictured in the youth population, which is techno geek. He further added that cyberchondria elevates distress consecutively causing high blood pressure, anxiety, and muscle spasm, which are generally triggered by an event like a sick person or the news of a death of someone close to them.

In the present world, the World Wide Web is the source for almost every piece of information for most people. Many of us access the Internet on a daily basis to get different kinds of information from it. And now we have also started using also the Internet to get health-related information. There are many websites available on the internet that can give us misleading information about health-related conditions and this can escalate anxiety and stress. Self-diagnosis and self-treatment may put people at risk as they have less or no medical knowledge and do not have descriptions for the medical conditions. These factors cumulatively make searching the Internet for health-related information more misleading and dangerous (46).

A recent study conducted in Oman by Al Dameery et al. (47) shows that there is a strong correlation between cyberchondriac experience and psychological stress. In their meta-analytic study, McMullan et al. (15) have presented a significant relationship between cyberchondria and health anxiety and have demonstrated the commonality between the two constructs. Using a structural equation modeling approach, Fergus and Russell (48) found that while cyberchondria overlaps with the affective (health worry) and perceptual components (increased vigilance for physical symptoms) of health anxiety, it does not relate to its cognitive (dysfunctional health beliefs) and behavioral components (avoidance or reassurance seeking). These results, together with other studies (49, 50), suggest that cyberchondria is an overlapping, yet distinct, entity in relation to health anxiety.

PREVALENCE OF CYBERCHONDRIA DURING COVID-19

As per the Internet World Stats (51) data ∼4.93 billion people worldwide are Internet users (September 2020), and most of its users are substantially located in Asia (51.8%) followed by Europe (14.8%) and Africa (12.8%). North America has the greatest Internet penetration rate (% of population using the Internet) at 89.9%, with Europe at 87.1%. The world average Internet penetration rate is 63.2%, indicating that the Internet has become the established medium for the dissemination of targeted messages to a huge audience (51). The Internet has become an alternative for a health practitioner, as outlined in a survey study conducted across 12 countries, where more than 12,000 individuals participated and showed that nearly half of them used "Google" as a search engine for self-diagnosis (52). The Telegraph (An Indian English daily newspaper) in March 2019 quoted the vice president and MD, of Google Health, saying that ∼7% of daily Google's searches belong to health-related searches, which account for about 70,000 searches per minute.

Due to the stay-at-home order by the governments during the COVID-19 pandemic, institutional organizations are closed, and people are asked to work from home. As a result, people's daily lives are being governed by the Internet like never before (53). Additionally, due to online classes, and work from home arrangements people are spending much more time on social media and playing online video games (54). When we compare the COVID-19 pandemic from previous large-scale epidemics, we get one novel issue related to mental health and this is the increased problematic use of the Internet (9). This may be because of the prolonged period of home quarantine and restrictions on face-to-face contact; because of which, people may undergo through greater distress and seek an escape through online activities (55). People's insecurity and anxiety for the disease can push them toward compulsive checking for information online which further escalate their anxiety, creating a vicious cycle of cyberchondria that is hard to stop (56, 57).

People perform all these health-related searches to reduce their stress and anxiety about the COVID-19 pandemic, but it may develop into habits of Internet searching and surfing that are difficult to break (58). The Internet and social media are flooded with information related to COVID-19. In news and articles, most of the pieces of information were discovered to be incomplete and inaccurate (59). Doherty-Torstrick et al. (60) found that truckloads of news information obscurely bundled with the curiosity on the epidemic situation heightened the health anxiety.

The novel case of COVID-19 came up rapidly, and this developed phobia among individuals. There are news and information all over the Internet and social media, and people started spending more and more time to collect information about it. These information, however, are not always authentic. Sometimes they are from some reliable sources but for most of the times they are only rumors and/or are based on false/misleading information/sources. This further adds to confusion in recognizing actual circumstances.

When these pieces of information are being produced and transferred speedily, most of the information is not put together and introduced in an optimal and perspicuous way. It creates vagueness among people, and it contributes to cognitive overload, which could be corroborated from previous studies which suggested that cyberchondria is correlated with cognitive overload (11) and uncertainty (61). Also, in a latest research Laato et al. (62), found that cyberchondria is a side effect of the COVID-19 pandemic. The main reason mentioned by them is increased trust on online content, which leads to sharing unverified information. Laato et al. (62) identified a positive correlation of cyberchondria with four major factors: reliance on the information a person is getting from online resources, information overload, perceived severity, and perceived vulnerability. It is, thus, the need of the hour to manage the implications of cyberchondria as the world is facing a global pandemic.

MANAGEMENT IMPLICATIONS

Due to the exponential increase in the role of the Internet in today's world, it is impossible to cut down on online searches of health-related information. Henceforth, it is imperative to manage and monitor the content of online searches. Though the treatment of cyberchondria is in its post-natal stage, researchers have developed a tool for its diagnosis, and little analytic attention has been paid in regard to its treatment. Cyberchondria has been included neither in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) nor in the International Statistical Classification of Diseases and Related Health Problems (ICD-11). This article builds on and contributes to discussion about the two aspects of treatment: the first aspect is to repeatedly curtail online health-related searches, and the second aspect is to manage anxiety-amplifying thoughts that arise due to the distorted cognition caused by ambiguous information. Starcevi and Berle (16) claimed that a person might primarily adhere to medical sites or forums that are credible and reliable, and then can eventually shift to critically appraising the content of the information. Instead of imposing the opinion to isolate oneself from the internet, one should stay online in a controlled fashion to avoid threatening and alarming information and a regular check-up with a doctor is a must for someone who notices any kind of abnormality in his or her body.

Due to the upsurge of the Internet and its accessibility, the youth is blindly following online information without thinking of its integrity. Henceforth, family members should educate their wards to be aware of the reliability and validity of the information source. This could be corroborated with the existing findings of Starcevi and Berle (16), who emphasized that, irrespective of the underlying factors, psycho-education is indispensable to improve online health reliant information literacy.

Psycho-education can play a significant role in reducing the effect of cyberchondria. Once the symptoms of cyberchondria have been diagnosed, it is essential to inform the patients about its detrimental effects and all the possible outcomes. We can make them aware of the negative consequences of their problematic use of the Internet for health purpose. Educational policies should be designed to advice patients about the credibility of online health searches, understand the information, and then incorporate it into their lives to manage their health problems (16, 42).

The increase in the online search of health-related information could be due to expensive doctor's visiting fees and treatment. Also, mistrust could also be a reason to avoid visiting doctors (63). Therefore, it is advisable for doctors to form a rapport with their patients and lend them an ear to understand their thought process and belief system, and clarify their doubts.

Metacognitive beliefs, particularly about the uncontrollability of thoughts, appear more relevant to cyberchondria (64) metacognitive treatment strategies, thus, become an important part of it's treatment package. The treatment helps in restructuring negative metacognitive beliefs. For instance, individuals may indulge themselves in detached mindfulness which is a novel metacognitive technique that focuses on memory, increases metacognitive awareness, and detaches oneself from predisposed thinking (65). Further the engagement phase, mainly focus on attentional modification and challenging metacognitive beliefs with respect to Internet use. During this phase, one may indulge in situational attentional refocusing, which impedes the patterns of set attention, maintains perceptions that are menacing, and enables the inconsistent metacognitive beliefs. Spada (66) sketched that individuals may cultivate the skill to purposefully guide their attention to non-verbal signals so as to stop themselves from indulging in repeated online searching behavior for health-related information.

At this point of time when the world is facing a global pandemic, with the sudden restrictions and limitations, it is problematic to visit a doctor every now and thus, one should focus on e-counseling from certified counselors or psychologists. Newby and McElroy (67) found in their study that people have experienced improvement in treating cyberchondria after getting the Internet-based Cognitive Behavior Therapy (iCBT). They found that following iCBT, there were major improvements on distress, compulsion, and excessiveness subscales of cyberchondria and moderate improvements on reassurance subscales. The result of this study suggests that the iCBT may help to reduce the repetitive behavior of online search of health information, the distress it caused, and lessen the effect of online searching on daily activities. The iCBT may also motivate people to consult with a health professional or an expert of that area to seek reassurance.

DoctorxDentist is a Singapore-based online medical portal that offers a convenient and easy way of getting information about COVID-19, and it also helps people avoid fake information. The DoctorxDentist platform provides specialist doctors and experts from the medical field, and these doctors and experts are well aware of the causes and consequences of cyberchondria. In this pandemic situation, the platform is providing articles related to COVID-19 for free to people who are searching for them. There is a team of doctors available for any kind of questions and queries. An individual may contact them for any query s/he has and the same would be answered by an expert doctor from the team. The same doctor can also be approached for an appointment if the individual develops any symptom related to any illness. It, therefore, is also a good initiative to prevent people from getting fake information online and also keep them away from information overload.

Furthermore, with the existing scenario of COVID-19, zero contact with the outer world and constant news of mishap compel one to stay active and worry about one's health. Thus, it causes citizens to neglect the above-mentioned activities to alleviate anxiety-intensifying thoughts. Consequently, it is cardinal for family members, if staying with patients, to closely monitor and regulate their daily activities. Parents should spend more time with their children and participate in fun activities, for example, scrabble, monopoly, painting, or dancing, thus creating a healthy environment. This would increase coping skills and create a stronger support network for priority groups. Anxiety-provoking thoughts could be further alleviated with the practice of relaxation techniques, yoga, and mindfulness.

CONCLUSION

The world has come to a standstill due to the COVID-19 pandemic. It has left a trail of destruction that is unprecedented in recent public memory, with 111,114,777 cases and global death surpassing 2,440,000 reported to date (1). Such epidemic took a toll on the mental health of the citizens. Adjusting to new lifestyle challenges, for example, working from home, attending online classes, and no contact with the outside world, has become very challenging for the entire world. In the existing scenario, indulging in maladaptive activities has also become logical. Citizens, particularly the youth, who have been constantly glued to the media, are indulging themselves in health-related online searches. The repetitive health-related online searches from unreliable sources have led to the maximization of anxiety-provoking symptoms called "Cyberchondria" which is a form of excessive health-related online searches by people who are extremely concerned and anxious about their health, which often results into a perplexed state of mind.

Although many researchers are working on cyberchondria, a separate manual for its treatment remains unexplored and unexamined. It is advisable to include cyberchondria as a disorder in one of the diagnostic manuals as such symptoms are often observed across the globe. In the current situation, citizens are often afraid to visit a doctor. Therefore, it is suitable to opt for e-counseling, which is provided at no cost or with minimal charges keeping the pandemic in mind. The counselors should focus on uploading online materials to educate the priority group to understand more about their behaviors and thoughts in an adaptive fashion. One should also be trained to differentiate between reliable and non-reliable sources and to try techniques such as mindfulness, meditation, yoga, and relaxation to calm oneself. Parents are also recommended to spend time with their children, monitor their day-to-day behavior, and also decrease their screen time. Finally, with the increase in digitalization, the decrease in Internet usage is not plausible; hence, it becomes vital for people with cyberchondria to be able to use the Internet in a controlled manner.

LIMITATIONS AND FURTHER SUGGESTIONS

The present article attempts to highlight the theoretical perspective of cyberchondria and its upsurge during the pandemic. However, this article is not devoid of limitations. Despite the article discussing about the possible strategies to prevent cyberchondria, it does not provide any empirical evidence in its support. Thus, future studies should focus on the planning and administration of these strategies to evaluate their effectiveness. Also the present paper did not put emphasis on susceptible factors causing cyberchondria, for example, hereditary factors and dispositional factors. Therefore, future studies are needed to explore the factors, other than repeated online health searches, which can lead to cyberchondria. The future studies should also put emphasis on the relation between cyberchondria and other forms of PIU and psychopathological underlying morbidities (14).

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

RV, SD, and TS conceptualized the outline of the manuscript. RV and SD prepared the first draft and final version of the manuscript. TS reviewed the manuscript and provided critical observations. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 26 May 2021
doi: 10.3389/fpsyt.2021.633551

Changing Patterns of Substance Use During the Coronavirus Pandemic: Self-Reported Use of Tobacco, Alcohol, Cannabis, and Other Drugs

Annemieke Benschop[1]*, *Floor van Bakkum*[2] and *Judith Noijen*[2]

[1] *Centre of Expertise Urban Vitality, Faculty of Health, Amsterdam University of Applied Science, Amsterdam, Netherlands,*
[2] *Jellinek Prevention, Arkin, Amsterdam, Netherlands*

OPEN ACCESS

Edited by:
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United States

Correspondence:
Annemieke Benschop
w.j.benschop@hva.nl

Specialty section:
This article was submitted to
Public Mental Health,
a section of the journal
Frontiers in Psychiatry

Received: 25 November 2020
Accepted: 27 April 2021
Published: 26 May 2021

Citation:
Benschop A, van Bakkum F and Noijen J (2021) Changing Patterns of Substance Use During the Coronavirus Pandemic: Self-Reported Use of Tobacco, Alcohol, Cannabis, and Other Drugs.
Front. Psychiatry 12:633551.
doi: 10.3389/fpsyt.2021.633551

As in many other countries worldwide, the coronavirus pandemic prompted the implementation of an "intelligent lockdown" in the spring of 2020 in the Netherlands, including the closure of nightlife venues and cancellation of festivals. Such restrictions and social distancing could particularly affect people who use alcohol or other drugs in recreational settings and give rise to new challenges and additional needs in the field of addiction prevention and care. To monitor changes in substance use and provide services with practical directions for tailored prevention, an anonymous web survey was set up, targeting a convenience sample aged 16 years or older through various social media and other online channels. Between May and October 2020, a total of 6,070 participants completed the survey, mainly adolescents and young adults (16–24 years old). These data were used to explore and describe changing patterns in substance use. Overall results showed declined current use compared to "pre-corona," but mask underlying variation in changing patterns, including discontinued (tobacco 10.4%, alcohol 11.3%, cannabis 16.3%, other drugs 30.4%), decreased (tobacco 23.0%, alcohol 29.1%, cannabis 17.4%, other drugs 20.7%), unchanged (tobacco 30.3%, alcohol 21.2%, cannabis 22.3%, other drugs 17.3%), increased (tobacco 29.6%, alcohol 32.1%, cannabis 32.9%, other drugs 25.3%), and (re)commenced use (tobacco 6.7%, alcohol 6.3%, cannabis 11.1%, other drugs 6.2%). Especially the use of drugs like ecstasy and nitrous oxide was discontinued or decreased due to the lack of social occasions for use. Increased use was associated with coping motives for all substance types. As measures combatting the coronavirus may need to be practiced for some time to come, possibly leading to prolonged changes in substance use with lingering "post-corona" consequences, timely and ongoing monitoring of changing patterns of substance use is vital for informing prevention services within this field.

Keywords: COVID-19, coronavirus, substance use, tobacco, alcohol, cannabis, drugs

INTRODUCTION

The pandemic of coronavirus disease 2019 (COVID-19) has massively affected the lives of people all over the world. Countries have taken drastic measures to contain the outbreak, from curfews to national quarantines. In March 2020, the Dutch government implemented a so-called "intelligent lockdown" to mitigate the spread of the virus. Daycare centers, schools and universities were closed, as were sports clubs, libraries, cinemas, theaters, museums, restaurants and nightlife venues; large social gatherings and events were canceled; almost all "contact professions" (e.g., hairdressers, driving instructors, physiotherapists) were suspended; both public and private meetings of people from different households were rigorously restricted; and 1.5-m social distancing and work-from-home orders were issued. In June most measures were lifted or relaxed (provided 1.5-m distance was maintained, thus restricting numbers of guests and customers), though festivals and club nights remained prohibited. However, rising infection rates warranted gradually more stringent measures from August onwards, yet again impeding social occasions like sports games, cultural outings, going out for drinks or dinner, or inviting friends to a party at home.

The impacts of both the coronavirus and the measures taken to reduce its spread are severe and disrupting on many societal levels, including public mental health (1, 2). Several authors have predicted or expressed concern about increased substance use liability due to emotional distress (3–9). However, Rehm et al. (10) postulated two (not mutually exclusive) scenarios with opposite predictions regarding the impact of the current pandemic on the level and patterns of alcohol consumption. The first scenario predicts an increase in consumption due to psychological distress, while the second scenario predicts a lowered level of consumption due to decreased physical and financial availability.

There is a growing amount of literature about the coronavirus and substance use, but many of these studies address the heightened risks of people using substances in contracting the virus or having poorer disease prognosis [cf. (11)]. Research into changing patterns of substance use is less common and often limited to alcohol and/or tobacco (12–24); some studies (also) look into changes in the use of cannabis (25–30), but few were found that included other drugs like "party drugs" that tend to be predominantly used in social contexts affected by the coronavirus measures (31–33).

Measures combatting the coronavirus may need to be practiced until 2022 (34), possibly leading to prolonged changes in substance use with lingering "post-corona" consequences. Health policy makers and services are expected to proactively address the emerging changes and related risks needs. Monitoring changing patterns of substance use is therefore vital for prevention and addiction care when developing and delivering appropriate public health responses and interventions. With all festivals being suspended and nightlife venues closed due to the "intelligent lockdown," prevention practice lost sight of a large and important group of people who use alcohol and other drugs in recreational settings. At the same time, restrictions and social distancing could particularly affect this population, resulting in changing substance use patterns and practices with associated risks. A signaling tool was rapidly needed to provide prevention services with practical directions for relevant and tailored educational information to promote healthy behaviors within this field.

Antenna Amsterdam (35) is an ongoing monitoring scheme that has been documenting developments and trends in recreational substance use in the Dutch capital since 1993, making it the oldest of such monitors running in Europe (36). Part of the mixed-methods approach is an annual on-site survey among varying target groups, including pub-goers and visitors of clubs and dance events. To address the needs of prevention services throughout the Netherlands for timely directions for targeted action an alternative nationwide online survey was set up. Interim national and regional results of the survey were regularly shared in dashboards and infographics within the Dutch network of prevention organizations to monitor changes in substance use patterns.

This paper is based on partial and preliminary data from this survey. Since the survey cannot be used to estimate drug use prevalence of the general population (37) and was not designed as an epidemiological effect study, the aim of this paper is not to test pre-formulated hypotheses about the impact of measures combating the coronavirus on public health, but to explore and describe changing patterns in substance use. Using the survey data we aim to assess to what extent the aforementioned scenarios of increased and decreased alcohol consumption (10) have taken place among people who use alcohol in the Netherlands, and if these scenarios also apply to the use of tobacco, cannabis and other drugs.

MATERIALS AND METHODS

Sample

In May 2020, the "Antenne NL Corona Special" survey about substance use, gaming and gambling during the coronavirus pandemic went online. A convenience sample was recruited by circulating the link through the university and the network of organizations for treatment and prevention of substance use and abuse throughout the Netherlands. Methods included placing targeted advertisements on social media platforms such as Facebook and Instagram, posting messages on websites and in newsletters, and sharing via communication channels of various interventions and programs. There was no predefined target population and the link could be widely disseminated, but recruitment efforts could also be aimed at (varying) specific groups (e.g., students) or users (e.g., alcohol consumers). The questionnaire was accessible for anyone aged 16 years or older. By commencing the survey, participants gave electronic consent to understanding the study purpose, being aware of voluntariness and anonymity (no identifying information or IP address was recorded), and permitting storage and use of their responses.

Between 12 May and 13 October 2020, the survey was completed 6,380 times. Repeated participation was allowed and reported in 310 (4.9%) questionnaires. Because questions about the "pre-corona" period could be skipped when participating for the second or subsequent time, this paper is based on a selection of 6,070 questionnaires where participants indicated first-time participation (answered negatively to the first question "Have you participated in this survey before?").

In this paper, we focus on the use of tobacco, alcohol, cannabis and other drugs (omitting gaming and gambling) prior to the time the measures combatting the coronavirus were enforced on 16 March 2020 in the Netherlands (further on: "pre-corona" use) and current use.

Measures

The online self-report questionnaires included the following measures.

Demographics were covered by questions about sex (male, female, other), age, residential municipality, type of persons participants were living with (multiple choice: none, parents, partner, housemates, children, other), enrollment in school or university (no, secondary or secondary vocational school, higher professional school, or university), and current working situation.

For current substance use, as narrow a time frame as possible was chosen to take into account the rapidly changing corona situation. For alcohol, tobacco and cannabis this was the last week, but for other drugs that are usually not used weekly by most this was stretched to last month. In an effort to measure "typical" substance use prior to the corona pandemic for comparison, the same narrow time frames would not be appropriate. Instead, use of alcohol, tobacco and cannabis was asked retrospectively for the pre-corona month (15 Feb—15 Mar 2020) and use of other drugs was asked for the pre-corona year (15 Mar 2019–15 Mar 2020).

Use of tobacco, alcohol and cannabis was measured by questions about the number of use days per week (0–7) and average amount (number of cigarettes/glasses/joints) per use day. Use of other drugs was measured by a multiple choice list (yes, no) of eleven substances: ecstasy (XTC/MDMA), amphetamines, cocaine, nitrous oxide, ketamine, LSD, psychedelic mushrooms/truffles, GHB, 2C-B, 3-MMC/4-MMC and/or any other drug (excluding tobacco, alcohol, cannabis, and prescription drugs).

Changes in substance use were derived from weekly consumption for tobacco, alcohol and cannabis (see Analyses). For other drugs, participants were asked in a single overall question to self-indicate whether they were using (a lot) more or less (frequently) than "pre-corona."

To asses motives for current use a short *ad-hoc* list of eight reasons was developed: Because I find it pleasant/fun/mind-expanding; Because I find it makes social moments more fun/cozy; Because I needed an outlet now that there are few other options; Because I wanted to feel less worried/afraid/angry/stressed; Because I wanted to feel less lonely; Because I couldn't resist, at a time when I actually didn't want to; Because I already had it at home; Because I always do at those moments, out of habit. Answer categories for each of these reasons were: totally agree, agree, neutral, disagree, totally disagree.

An *ad-hoc* eight-item multiple choice list (yes, no) was developed to asses reasons for current discontinued or decreased other drug use: It's better for my state of mind; It's better for my health/fitness; I had less free time; I had fewer social occasions (going out, appointments, visits, parties, etc.); I was home alone less often; Someone in my environment has asked for it; I was ill/did not feel well. This question was not asked for tobacco, alcohol or cannabis use.

Analyses

For the purpose of analyses, age was recoded into four categories (16–17 years, 18–24 years, 25–39 years, and 40+ years) and residential municipality was recoded into two categories (large > 100.000 inhabitants, and small < 100.000 inhabitants). Three working situations were distinguished: not working [no job or own business or (most) work has come to standstill], working from home (mostly), and working on location (mostly). And five types of household were derived from type of persons participants were living with: alone, with partner/housemates only, with parents only (and any siblings), with children (and any partner or other persons), and other.

For tobacco, alcohol and cannabis prevalence rates were derived from number of use days per week. Responses of large amounts per day (sometimes up to hundreds) were not classified as invalid and deleted, but perceived as meaning "a lot" and maximized around the 97.5th percentile (80 cigarettes, 20 glasses and 20 joints). Days per week and amount per day were multiplied to derive weekly consumption. Number of other drug types used was derived by counting the number of positive answers to the multiple choice questions, excluding the "other drug" category.

After recoded and derived variables were created, a four-step analyses procedure was carried out.

First, for each type of substance a selection was made of respondents with either current use or "pre-corona" use. Descriptive statistics were calculated for the total sample and the subsamples of selected respondents (**Table 1**).

Second, within the subsamples, "pre-corona" and current use were compared using McNemar tests for prevalence rates, and paired *T*-tests for average number of days, average amount per day and average weekly consumption (**Table 2**).

Third, five groups were identified within each subsample, based on the difference between "pre-corona" and current use: (1) Stopped: "Pre-corona" use, but no current use; (2) Less: Both "pre-corona" and current use, and lower weekly consumption of tobacco/alcohol/cannabis or reported (a lot) less (frequent) use of other drugs; (3) Same: Both "pre-corona" and current use, and the same weekly consumption of tobacco/alcohol/cannabis or reported the same use of other drugs; (4) More: Both "pre-corona" and current use, and higher weekly consumption of tobacco/alcohol/cannabis or reported (a lot) more (frequent) use of other drugs; and (5) Started: Current use, but no "pre-corona" use. "Pre-corona" and current use were compared across these five groups using ChiSq and ANOVA tests (**Tables 3A,B**).

Fourth, associations between change in use and demographic characteristics (**Supplementary Tables 1–4**), reasons for current use (**Table 4**) and reasons for discontinued/decreased use

TABLE 1 | (Sub)sample characteristics.

	Total sample	Subsamples with "pre-corona" and/or current use[a]			
		Tobacco	Alcohol	Cannabis	Other drugs[b]
n	6,070	3,310	5,176	2,956	3,072
% of total sample	–	54.5%	85.3%	48.7%	50.6%
Sex					
Male	50.0%	56.4%	50.6%	62.4%	58.5%
Female	49.5%	43.0%	48.9%	36.9%	41.0%
Other	0.5%	0.6%	0.5%	0.7%	0.5%
Age					
Average (SD)	29.1 (16.8)	23.4 (11.8)	28.1 (16.0)	20.5 (7.3)	21.9 (8.0)
16–17	20.7%	26.4%	20.2%	30.5%	20.0%
18–24	43.7%	53.5%	46.5%	59.0%	61.8%
25–39	12.9%	10.5%	13.2%	7.6%	13.8%
40+	22.7%	9.5%	20.2%	2.9%	4.4%
Place of residence					
Small (pop. < 100.000)	52.2%	53.0%	51.7%	51.6%	47.1%
Large (pop. > 100.000)	47.8%	47.0%	48.3%	48.4%	52.9%
Student					
No	41.1%	30.1%	39.1%	21.5%	28.9%
Secondary (vocational)	34.4%	44.0%	34.1%	48.7%	36.9%
Higher professional or university	24.4%	25.9%	26.7%	29.8%	34.2%
Work					
Not working	38.6%	39.2%	37.7%	40.4%	38.0%
Working from home	15.1%	9.7%	15.3%	7.2%	11.0%
Working on location	46.4%	51.1%	47.1%	52.4%	51.0%
Household					
Alone	12.3%	9.6%	11.9%	7.0%	9.0%
With partner/housemate(s)	25.5%	21.4%	25.6%	19.5%	26.0%
With parent(s)	48.4%	59.7%	49.5%	67.3%	57.3%
With child(ren)	11.4%	6.3%	10.7%	3.5%	4.6%
Other	2.4%	2.9%	2.4%	2.7%	3.1%

[a] *selection of respondents with either "pre-corona" use ("pre-corona" month, 15 Feb–15 Mar 2020, for tobacco, alcohol and cannabis; "pre-corona" year, 15 Mar 2019–15 Mar 2020, for other drugs) or current use (last week for tobacco, alcohol and cannabis; last month for other drugs).*
[b] *ecstasy, amphetamines, cocaine, nitrous oxide, ketamine, LSD, psychedelic mushrooms/truffles, GHB, 2C-B, 3-MMC/4-MMC, and/or any other drug (excluding tobacco, alcohol, cannabis, and prescription drugs).*

(**Table 5**) were examined using ChiSq and ANOVA tests. When comparing demographics, the "other" category for sex and household were omitted from analyses. When comparing reasons for current use, respondents without current use ("stopped") were omitted from analyses. The latter analyses were limited to respondents with discontinued ("stopped") or decreased ("less") use of other drugs.

Overall model results are presented (no pairwise *post-hoc* tests were computed). Analyses were carried out using IBM SPSS Statistics 25.

RESULTS

Table 1 shows numbers and characteristics of the total sample and subsamples of respondents with "pre-corona" and/or current use of tobacco, alcohol, cannabis and other drugs. The majority of respondents use alcohol; the subsamples of those using tobacco, cannabis and other drugs comprise about half of the total sample. In the total sample males and females, and respondents from both small and large municipalities are equally divided, while males make up a (small) majority in the subsamples. Both the total sample and subsamples consist for a large part of young adults (18–24 years) and students living with parents. This is especially true for subsamples of respondents who use tobacco, cannabis and other drugs; a little less so for the subsample of respondents who use alcohol. As far as respondents have a job or own a business, they mostly work on location and not from home.

Within all subsamples current prevalence rates are lower compared to "pre-corona" (**Table 2**). Those who indicated continued use of tobacco and alcohol consumed increased in frequency (tobacco: from 5.4 to 5.6 days per week; alcohol from 2.9 to 3.2 days per week), but decreased in amounts (tobacco: from 12.7 to 12.0 cigarettes per day; alcohol: from 5.7 to 5.1 glasses per day), so that the average weekly consumption

TABLE 2 | "Pre-corona" and current use of tobacco, alcohol, cannabis, and other drugs (paired tests).

	"Pre-corona" use	Current use	ChiSq/T (df)	p	Cohen's g/d
Tobacco (n = 3,310)[a]					
Prevalence rate	93.3%	89.6%	26.343	<0.001	0.109
Average days per week (SD)[b]	5.4 (2.2)	5.6 (2.1)	5.593 (2,744)	<0.001	0.107
Average amount (cigarettes) per day (SD)[b]	12.7 (15.9)	12.0 (14.4)	−3.862 (2,744)	<0.001	−0.074
Average weekly consumption (SD)[b]	79.9 (109.2)	77.6 (100.9)	−1.901 (2,744)	0.057	−0.036
Alcohol (n = 5,176)[a]					
Prevalence rate	93.7%	88.7%	72.422	<0.001	0.141
Average days per week (SD)[b]	2.9 (1.8)	3.2 (1.9)	12.675 (4,263)	<0.001	0.194
Average amount (glasses) per day (SD)[b]	5.7 (4.6)	5.1 (4.2)	−10.983 (4,263)	<0.001	−0.168
Average weekly consumption (SD)[b]	17.2 (20.7)	17.3 (20.1)	−0.556 (4,263)	0.578	0.009
Cannabis (n = 2,956)[a]					
Prevalence rate	88.9%	83.7%	29.660	<0.001	0.096
Average days per week (SD)[b]	4.3 (2.4)	4.8 (2.8)	12.110 (2,145)	<0.001	0.261
Average amount (joints) per day (SD)[b]	3.8 (4.5)	3.9 (4.1)	1.158 (2,145)	0.247	0.025
Average weekly consumption (SD)[b]	20.8 (31.7)	22.3 (29.4)	3.332 (2,145)	0.001	0.072
Other drugs (n = 3,072)[a,c]					
Any other drugs	93.8%	69.6%	492.032	<0.001	0.331
Ecstasy	73.2%	38.2%	794.952	<0.001	0.370
Amphetamines	32.9%	15.6%	386.663	<0.001	0.367
Cocaine	39.5%	24.3%	283.323	<0.001	0.304
Nitrous oxide	47.1%	20.7%	604.881	<0.001	0.374
Ketamine	35.6%	24.0%	179.259	<0.001	0.252
LSD	8.8%	6.0%	30.754	<0.001	0.188
Psychedelic mushrooms/truffles	14.6%	9.8%	49.920	<0.001	0.172
GHB	7.3%	3.4%	84.211	<0.001	0.354
2C-B	28.8%	18.2%	135.697	<0.001	0.208
3-MMC/4-MMC	10.1%	8.8%	6.500	0.011	0.085
Average number of drug types (SD)[b]	3.7 (2.2)	2.6 (1.8)	−25.103 (1,946)	<0.001	−0.569

[a] *subsamples of respondents with either "pre-corona" use ("pre-corona" month, 15 Feb–15 Mar 2020, for tobacco, alcohol and cannabis; "pre-corona" year, 15 Mar 2019–15 Mar 2020, for other drugs) or current use (last week for tobacco, alcohol and cannabis; last month for other drugs).*
[b] *applies only to those with "pre-corona" use and current use, respectively.*
[c] *ecstasy, amphetamines, cocaine, nitrous oxide, ketamine, LSD, psychedelic mushrooms/truffles, GHB, 2C-B, 3-MMC/4-MMC, and/or any other drug (excluding tobacco, alcohol, cannabis, and prescription drugs).*

remained the same. Those continuing to use cannabis also increased their frequency of use (from 4.3 to 4.8 days per week), but did not change the amount. Average weekly consumption of cannabis therefore increased from 20.8 to 22.3 joints per week. Within the category of other drugs, ecstasy and nitrous oxide showed the most prominent decline in use. Respondents with both "pre-corona" and current drug use narrowed their drugs palette and used fewer different types of drugs (from 3.7 to 2.6 drug types on average).

While current overall prevalence rates in the subsamples were either lower than or similar to "pre-corona," **Tables 3A**,**B** show that there are also respondents with increased use, including those who did not use in the "pre-corona" period but currently do. The latter group ("started") formed around 6% of the subsamples of respondents who used tobacco, alcohol and other drugs, and 11.1% for cannabis.

Respondents who started using tobacco, alcohol and cannabis since the coronavirus measures came into effect do so less frequently and in smaller amounts than those already using (**Table 3A**). Almost a third of respondents using tobacco (29.6%), alcohol (32.1%), and cannabis (32.9%) smoked and drank more than "pre-corona" ("more") and increased both frequency and amount of use, amounting to about a doubling of the weekly consumption. In some cases the total increase is limited to 2 cigarettes/glasses/joints per week, but there are also those who show a substantial increase in weekly consumption of more than 20 cigarettes/glasses/joints. Conversely, respondents using less tobacco (23.0%), alcohol (29.1%), and cannabis (17.4%) ("less") reduced both frequency and quantity, cutting the average weekly consumption in half. Notably, these respondents with decreased use show the highest "pre-corona" weekly consumption of alcohol (average 24.6 glasses) and cannabis (average 33.4 joints), and the second highest weekly tobacco consumption (average 97.8 cigarettes). Those who stopped using tobacco (10.4%), alcohol (11.3%), and cannabis (16.3%) since the coronavirus measures came into effect

TABLE 3A | Change in the use of tobacco, alcohol and cannabis—current use compared to "pre-corona" use.

	Stopped[a]	Less[b]	Same[c]	More[d]	Started[e]	ChiSq/F(df = 3)	*p*	EtaSq
Tobacco (*n* = 3,310)[f]								
% (*n*)	10.4% (344)	23.0% (762)	30.3% (1, 3)	29.6% (980)	6.7% (221)			
Av. "pre-corona" use (SD)					N/A			
Days per week	3.2 (2.4)	5.8 (1.8)	6.1 (1.9)	4.5 (2.4)		221,638	<0.001	0.177
Amount per day	6.3 (8.5)	15.6 (18.8)	15.5 (17.1)	4.6 (9.7)		80,361	<0.001	0.072
Weekly consumption	28.1 (44.0)	97.8 (127.1)	104.8 (121.0)	40.7 (59.0)		105,967	<0.001	0.093
Av. current use (SD)	N/A							
Days per week		4.6 (2.4)	6.1 (1.9)	5.9 (1.6)	2.7 (2.1)	242,571	<0.001	0.197
Amount per day		7.6 (1.2)	15.5 (17.1)	11.9 (13.0)	4.6 (7.7)	68,801	<0.001	0.065
Weekly consumption		42.8 (67.7)	104.8 (121.0)	76.8 (91.0)	20.4 (52.4)	85,848	<0.001	0.080
Change in weekly consumption			N/A					
2 cigarettes or less	31.7%	7.2%		6.1%	41.2%			
2–10 cigarettes	26.7%	18.4%		22.0%	29.9%			
10–20 cigarettes	10.8%	18.8%		19.1%	9.5%			
More than 20 cigarettes	30.8%	55.6%		52.8%	19.5%			
Alcohol (*n* = 5,176)[f]								
% (*n*)	11.3% (585)	29.1% (1,505)	21.2% (1,098)	32.1% (1,661)	6.3% (327)			
Av. "pre-corona" use (SD)					N/A			
Days per week	2.3 (1.5)	3.3 (1.7)	3.1 (2.2)	2.3 (1.5)		135,471	<0.001	0.077
Amount per day	4.6 (4.0)	7.4 (4.9)	5.0 (4.6)	4.7 (3.9)		127,145	<0.001	0.073
Weekly consumption	10.4 (15.2)	24.6 (24.0)	16.8 (23.2)	10.7 (11.6)		158,487	<0.001	0.089
Av. current use (SD)	N/A							
Days per week		2.3 (1.5)	3.2 (2.2)	4.0 (1.7)	2.0 (1.3)	328,314	<0.001	0.177
Amount per day		4.3 (3.4)	4.9 (4.6)	6.0 (4.4)	4.0 (3.8)	57,653	<0.001	0.036
Weekly consumption		10.0 (11.2)	16.8 (23.2)	24.4 (21.7)	9.2 (15.5)	172,304	<0.001	0.101
Change in weekly consumption			N/A					
2 glasses or less	26.7%	15.8%		13.1%	33.6%			
2–10 glasses	45.0%	41.9%		44.7%	43.7%			
10–20 glasses	17.3%	21.8%		23.5%	14.1%			
More than 20 glasses	11.1%	20.5%		18.8%	8.6%			
Cannabis (*n* = 2,956)[f]								
% (*n*)	16.3% (483)	17.4% (514)	22.3% (659)	32.9% (973)	11.1% (327)			
Av. "pre-corona" use (SD)					N/A			
Days per week	2.1 (1.8)	5.2 (1.9)	4.8 (2.6)	3.4 (2.2)		229,751	<0.001	0.208
Amount per day	1.7 (1.9)	5.7 (5.4)	4.4 (5.4)	2.3 (2.2)		123,249	<0.001	0.123
Weekly consumption	5.2 (11.7)	33.4 (38.1)	27.5 (39.1)	9.5 (13.4)		146,007	<0.001	0.143
Av. current use (SD)	N/A							
Days per week		3.8 (2.3)	4.8 (2.6)	5.3 (1.8)	2.2 (1.7)	182,895	<0.001	0.182
Amount per day		3.0 (3.0)	4.4 (5.4)	3.9 (3.4)	1.7 (1.6)	45,216	<0.001	0.052
Weekly consumption		14.5 (20.9)	27.5 (39.1)	22.8 (24.3)	5.0 (10.4)	60,038	<0.001	0.068
Change in weekly consumption			N/A					
2 joints or less	67.1%	17.5%		20.3%	60.6%			
2–10 joints	21.7%	36.8%		36.1%	29.4%			
10–20 joints	4.6%	19.5%		24.5%	5.5%			
More than 20 joints	6.6%	26.3%		19.1%	4.6%			

("stopped") showed less extensive "pre-corona" consumption patterns. Current consumption of tobacco and cannabis was highest among respondents with unchanged use ("same"); current alcohol use was heaviest among those with increased use ("more").

Compared to tobacco, alcohol and cannabis, a larger proportion of respondents stopped using other drugs ("stopped" 30.4%) (**Table 3B**). These respondents showed a less extensive pattern of "pre-corona" use compared to respondents with continued use (2.3 compared to 3.5–4.0 drug types on average).

TABLE 3B | Change in the use of other drugs—current use compared to "pre-corona" use.

	Stopped[a]	Less[b]	Same[c]	More[d]	Started[e]	ChiSq/F(df = 3)	*p*	Cramer's V/EtaSq
Other drugs (*n* = 3,072)[f,g]								
% (*n*)	30.4% (935)	20.7% (637)	17.3% (532)	25.3% (778)	6.2% (190)			
"Pre-corona" use					N/A			
Ecstasy	68.2%	89.0%	80.6%	78.9%		99.507	<0.001	0.186
Amphetamines	22.0%	46.2%	39.1%	38.7%		112.514	<0.001	0.198
Cocaine	30.4%	51.0%	46.8%	45.8%		82.622	<0.001	0.169
Nitrous oxide	44.4%	54.0%	52.8%	52.2%		19.018	<0.001	0.081
Ketamine	21.0%	52.1%	43.2%	43.2%		184.631	<0.001	0.253
LSD	4.5%	13.8%	9.4%	11.4%		45.095	<0.001	0.125
Psychedelic mushrooms/truffles	11.0%	17.0%	22.0%	15.6%		32.356	<0.001	0.106
GHB	4.2%	11.3%	8.3%	9.0%		29.680	<0.001	0.101
2C-B	18.7%	42.5%	33.3%	33.8%		110.196	<0.001	0.196
3-MMC/4-MMC	4.9%	13.8%	10.3%	15.4%		57.302	<0.001	0.141
Av. number of drug types (SD)	2.3 (1.6)	4.0 (2.1)	3.5 (2.1)	3.5 (2.2)		102.731	<0.001	0.097
Current use	N/A							
Ecstasy		43.3%	55.1%	65.4%	50.0%	71.099	<0.001	0.182
Amphetamines		17.7%	20.7%	30.2%	11.6%	48.839	<0.001	0.151
Cocaine		29.4%	35.5%	43.4%	16.8%	60.973	<0.001	0.169
Nitrous oxide		22.6%	28.0%	36.0%	33.2%	31.871	<0.001	0.122
Ketamine		29.7%	31.8%	45.5%	13.7%	86.392	<0.001	0.201
LSD		7.8%	9.4%	10.4%	2.1%	14.237	0.003	0.082
Psychedelic mushrooms/truffles		10.2%	16.0%	14.9%	18.9%	13.611	0.003	0.080
GHB		3.5%	5.1%	6.6%	2.1%	10.718	0.013	0.071
2C-B		19.8%	21.2%	36.4%	18.9%	67.312	<0.001	0.177
3-MMC/4-MMC		8.3%	10.3%	18.9%	7.4%	45.818	<0.001	0.146
Av. number of drug types (SD)		2.0 (1.4)	2.4 (1.6)	3.2 (1.9)	1.8 (1.3)	75.540	<0.001	0.096

[a] "Pre-corona" use, but no current use.
[b] both "pre-corona" and current use, and lower weekly consumption of tobacco/alcohol/cannabis or reported (a lot) less (frequent) use of other drugs.
[c] both "pre-corona" and current use, and the same weekly consumption of tobacco/alcohol/cannabis or reported the same use of other drugs.
[d] both "pre-corona" and current use, and higher weekly consumption of tobacco/alcohol/cannabis or reported (a lot) more (frequent) use of other drugs.
[e] current use, but no "pre-corona" use.
[f] subsamples of respondents with either "pre-corona" use ("pre-corona" month, 15 Feb—15 Mar 2020, for tobacco, alcohol, and cannabis; "pre-corona" year, 15 Mar 2019–15 Mar 2020, for other drugs) or current use (last week for tobacco, alcohol and cannabis; last month for other drugs).
[g] ecstasy, amphetamines, cocaine, nitrous oxide, ketamine, LSD, psychedelic mushrooms/truffles, GHB, 2C-B, 3-MMC/4-MMC, and/or any other drug (excluding tobacco, alcohol, cannabis, and prescription drugs).

In fact, many used no more than one type of drug before the coronavirus measures came into effect, mostly ecstasy or nitrous oxide. Respondents reporting decreased (but continued) other drug use ("less") reduced the number of drug types used from 4.0 to 2.0 on average [paired T(df) = −27.020(636), $p <$ 0.001, Cohen's d = −1.071]. Markedly, respondents reporting increased use ("more") also showed a reduction in the number of drug types used [from 3.5 to 3.2, T(df) = −5.259(777), $p \leq$ 0.001, Cohen's d = −0.189]. Moreover, current prevalence rates were lower than "pre-corona" rates for ecstasy (65.4% vs. 78.9%, McNemar paired ChiSq = 45.255, $p \leq 0.001$, Cohen's g = 0.220), amphetamines (30.2 vs. 38.7%, ChiSq = 24.006, $p \leq$ 0.001, Cohen's g = 0.188), nitrous oxide (36.0 vs. 52.2%, ChiSq = 73.703, $p \leq 0.001$, Cohen's g = 0.297) and GHB (6.6 vs. 9.0%, ChiSq = 7.200, $p = 0.007$, Cohen's g = 0.211), and only higher for 3-MMC/4-MMC (18.9 vs. 15.4%, ChiSq = 8.557, $p = 0.003$, Cohen's g = 0.171).

Associations between change in use and demographic characteristics varied between types of substance. For alcohol, increased use was relatively more common among adults (25–39 years) and decreased use relatively more common among young adults (18–24 years). For other drugs, however, the opposite was true. **Supplementary Material** about demographic characteristics associated with changing patterns in substance use is available for professionals seeking input for tailored prevention.

Regardless of change in substances use, the most endorsed reason for current use of alcohol, cannabis or other drugs was either "Because I find it pleasant/fun/mind-expanding" or "Because I find it makes social moments more fun/cozy" (**Table 5**). Tobacco was often used out of habit. On face value, this seemed especially true for those with unchanged use ("same" average score 0.9, compared to −0.6 to 0.6 in other four groups). Respondents with

TABLE 4 | Reasons for current use[a].

	Total[b]	Less[c]	Same[d]	More[e]	Started[f]	F (df = 3)	*p*	EtaSq
Tobacco[(n)]	2,966	762	1,003	980	221			
Because I find it pleasant/fun/mind-expanding	0.5 (1.1)	0.5 (1.1)	0.5 (1.1)	0.5 (1.1)	0.1 (1.3)	8.187	<0.001	0.008
Because I find it makes social moments more fun/cozy	0.6 (1.1)	0.8 (1.0)	0.5 (1.2)	0.7 (1.1)	0.4 (1.3)	13.336	<0.001	0.013
Because I needed an outlet now that there are few other options	0.0 (1.3)	−0.1 (1.3)	−0.2 (1.3)	0.3 (1.3)	−0.1 (1.4)	29.245	<0.001	0.029
Because I wanted to feel less worried/afraid/angry/stressed	−0.1 (1.4)	−0.1 (1.4)	−0.3 (1.4)	0.1 (1.4)	−0.3 (1.5)	13.688	<0.001	0.014
Because I wanted to feel less lonely	−0.8 (1.2)	−0.9 (1.1)	−0.9 (1.2)	−0.7 (1.2)	−0.9 (1.2)	8.643	<0.001	0.009
Because I couldn't resist, at a time when I actually didn't want to	−0.4 (1.3)	−0.4 (1.3)	−0.5 (1.3)	−0.2 (1.3)	−0.5 (1.4)	11.234	<0.001	0.011
Because I already had it at home	0.0 (1.3)	0.0 (1.3)	0.0 (1.3)	0.2 (1.3)	−0.4 (1.4)	16.605	<0.001	0.017
Because I always do at those moments, out of habit	0.6 (1.2)	0.6 (1.2)	0.9 (1.1)	0.6 (1.2)	−0.6 (1.3)	111.530	<0.001	0.101
Alcohol[(n)]	4,591	1,505	1,098	1,661	327			
Because I find it pleasant/fun/mind-expanding	1.0 (1.0)	1.0 (1.0)	0.9 (1.0)	1.1 (0.9)	0.6 (1.2)	21.349	<0.001	0.014
Because I find it makes social moments more fun/cozy	0.9 (1.1)	1.0 (1.0)	0.7 (1.1)	1.0 (1.0)	0.6 (1.3)	26.893	<0.001	0.017
Because I needed an outlet now that there are few other options	−0.4 (1.3)	−0.6 (1.3)	−0.7 (1.3)	0.0 (1.4)	−0.7 (1.3)	71.275	<0.001	0.045
Because I wanted to feel less worried/afraid/angry/stressed	−0.8 (1.3)	−0.9 (1.2)	−1.0 (1.2)	−0.6 (1.3)	−0.9 (1.3)	32.787	<0.001	0.021
Because I wanted to feel less lonely	−1.0 (1.2)	−1.0 (1.2)	−1.1 (1.1)	−0.8 (1.3)	−1.1 (1.2)	22.367	<0.001	0.014
Because I couldn't resist, at a time when I actually didn't want to	−1.1 (1.1)	−1.2 (1.0)	−1.2 (1.1)	−0.8 (1.2)	−1.3 (1.1)	40.906	<0.001	0.026
Because I already had it at home	−0.3 (1.3)	−0.3 (1.3)	−0.5 (1.3)	−0.1 (1.3)	−0.5 (1.4)	27.254	<0.001	0.018
Because I always do at those moments, out of habit	−0.1 (1.3)	−0.2 (1.3)	0.0 (1.3)	−0.1 (1.3)	−1.0 (1.2)	58.511	<0.001	0.037
Cannabis[(n)]	2,473	514	659	973	327			
Because I find it pleasant/fun/mind-expanding	1.5 (0.7)	1.5 (0.7)	1.5 (0.8)	1.5 (0.7)	1.3 (0.8)	11.109	<0.001	0.013
Because I find it makes social moments more fun/cozy	0.8 (1.1)	1.0 (1.1)	0.7 (1.2)	0.9 (1.1)	0.4 (1.2)	19.254	<0.001	0.023
Because I needed an outlet now that there are few other options	0.2 (1.4)	0.1 (1.3)	0.1 (1.4)	0.5 (1.3)	0.0 (1.5)	17.827	<0.001	0.021
Because I wanted to feel less worried/afraid/angry/stressed	0.1 (1.5)	0.1 (1.5)	0.0 (1.5)	0.2 (1.4)	−0.2 (1.5)	6.498	<0.001	0.008
Because I wanted to feel less lonely	−0.6 (1.4)	−0.5 (1.4)	−0.7 (1.4)	−0.4 (1.4)	−0.7 (1.4)	5.442	0.001	0.007
Because I couldn't resist, at a time when I actually didn't want to	−0.5 (1.4)	−0.5 (1.3)	−0.7 (1.4)	−0.3 (1.4)	−1.0 (1.3)	22.442	<0.001	0.027
Because I already had it at home	0.1 (1.4)	0.2 (1.3)	0.1 (1.4)	0.4 (1.3)	−0.5 (1.4)	39.827	<0.001	0.046
Because I always do at those moments, out of habit	0.2 (1.4)	0.4 (1.3)	0.4 (1.4)	0.3 (1.3)	−1.1 (1.1)	111.739	<0.001	0.120
Other drugs[(n)]	2,137	637	532	778	190			
Because I find it pleasant/fun/mind-expanding	1.4 (0.9)	1.3 (0.9)	1.4 (0.9)	1.5 (0.8)	1.2 (1.1)	8.975	<0.001	0.012
Because I find it makes social moments more fun/cozy	0.8 (1.1)	0.7 (1.1)	0.7 (1.1)	0.9 (1.0)	0.5 (1.3)	12.056	<0.001	0.017
Because I needed an outlet now that there are few other options	−0.1 (1.4)	−0.2 (1.4)	−0.3 (1.4)	0.3 (1.5)	−0.3 (1.5)	23.497	<0.001	0.032
Because I wanted to feel less worried/afraid/angry/stressed	−0.7 (1.4)	−1.0 (1.2)	−1 (1.2)	−0.5 (1.4)	−0.5 (1.5)	20.810	<0.001	0.028
Because I wanted to feel less lonely	−1.0 (1.3)	−1.1 (1.1)	−1.2 (1.1)	−0.7 (1.4)	−0.8 (1.4)	22.096	<0.001	0.030
Because I couldn't resist, at a time when I actually didn't want to	−0.9 (1.3)	−1.0 (1.2)	−1.0 (1.2)	−0.6 (1.4)	−0.9 (1.3)	22.505	<0.001	0.031
Because I already had it at home	−0.5 (1.4)	−0.6 (1.3)	−0.7 (1.3)	−0.2 (1.4)	−0.5 (1.4)	15.996	<0.001	0.022
Because I always do at those moments, out of habit	−0.9 (1.2)	−1 (1.1)	−0.9 (1.2)	−0.7 (1.3)	−1.2 (1.1)	13.125	<0.001	0.018

[a] *average (SD) score on Likert scale: totally agree (+2), agree (+1), neutral (0), disagree (−1), totally disagree (−2). Applies only to respondents with current use.*
[b] *subsamples of respondents with current use (last week for tobacco, alcohol and cannabis; last month for other drugs).*
[c] *both "pre-corona" and current use, and lower weekly consumption of tobacco/alcohol/cannabis or reported (a lot) less (frequent) use of other drugs.*
[d] *both "pre-corona" and current use, and the same weekly consumption of tobacco/alcohol/cannabis or reported the same use of other drugs.*
[e] *both "pre-corona" and current use, and higher weekly consumption of tobacco/alcohol/cannabis or reported (a lot) more (frequent) use of other drugs.*
[f] *current use, but no "pre-corona" use.*
[(n)] *ecstasy, amphetamines, cocaine, nitrous oxide, ketamine, LSD, psychedelic mushrooms/truffles, GHB, 2C-B, 3-MMC/4-MMC, and/or any other drug (excluding tobacco, alcohol, cannabis, and prescription drugs).*

unchanged use of alcohol also seemed to report habitual use more often than the other groups (0.0, compared to −0.1 to −1.0). Those with increased use of tobacco, alcohol, cannabis or other drugs ("more") showed relatively high scores for the other reasons of use ("I needed an outlet…", "I wanted to feel less worried…", "I wanted to feel less lonely," "I couldn't resist…", and "I already had it at home").

Having fewer social occasions than "pre-corona" was the most important reason to discontinue or decrease other drug use (65.3%), followed by physical (26.1%), and mental (19.3%) health. Overall, those who reduced their use of other drugs and those who had stopped using altogether reported similar reasons for doing so, but lack of social occasions was endorsed more often by respondents with decreased other drug use.

TABLE 5 | Reasons for discontinued/decreased other drug use.

	Total[a]	Stopped[b]	Less[c]	ChiSq (df = 1)	p	Cramer's V
Other drugs (n)[d]	1,572	935	637			
It's better for my state of mind	19.3%	19.6%	19.0%	0.081	0.776	0.007
It's better for my health/fitness	26.1%	25.9%	26.4%	0.047	0.828	0.005
I had less free time	9.9%	8.9%	11.5%	2.828	0.093	0.042
I had fewer social occasions (going out, appointments, visits, parties, etc.)	65.3%	60.5%	72.2%	22.796	<0.001	0.120
I was home alone less often	5.3%	4.8%	6.1%	1.285	0.257	0.029
Someone in my environment has asked for it	3.1%	3.6%	2.4%	2.061	0.151	0.036
I was ill/did not feel well	2.4%	1.8%	3.1%	2.879	0.090	0.043

[a] *subsamples of respondents with discontinued ("stopped") or decreased ("less") other drug use (last month use compared to "pre-corona" year, 15 Mar 2019–15 Mar 2020).*
[b] *"Pre-corona" use, but no current use.*
[c] *both "pre-corona" and current use, and lower weekly consumption of tobacco/alcohol/cannabis or reported (a lot) less (frequent) use of other drugs.*
[d] *ecstasy, amphetamines, cocaine, nitrous oxide, ketamine, LSD, psychedelic mushrooms/truffles, GHB, 2C-B, 3-MMC/4-MMC, and/or any other drug (excluding tobacco, alcohol, cannabis, and prescription drugs).*

DISCUSSION

This paper is based on data from a survey about "pre-corona" (before measures combatting the coronavirus pandemic came into effect in March 2020) and current substance use among Dutch respondents aged 16 years and older recruited through online channels. The survey was set up as a monitoring tool, using a short questionnaire and a convenience sample, to provide descriptive results for prevention practice.

The total sample was divided into subsamples of 3,310 respondents who had smoked tobacco either during the "pre-corona" month or last week, 5,176 respondents who had drank alcohol, 2,956 respondents who had used cannabis, and 3,072 respondents who had used other drugs (e.g., ecstasy, amphetamines, cocaine, nitrous oxide) in the "pre-corona" year or last month. Within these subsamples, overall results showed declined use compared to "pre-corona." However, overall figures mask underlying variation in changing patterns, including discontinued (tobacco 10.4%, alcohol 11.3%, cannabis 16.3%, other drugs 30.4%), decreased (tobacco 23.0%, alcohol 29.1%, cannabis 17.4%, other drugs 20.7%), unchanged (tobacco 30.3%, alcohol 21.2%, cannabis 22.3%, other drugs 17.3%), increased (tobacco 29.6%, alcohol 32.1%, cannabis 32.9%, other drugs 25.3%), and (re)commenced use (tobacco 6.7%, alcohol 6.3%, cannabis 11.1%, other drugs 6.2%). Others have also found both less and more substance use following enforcement of coronavirus measures (12–16, 20–27, 29, 38). The two opposite scenarios Rehm et al. (10) predicted from literature and a review of the effects of past economic crises on alcohol consumption, one with increased and one with decreased use, apparently co-exist and also pertain to other substances. These results inform prevention practice about differential effects of corona measures on substance use that are masked by population trend curves, as the effects of opposite patterns of increased and decreased use cancel each other out.

Discontinued use was found to be much more common for other drugs than for tobacco, alcohol and cannabis, but for all substance types applied that those who stopped using showed less extensive "pre-corona" consumption patterns. Notably, the groups with decreased use showed relatively high levels of "pre-corona" use. This finding contradicts other studies who reported heavier pre-pandemic drinking patterns among respondents with increased alcohol use (13, 20). In this study, increased use of any of the substances was not associated with heavier "pre-corona" use. Current consumption of tobacco and cannabis was highest for respondents with unchanged use, while respondents with increased use showed most extensive current use of alcohol and other drugs, although the latter group did show lower prevalence rates for ecstasy, amphetamines, nitrous oxide and GHB. Respondents having taken up substance use (again) after the coronavirus measures came into effect showed less extensive current consumption patterns compared to the other groups.

Associations between change in use and demographic characteristics varied between types of substance, indicating for instance that different age groups are at risk for increased use of alcohol and other drugs. This underlines the need for tailored prevention targeting specific populations for specific substances. Associations between change in use and reasons for current use showed a consistent pattern across different substances. All substances, regardless of change in use, were often used for pleasure and social reasons. In fact, the lack of social occasions was reported as the main reason for discontinued and decreased other drug use. But respondents with increased use of tobacco, alcohol, cannabis and other drugs were also more likely to report additional reasons for use, in particular needing an outlet and wanting to feel less worried/afraid/angry/stressed or lonely. These reasons can be seen as coping motives, which have been linked to problematic use of alcohol [e.g., (39)], cannabis [e.g., (40)], and ecstasy [e.g., (41)] in general, and have more specifically been found to mediate the link between stressors (having children at home, depression, social connectedness, income loss, and living alone) and alcohol-related problems during the coronavirus pandemic (42). This is perhaps the most important finding from a prevention point of view.

In this paper, we looked at changes in the use of tobacco, alcohol, cannabis and other drugs separately. Further analyses, taking into account combined use, should reveal whether the groups with increased or decreased use overlap, or whether there are also groups in which decreased use of one type of substance is associated with increased use of another.

Another further exploration of the data would be to study changing patterns across time. Short-term changes immediately after the measures came into effect may differ from long-term changes after months of restrictions and accumulating socio-economic consequences. In addition, government measures varied with infection rates over time. In fact, on 14 October 2020 (the day after survey data for this paper was extracted) a new "partial lockdown" was enforced, that has been tightened into a "hard lockdown" since 14 December 2020 (while the survey was still ongoing).

Limitations

Because of anonymity, it cannot be ascertained that the sample consist of unique individuals. A selection was made of respondents who answered negatively to the question whether they had previously participated. The chance of duplication is estimated to be small because no incentives were given and there was nothing to gain by filling out the questionnaire for the second or subsequent time and lying about it.

This study cannot claim optimal generalizability due to under-coverage and self-selection inherent to web surveys (43). Substance use is over-represented in the total sample (tobacco 54.5%, alcohol 85.3%, cannabis 48.7%, other drugs 50.6%) when compared to the general Dutch population (tobacco 22.4%, alcohol 80.4%, cannabis 7.5%, ecstasy 2.8%, amphetamines 1.1%, cocaine 1.6%, nitrous oxide 2.7%) (44), and even subsamples of respondents who use these substances may not be representative of populations of users. Because of under-coverage some groups of users will be insufficiently presented in our sample (e.g., elderly or marginalized users), while self-selection may have caused our sample to be skewed toward young users who have experienced changing consumption patterns. Furthermore, the sample studied is relatively young (mainly 16–24 years). In this age group personality and brain development is still in process, and both are of significant influence on substance use trajectories (45). Proportion sizes of discontinued, decreased, unchanged, increased and (re)commenced use can therefore not be extrapolated to absolute figures for the general population.

To limit questionnaire length, detailed information on frequency and amount of use was not collected for drugs other than tobacco, alcohol and cannabis. Changing patterns in the use of other drugs is therefore based on self-report rather than objective measures. When asked if using more or less drugs than "pre-corona" the reference time frame was the "pre-corona" year (15 March 2019–15 March 2020), but respondents may have reflected on the time directly preceding the coronavirus measures. This period is "slow season" for music festivals (29–53 per month in Jan-Mar 2019; 118–174 per month in Apr-Sep 2019) (46), which are often preferred settings for drugs like ecstasy and nitrous oxide. Compared to that time, any drug use after the coronavirus measures came into effect could have felt like an increase in the respondents' minds. This may explain why respondents reported increased use of other drugs that could not be corroborated with increased prevalence rates. Measuring change in other drug use in a single question also impedes the ability to examine more complex patterns like selection (choosing a particular drug to use or quit) or substitution (replacing one drug with another).

Finally, some remarks about the definition of changing patterns. This was based on the frequency and amount of use in two relatively short periods for tobacco, alcohol and cannabis ("pre-corona" month and last week). Neither of these periods may have reflected "typical" consumption patterns and any absence of use may be "coincidental." Discontinued use (defined as "pre-corona" use, but no last week use), for instance, may also include incidental (non-weekly) use and does not necessarily imply that there has not been any use since the coronavirus measures came into effect. Furthermore, increased and decreased use was derived from the difference in weekly consumption. In some cases differences were limited to only a few cigarettes/glasses/joints per week. For one person a small decrease in substance use may imply a clinically relevant risk level reduction, while for another a large decrease may not affect risk level outcome. For example, a female decreasing weekly consumption from 15 to 13 glasses will thereby fall below the threshold of excessive drinking, defined as more than 14 glasses a week for females in the Netherlands (44), while for a female decreasing weekly consumption from 25 to 15 glasses the end point will not fall below the threshold and the risk level outcome will remain that of excessive drinking. The current classification of changing patterns does not discern between these two examples and both are assigned to the "less" group. The aim of this paper was to explore different patterns of change in substance use. A more comprehensive examination of decreased or increased use may take different end points in terms of amount and frequency into account, but the survey did not measure any functional outcomes (e.g., health or use-related problems).

Conclusion

People show varying changing patterns of substance use since social distancing and other measures combatting the coronavirus came into effect. Some are using more than "pre-corona," some are using less, and others are currently not using at all. Especially the use of drugs like ecstasy and nitrous oxide was discontinued or decreased due to the lack of social occasions for use. Those who increased their intake of tobacco, alcohol, cannabis or other drugs are more likely to report coping motives for use.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AB contributed to the study design, questionnaire development, analysis, interpretation, and wrote the manuscript. FB contributed to the study design, interpretation, and assisted in drafting and reviewing the manuscript. JN contributed to the study design, questionnaire development, coordination of data collection, and assisted in drafting and reviewing the manuscript. All authors agree to be accountable for the content of the work and provided approval of the manuscript.

FUNDING

This study was funded from an annual grant from the municipality of Amsterdam to Jellinek Prevention as part of a structural monitoring effort. Jellinek Prevention commissioned the Amsterdam University of Applied Science to conduct the survey as part of the Antenna Amsterdam monitor.

ACKNOWLEDGMENTS

The authors acknowledge the member organizations of Verslavingskunde Nederland (Dutch Addiction Association) for their recruitment efforts, and thank Tom Bart (Jellinek Prevention), Anneke Goudriaan (Arkin), and Jannet de Jonge (Amsterdam University of Applied Science) for commenting on the draft manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.633551/full#supplementary-material

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Conflict of Interest: AB is employed by the Amsterdam University of Applied Science, a public knowledge institution offering higher professional education. FB and JN are employed by Arkin, a non-profit organization for mental health and addiction care. The authors declare that this study was funded from an annual grant from the municipality of Amsterdam as part of a structural monitoring effort. The funder was not involved in the study design, collection, analysis, interpretation of data, the writing of this article or the decision to submit it for publication.

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BRIEF RESEARCH REPORT
published: 14 June 2021
doi: 10.3389/fpsyt.2021.634454

Compulsive Hoarding Symptoms and the Role of Mindfulness Skills During Social Distancing for the COVID-19 Pandemic: An Exploratory Survey

Donatella Marazziti [1,2,3]*, ***Andrea Pozza*** [4], ***Federico Mucci*** [5] ***and Davide Dettore*** [6]

[1] Department of Clinical and Experimental Medicine, Section of Psychiatry, University of Pisa, Pisa, Italy, [2] Saint Camillus International University of Health and Medical Sciences, Rome, Italy, [3] BRF Foundation, Lucca, Italy, [4] Department of Medical Sciences, Surgery and Neurosciences, University of Siena, Siena, Italy, [5] Department of Biotechnology, Chemistry and Pharmacy, University of Siena, Siena, Italy, [6] Department of Health Sciences, University of Florence, Florence, Italy

People reporting compulsive hoarding symptoms (CHS) have lower mindfulness skills than those without such symptoms. Mindfulness skills can have the role of a protective buffer against stressful periods. The quarantine imposed to contain the COVID-19 spread had a negative impact on daily habits and healthy behaviors (including social interactions). An increased attachment to objects might be one of the under-recognized psychological consequences of these difficult times, yet no study focused on CHS. Through an online survey in men who were on quarantine during the pandemic, this exploratory survey examined the prevalence of men reporting CHS during this period and explored the role of mindfulness skills on CHS controlling for anxious-depressive/stress symptoms. Forty-three men from the general population completed the Obsessive Compulsive Inventory-Revised (OCI-R), Cognitive and Affective Mindfulness Scale-Revised (CAMS-R) and Depression Anxiety Stress Scales-21 (DASS-21). Twenty-eight percent reported CHS. No differences on the scores of the questionnaires emerged between men with and without CHS, except on CAMS-R Attention scores. In a logistic regression analysis lower CAMS-R Attention scores predicted CHS ($\beta = -0.34$, $p = 0.03$). This is the first, yet preliminary investigation on CHS during quarantine. The prevalence of CHS appears higher than the rates (4%) reported in the last years before the COVID-19 outbreak. Perhaps people showed more intense hoarding tendencies during quarantine/social distancing, and this pattern should be monitored. Larger samples, longitudinal designs and clinician-rated instruments are needed to support or not our findings.

Keywords: COVID-19 pandemic, social distancing, coronavirus, compulsive hoarding, behavioral addiction, mindfulness, obsessive - compulsive disorder

OPEN ACCESS

Edited by:
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Zita Sousa,
Polytechnic Institute of Porto, Portugal

****Correspondence:***
Donatella Marazziti
dmarazzi@psico.med.unipi.it

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *27 November 2020*
Accepted: *14 May 2021*
Published: *14 June 2021*

Citation:
Marazziti D, Pozza A, Mucci F and Dettore D (2021) Compulsive Hoarding Symptoms and the Role of Mindfulness Skills During Social Distancing for the COVID-19 Pandemic: An Exploratory Survey. Front. Psychiatry 12:634454. doi: 10.3389/fpsyt.2021.634454

INTRODUCTION

During the last year, the outbreak of the COVID-19 pandemic has dramatically impacted on the societies of most countries worldwide (1). To cope with the spread of the infection, several national governments adopted a series of countermeasures including social distancing, more or less severe moving and activities restrictions, and quarantine. This social change represented and still represents a highly stressful life event with a negative impact on daily habits and healthy behaviors including social interactions. Therefore, it may potentially favor the onset of symptoms in individuals with a pre-existing vulnerability toward psychopathological conditions (2–6).

Once classified as a symptom dimension of obsessive–compulsive disorder (OCD) (7), hoarding disorder (HD) is now included as a separate psychopathological category in the OCD and Related Disorders chapter of DSM-5 (8). The clinical picture consists of a persistent and distressing difficulty discarding possessions, regardless of their actual value, due to a perceived need to save them. This behavioral pattern results in the accumulation of items that clutter living areas and compromises their intended use, causing significant impairment in social, occupational, or other areas of functioning. According to a recent review, around 2% of the general population meets the criteria for a full HD diagnosis, prevalence rates do not substantially change across developed countries and, it may increase with age (9). The prevalence of clinically significant compulsive hoarding symptoms (CHS) in people who do not meet the criteria for a full diagnosis was identified in 4–6% of the general population, and it was greater in older than younger age groups, greater in men than women (10).

The HD causes an important impairment in the quality-of-life levels of individuals (11), and it imposes a significant burden on their family members that is comparable with that experienced by natural caregivers of dementia people (12, 13). The HD is associated with high societal costs and its public health consequences include lack of hygiene and bad odors: it also contributes to the faster deterioration of buildings, infection of dwellings with rodents and insects and increased fire hazards (14–16). Like other obsessive-compulsive spectrum disorders, HD is often an under-recognized and untreated pathological condition (17). According to some studies [e.g., (18)], people suffering from HD may wait for a long time before attending a mental health facility or seeking professional help. In addition, most of them may be not enough aware of their symptoms due to social stigma and poor mental health literacy (19). Therefore, early identification of vulnerable cases seems to be a crucial public health strategy, particularly during a difficult period for healthcare services like the present one.

Mindfulness skills are a protective factor against stressful situations and periods that include the ability of staying in the present moment in a non-judgemental way (20). Being mindful means to be aware of both external and internal stimuli, and wittingly re-direct one's attention to the present moment, so that one is neither overwhelmed by the violence of thoughts, emotions, and sensations, nor led in one's actions and choices by those cognitive contents and affects. Several different definitions of mindfulness share one common element: the non-judgemental attitude toward one's inner experience (21, 22). Recent evidence showed the potentially protective role of mindfulness skills against the development and maintenance of psychological distress during the pandemic, but not only, in various populations [e.g., (23–25)]. Previous evidence suggested that CHS people show lower mindfulness skills, as compared with those not reporting such symptoms (26).

In conclusion, CHS represent a problematic, often under-recognized and under-reported, condition that significantly interferes with quality of life. Thus, there is a strong need for a better knowledge of the psychological factors which can protect from the development and maintenance of this condition during a difficult time like the present one.

Rationale and Aims

The quarantine imposed by the governments to contain the COVID-19 spread represents a dramatic social change with a potentially severe impact on daily habits and healthy behaviors (including social interactions). An increased attachment to possessions and objects might be an under-recognized mental health negative outcome of these difficult times. Although there is a great effort to investigate the mental health effects of the quarantine, no study focused on CHS. In particular, it seems to be of great relevance to explore the psychological factors potentially related to a lower level of psychopathological conditions during the pandemic (27). A recent umbrella review suggested that, despite the quite large amount of data, more evidence is needed about the protective factors associated with OCD-related disorders or traits (28).

Based upon an online survey in a group of men who were in quarantine during the COVID-19 pandemic, the present exploratory survey examined the prevalence of men reporting clinically significant CHS during this particular period. In addition, the role of the mindfulness skills on the presence of clinically relevant CHS was explored.

METHODS

Eligibility Criteria and Recruitment Procedure

Eligibility criteria included the fact that participants had provided written informed consent and declared to be in quarantine. Participation was anonymous, voluntary, and uncompensated. The data of this study represent a secondary analysis of a larger web-based online study which was conducted via Google form and aimed to explore the broad OCD-related features in the Italian general population during the COVID-19 pandemic. Participants were recruited through convenience sampling. Specifically, the web-based advertisement of the study was spread from 9th March 2020 to the end of April 2020, the period in which the complete quarantine was imposed by the Italian government. The advertisement was posted on a series of Facebook online groups, where the objectives, the target population, the characteristics of the self-report instruments and the fact that anonymity was assured were presented. All participants were in complete quarantine imposed by the national government to cope with the spread of the COVID-19.

Forty-three men recruited from the general population responded to an online survey about the quarantine mental health effects and completed a series of self-report questionnaires.

The study was approved by the Ethics Committee of the University where it was conducted.

Measures

Obsessive Compulsive Inventory-Revised (OCI-R)

The OCI-R (29) measures the severity of obsessive-compulsive symptoms using 18 items grouped into six subscales assessing six subtypes (Washing, Obsessing, Hoarding, Ordering, Checking, and Mental Neutralizing) through a 5-point Likert scale (0 = Not at all, 4 = Extremely) (29). The Italian version showed acceptable to good internal consistency (Cronbach's alpha > 0.70 for all the subscales), and test-retest reliability (Pearson's $r > 0.70$) (30).

Cognitive and Affective Mindfulness Scale-Revised (CAMS-R)

It is a 12-item scale that measures everyday mindfulness and focuses on the degree to which respondents experience their thoughts and feelings (31). Items are rated on a 4-point Likert scale from 1 (rarely/not at all) to 4 (almost always). Scores on the scale are summed. Higher scores reflect greater mindfulness. Internal consistency across the 12 items was acceptable to good for two student samples (alpha = 0.74–0.80). The Italian version (32) showed four subscales with acceptable internal consistency including Attention (i.e., the ability to regulate attention), Present Focus (i.e., the orientation to present experience), Awareness (awareness of experience) and Acceptance (i.e., the attitude of acceptance or non-judgment toward experience).

Depression Anxiety Stress Scales-21 (DASS-21)

The DASS-21 (33) is a measure of psychological distress and comprises three subscales measuring depression, anxiety, and stress, respectively. All the scales comprise seven items each. Participants rated the extent to which the item applied to them over the last week on a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). The total scores for each scale are calculated by summing scores on the seven items and multiplying the total by two. The DASS-21 has very good psychometric properties (34). The Italian version showed good internal consistency (35).

Data Analyses

Participants with clinically significant CHS were identified if they reported a score on the OCI-R Hoarding subscale higher than the 95th percentile of the normal distribution reported in the validation study (30). Group differences were tested by a series of one-way analyses of variance (ANOVAs), specifically the differences on age, the scores on the CAMS-R and DASS-21 between participants with and without clinically significant CHS. Cohen's d indices were calculated as effect sizes and they were interpreted according to the following criteria: values equal to 0.80 or higher were interpreted as large, values up to 0.50 as medium, and values up to 0.20 as small (36). Non-parametric tests were used to examine between-group differences on socio-demographics. Finally, a logistic regression analysis was carried out entering as predictors the scores on the CAMS-R and/or DASS-21 subscale scores that had a significant p-value in the ANOVAs and/or a large effect size, and the group categories (participants with and without clinically significant CHS) as outcome. The data analyses were conducted through the Statistical Packages for Social Sciences (SPSS) 25,00 version.

TABLE 1 | Demographic characteristics of participants ($n = 43$).

	M (SD; range)	*n* (%)
Age (years)	25.77 (4.40; 19–39)	
Marital status		
Single		21 (48.8)
Engaged or married		22 (51.2)
Occupational status		
Student		25 (58.1)
Working		16 (37.2)
Other		2 (4.7)
Education level		
Middle school		5 (11.6)
High school		24 (55.8)
Degree		5 (11.6)
Compulsive hoarding symptoms		
(OCI-R Hoarding subscale score ≥ 95th percentile of the normal distribution)		
Yes		12 (27.9)
No		31 (72.1)

M, mean; n, number of participants; OCI-R, obsessive compulsive inventory-revised; SD, standard deviation.

RESULTS

Sociodemographic and Clinical Characteristics of the Group

Forty-three young men were included in the study (**Table 1**). Mean age was 25.77 years (SD = 4.40) ranging from 19 to 39. Twelve participants (27.9% of the group) reported clinically significant CHS, as shown by a score higher than the 95th percentile of the OCI-R Hoarding subscale scores of the community distribution reported in the validation paper of the measure (30).

Group Differences and Effects of Mindfulness Skills on CHS

No differences were found between men with and without CHS on socio-demographic variables including age [$F_{(1,\,41)} = 0.88$, $p = 0.35$], marital status [$\chi^2_{(1)} = 0.009$, $p = 0.92$], occupational status [Kruskal-Wallis $H_{(1)} = 0.61$, $p = 0.43$], and education level [Kruskal-Wallis $H_{(1)} = 1.52$, $p = 0.21$].

Significant differences between men with and without CHS emerged only on the scores of the CAMS-R Attention with a large effect size, but not on the scores of the CAMS-R or DASS-21 (**Table 2**).

The logistic regression analysis included only the scores on the CAMS-R Attention which resulted associated with a significant p-value and a large effect size in the ANOVA. The results of this analysis showed that lower scores on the CAMS-R Attention scores predicted the presence of CHS ($\beta = -0.34$, Wald = 4.55, $p = 0.03$): individuals with lower CAMS-R Attention scores were more likely to have CHS.

TABLE 2 | Comparison between men with and without CHS on the clinical scales (n = 43).

	Compulsive hoarding symptoms (OCI-R Hoarding subscale score ≥ 95th percentile of the normal distribution)	Mean	SD	95% CI		$F_{(df)}$	p-value	Cohen's d
				Lower	Upper			
CAMS-R Attention	Yes (n = 31)	8.29	2.003	7.56	9.03	$5.43_{(1,41)}$	0.025	−0.80
	No (n = 12)	6.50	2.844	4.69	8.31			
CAMS-R Present Focus	Yes (n = 31)	7.61	2.201	6.81	8.42	$0.68_{(1,41)}$	0.41	−0.28
	No (n = 12)	7.00	2.132	5.65	8.35			
CAMS-R Acceptance	Yes (n = 31)	8.52	2.249	7.69	9.34	$0.33_{(1,41)}$	0.56	−0.20
	No (n = 12)	8.08	2.021	6.80	9.37			
CAMS-R Awareness	Yes (n =31)	8.19	1.990	7.46	8.92	$2.51_{(1,41)}$	0.12	−0.53
	No (n = 12)	7.17	1.642	6.12	8.21			
DASS-21 Depression	Yes (n = 31)	6.29	6.198	4.02	8.56	$0.91_{(1,41)}$	0.34	0.32
	No (n = 12)	8.17	4.387	5.38	10.9			
DASS-21 Anxiety	Yes (n = 31)	3.29	3.514	2.00	4.58	$1.42_{(1,41)}$	0.23	0.40
	No (n = 12)	4.67	3.025	2.74	6.59			
DASS-21 Stress	Yes (n = 31)	8.26	5.899	6.09	10.42	$1.71_{(1,41)}$	0.19	0.44
	No (n = 12)	10.67	3.774	8.27	13.06			

CAMS-R, cognitive and affective mindfulness scale-revised; CHS, compulsive hoarding symptoms; CI, confidence interval; d, effect size; DASS-21, depression anxiety stress scales-21 items; OCI-R, obsessive compulsive inventory-revised; SD, standard deviation.

DISCUSSION

The present exploratory study is the first empirical contribution investigating CHS in a group of men of the general population during the quarantine. The prevalence of such symptoms (28%) appears higher than the rates (4–6%) generally reported in the last years before the COVID-19 outbreak in the general population (10). This finding suggests that perhaps people have more intense hoarding behaviors during quarantine and social distancing, and this behavioral pattern should be more carefully monitored during the pandemic. As already reported (18), CHS are generally under-recognized by practitioners and under-reported by the individuals themselves. Such an increase of CHS during the quarantine might be attributed to a variety of factors including stocking of masks, soaps, sanitizers, disinfectants that can lead to CHS, increased stress subsequent to quarantine and nation-wide lockdown in response to the COVID-19, a lower chance for interpersonal contacts that increases people's attachment to objects, and a higher chance for compulsive online shopping as a way to cope with quarantine-related distress and loneliness (27).

The present preliminary findings suggest that the ability to regulate attention can protect from CHS and play the role of a psychological factor associated with a lower level of CHS during this dramatic social change when the individual may not interact with people and must stay at home. This potentially protective role of the attention facet of mindfulness skills appears consistent with an increasing amount of data which show the relation between a higher level of this mindfulness skill and a lower level of psychological distress during the pandemic in various populations [e.g., (24, 25)]. It might be speculated that an attitude based upon attention regulation can be associated with an increased distress tolerance and regulation which has been found to be a significant predictor of CHS (37–39). However, the other mindfulness skills were not predictive of CHS, specifically the orientation to present or immediate experience, the awareness of experience, and an attitude of acceptance or non-judgment toward experience. In contrast with previous data (40, 41), we did not detect any differences on anxious-depressive symptoms and stress levels on CHS that prevented the inclusion of these features as predictors in the regression analysis. However, not all the previous studies confirmed that distress levels are higher amongst people with HD or CHS. For example, Worden et al. (42) found that distress levels did not discriminate a clinical group with HD from a control group after controlling for depressive and anxious symptoms. One possible explanation for this result is that the CHS group was not composed of individuals who sought help for CHS; for this reason, maybe the level of distress in this group was not high. An alternative explanation might be that both the groups were in quarantine when they completed the survey, and they were not compared on distress levels with another group who was not in quarantine. As observed elsewhere, the quarantine may increase the likelihood that people with obsessive-compulsive spectrum conditions develop psychological distress (43).

Since the present one was an exploratory survey, some important limitations should be pointed out.

Firstly, the small sample size prevented the assessment of the effects of further variables. For example, it might be interesting to investigate the effects of other variables related to CHS, such as attachment styles, or other psychopathological symptoms potentially overlapped with CHS such as Internet addiction symptoms, compulsive shopping symptoms and obsessive-compulsive symptoms (44–46). Another key aspect to be noted is that if we used a Bonferroni correction to test the ANOVA-based comparisons, Bonferroni-adjusted p-value would be 0.007 (=0.05/7), thus the observed significance for CAMS-R Attention

($p = 0.025$) would be lost. The small sample size might be a cause of this problem. In addition, perhaps the lack of significant effects of some predictors in the logistic regression analysis might be attributed to the low power of the statistical analysis. Therefore, future research should include larger samples. The cross-sectional design did not allow a causal relationship to be established. Therefore, it may be interesting to explore whether specific mindfulness skills can predict the onset of CHS over time in prospective studies during the pandemic. Moreover, by using a longitudinal design it would be important to understand whether, or not the quarantine can increase the risk of developing CHS. For example, it would be interesting to explore whether the reduction of social contacts during the quarantine and social distancing might be a mediator of an increased risk of CHS, since social relationships and support have a protective effect against obsessive-compulsive spectrum symptoms (47–49).

Another relevant shortcoming regards the use of self-report measures. Future research should integrate self-report instruments with clinician-administered tools (e.g., interviews). In addition, despite CHS are more likely to be present among men, future research should include also a group of women and explore the potential role of gender.

In conclusion, this is the first investigation on CHS during quarantine. The prevalence of CHS appears higher than the rates reported in the last years before the COVID-19 outbreak. Perhaps people have more intense hoarding tendencies during quarantine/social distancing, and this pattern should be monitored further. Larger samples, longitudinal designs and clinician-rated instruments are needed to support or not our findings.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Florence. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DM designed the study, conducted the literature searches, collected and analyzed the data, wrote the first draft of the paper, and edited the final version. AP designed the study, conducted the literature searches, collected and analyzed the data, and wrote the first draft of the paper. FM designed the study, analyzed the data, and edited the final version of the paper. DD designed the study, collected the data, wrote the first draft, and edited the final version of the paper. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

CASE REPORT
published: 28 June 2021
doi: 10.3389/fpsyt.2021.688147

Psychomotor Agitation Non-responsive to Treatment: A Case Report of Phenibut Withdrawal Syndrome

Cecilia Maria Esposito [1], Gian Mario Mandolini [1], Giuseppe Delvecchio [2], Alessio Fiorentini [1] and Paolo Brambilla [1,2]*

[1] Department of Neurosciences and Mental Health, Fondazione Istituto di Ricovero e Cura a Carattere Scientifico Ca' Granda, Ospedale Maggiore Policlinico, Milan, Italy, [2] Department of Pathophysiology and Transplantation, University of Milan, Milan, Italy

OPEN ACCESS

Edited by:
Giuseppe Bersani, Sapienza University of Rome, Italy

Reviewed by:
Domenico De Berardis, Azienda Usl Teramo, Italy
Fabrizio Schifano, University of Hertfordshire, United Kingdom
Jolanta B. Zawilska, Medical University of Lodz, Poland

****Correspondence:***
Alessio Fiorentini
alessio.fiorentini@gmail.com

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *30 March 2021*
Accepted: *14 May 2021*
Published: *28 June 2021*

Citation:
Esposito CM, Mandolini GM, Delvecchio G, Fiorentini A and Brambilla P (2021) Psychomotor Agitation Non-responsive to Treatment: A Case Report of Phenibut Withdrawal Syndrome. Front. Psychiatry 12:688147. doi: 10.3389/fpsyt.2021.688147

Background and Objectives: Phenibut (4-amino-3-phenyl-butyric acid), acting as a GABA-B receptor agonist, has a beneficial effect on anxiety. Although its medical use is not approved in western countries, it can be easily obtained worldwide *via* the Internet, so it spread as a substance of abuse. In recent years, some case reports have, therefore, highlighted episodes of acute toxicity or withdrawal, but it is still a largely unknown phenomenon.

Methods: In this case report, a 50-year-old woman was admitted to the emergency room with psychomotor agitation, psychotic symptoms, and insomnia, and was non-responsive to treatment. She was hospitalized at the psychiatry ward for 25 days and gave her consent for the publication of the present case report.

Results: The suspicion of phenibut withdrawal allowed to establish the appropriate management, leading to the *restitutio ad integrum* of the psychopathological case.

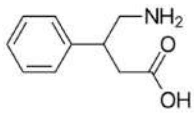
Conclusions: In the face of an incoercible psychomotor agitation case, the knowledge of the so-called novel psychoactive substances allows for more appropriate clinical management of intoxication and withdrawal syndromes. This is a scientifically significant report as it provides therapeutic and outcome data concerning a syndrome that is still quite unfamiliar.

Keywords: withdrawal, psychiatric aspects, psychopharmacology, phenibut, psychomotor agitation

INTRODUCTION

Phenibut (4-amino-3-phenyl-butyric acid) is a glutamic acid derivative compound synthesized in Russia in the early 1960s and available nowadays in ex-Soviet countries as a cognitive enhancer, food supplement, adjuvant for anxiety and insomnia, and alcohol withdrawal symptoms (1). This substance seems to primarily act as a γ-aminobutyric acid (GABA) B receptor agonist, consequently closing voltage-dependent calcium channels and inhibiting neurotransmission, similar to other drugs, such as pregabalin, gabapentin, and baclofen (2). Moreover, phenibut seems also to boost both dopaminergic and serotoninergic neurotransmission (3). The pharmacological characteristics of

TABLE 1 | Phenibut: chemical and pharmacological characteristics.

Phenibut, Anvifen, Fenibut, Noofen
4-Amino-3-phenyl-butyric acid
Chemical structure: $C_{10}H_{13}NO_2$ 
Pharmacological characteristics: - GABA-mimetic, primarily at GABA(B) and, to some extent, at GABA(A) receptors - Stimulator of dopamine receptors and antagonizes beta-phenethylamine, a putative endogenous anxiogenic - Blocker of α2δ subunit-containing voltage-dependent calcium channels

phenibut can be viewed in **Table 1**. However, even though its medical use is not approved in western and European countries, since it was classified as a novel psychoactive substance (NPS) by the United Nations Office of Drug and Crime (UNODC), phenibut can be easily obtained worldwide *via* the Internet as a dietary supplement in the form of powder, pills, or crystals with an increasing risk of potential misuse (4). In this regard, both acute intoxication and withdrawal syndromes related to phenibut consumption have been reported in literature (5). Specifically, intoxication mainly induces the risk of respiratory failure, paradoxical agitation, seizures, and delirium, while withdrawal is a condition that can last for a significant period and is characterized by psychomotor agitation, psychosis, autonomic instability, seizures, nausea, and vomiting (6, 7). These clinical conditions must be timely recognized and treated in order to avoid serious complications, such as respiratory or acute renal failures due to rhabdomyolisis (5). However, the clinical manifestation characterized by non-specific signs and symptoms together with the lack of a specific protocol for the treatment of both phenibut intoxication and withdrawal symptoms could delay the recognition of these syndromes and their effective management. Therefore, the description of case reports related to phenibut misuse is crucial in order to make clinicians aware of this emerging NPS misuse.

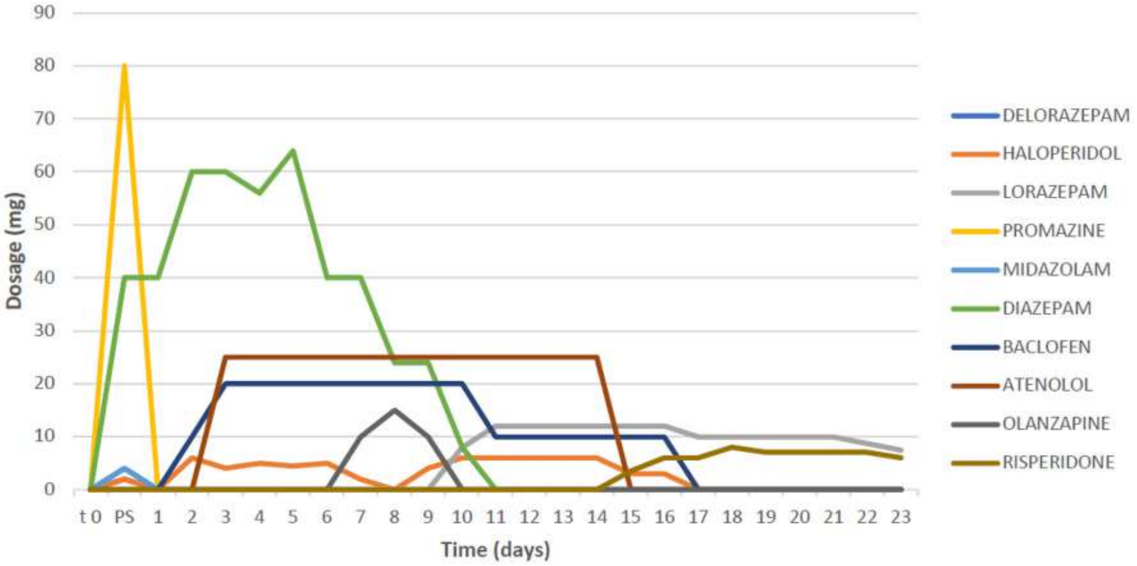
CASE REPORT

A 50-year-old woman with previously unknown psychiatric history was admitted to the emergency department at night in a state of confusion and psychomotor agitation. Her partner declared that during the morning, the patient suddenly developed motor stereotypies, hyperactivity, and fluctuations of both attention and consciousness. Although her partner denied that the patient had used any psychoactive drugs or alcohol previously, he reported an occasional consumption of diazepam oral solution for anxiety. The patient was not taking any drug therapy with medical prescription. Since psychomotor agitation was becoming more severe with the patient's risk of self-injurious conduct, intramuscular medication with delorazepam up to 6 mg was administered without any substantial modification of

FIGURE 1 | Pictures of phenibut tablets in various commercial formulations (Fenibut, Anvifen, and Noofen) found at patient's home.

the symptomatology. Meanwhile, a CT scan without contrast, performed at the emergency room, was negative for acute neurological events, while toxicological screening of urine (research for opioids, cocaine, methamphetamine, cannabinoids, and benzodiazepines) was positive only for benzodiazepines. The patient's blood tests showed no significant alterations except for creatine phosphokinase (CPK), while the electrocardiogram detected no significant alterations except for a tachycardia (120 beats for a minute). After 2 h of intramuscular therapy with benzodiazepines, haloperidol, and promazine, the patient had no clinical improvement showing abnormal motor behaviors, disorganized thinking, echolalia, visual hallucinations, and total insomnia. Her partner was able to recover a series of tablets at home, of which phenibut, in its various commercial formulations (Fenibut, Anvifen, and Noofen) was the main ingredient (**Figure 1**). Upon contacting the Poison Control Center, the clinical symptomatology presented by the patient was suspected to be related to phenibut withdrawal since the patient had started consuming phenibut in the previous months. It was subsequently possible to reconstruct that the interval between the last dose of phenibut and the onset of symptoms was about 3 days. The patient was, therefore, hospitalized in the psychiatric ward. Meanwhile, intravenous diazepam up to 30 mg and intramuscular haloperidol up to 5-mg therapy was administered. Following the recommendations for phenibut withdrawal syndrome from previous case reports (5), a baclofen medication of up to 20 mg/day was started. This is because previous literature reported baclofen as a GABA-B agonist, which allows an alternative binding of GABA-B receptors and,

TABLE 2 | Timeline regarding drug treatment and dosages.



therefore, an improvement on withdrawal (8). A time course regarding the drug treatment and the dosages used is shown in **Table 2**.

Despite the therapy, the patient still spent two completely sleepless nights, experiencing visual hallucinatory disturbances, disorganized behavior, and thinking, with no clearly structured delusions. Psychometric rating scales were performed, with evidence of significant alteration of the mental state [Brief Psychiatric Rating Scale (BPRS) = 75, Hamilton Rating Scale for Depression (HAM-D) = 24, Mania Rating Scale (MRS) = 22, Positive and Negative Syndrome Scale (PANSS) = 102, and Global Assessment of Functioning (GAF) = 25]. Afterward, her mental status began to change from agitation, self-directed aggressiveness, and persecutory delusions to episodes of catatonia, during which she did not react to stimuli and appeared hostile and opposed to any therapeutic contact. Electroencephalogram (EEG) and magnetic resonance imaging (MRI) were performed, with the former showing rapid rhythms compatible with benzodiazepine therapy, and the latter exhibiting rare punctiform hyperintense signal alterations in T2-FLAIR affecting the bihemispheric subcortical white matter of non-specific gliotic significance. In the context of catatonia, the patient developed bladder globe and urinary tract infection with the consequent need for antibiotic treatment (ceftriaxone 2 g for 6 days). She never showed signs of kidney damage, and there was a progressive decrease in CPK (from 1,504 to 195 U/L). Instead, a picture of autonomic instability emerged, characterized by pressure peaks and tachycardia; therefore, atenolol treatment up to 10 mg/day was started, and this had positive effects on symptoms.

Meanwhile, it was possible to view previous health records, and the patient's medical history was reconstructed. She did not suffer from any major medical diseases, but she had been previously treated by private psychiatrists at the age of 36, for depressive episodes in the context of bipolar disorder with psychotic features. She had not been working for 20 years, and she had been living with her partner, living a mainly solitary life with few social interactions. Complete intercritical resolution of the depressive episodes was reported, with a return to the previous functioning. However, for cultural reasons, the patient continued to have magical thoughts. Amitriptyline and benzodiazepines were the last pharmacological therapy administered, prescribed 3 years before the current episode by a private psychiatrist and consumed by the patient without any medical supervision, which, due to her history of poor pharmacological compliance and her tendency to prefer natural remedies, may have not been taken correctly. She had no history of substance abuse, although a trend of excessive consumption of benzodiazepines was also reconstructed for anxiolytic and hypno-inductive purposes.

In light of the catatonic state, the therapy was changed from diazepam to intravenous lorazepam up to 12 mg/day (9). Furthermore, since occasional lengthening of the QT interval was detected through ECG, haloperidol was replaced first with olanzapine, then with risperidone up to 6 mg in order to facilitate the management of psychomotor agitation with a daily QT monitoring. Gradually, the patient progressively showed a reduction in both disorganized thinking and agitation. In addition, psychotic symptoms, such as persecutory delusions and both visual and auditory hallucinations, slowly diminished until finally ending after 4 weeks. Atenolol therapy was stopped after 15 days, and the patient did not experience any further symptoms of autonomic instability.

After resolving the psychotic symptomatology, the patient showed positive recovery in regard to delusional thinking and hallucinatory phenomena, but she also experienced a few days of moderate expansive mood, which resolved after a few days. The patient revealed that she had been consuming phenibut in high dosage (up to 5 g/day) in the previous months in order to treat anxiety and insomnia that began during the COVID-19 pandemic quarantine. Therefore, the diagnosis of phenibut withdrawal was confirmed. Finally, psychometric rating scales were performed at the end of the hospitalization showing the following results: BPRS = 25, HAM-D = 5, MRS = 2, PANSS = 37, GAF = 80. We concluded on a diagnosis of withdrawal psychosis and mixed psychotic episode in the context of bipolar disorder. The patient was, therefore, discharged after 25 days of hospitalization, with a diagnosis of withdrawal psychosis and mixed psychotic episode in bipolar disorder, and with the following treatment: risperidone 6 mg and lorazepam 10 mg/day.

Although it was impossible to have a detailed view of her perspective during the entire hospitalization, at the time of discharge, the patient expressed feelings of relief and amazement concerning her well-being. She also said that she had lived "a nightmare" and that she not only had fear but also, in some moments, the certainty that it would never end. The patient gave her informed consent for the publication of the present case report.

CONCLUSIONS

This case report aims to underline the disruptive action that NPS can have in the psyche of a subject, especially due to intoxication and abstinence. In this case, surely the duration of the episode is not to be attributed only to the severity of the condition of abuse but also to the presence of the patient's previous psychiatric disorder. In fact, the previous diagnosis of bipolar disorder may have affected both the emotional instability, which pushed the patient toward the abuse of phenibut, and the severity of the consequent psychopathological picture (10). Moreover, in this patient, it seems that the abuse was not determined by a sensation-seeking modality but by the inability to manage feelings of emptiness and fear due to the COVID-19 pandemic emergency that recently occurred in northern Italy (11, 12). The observation of the exotoxic origin of the very serious episode of psychosis described in this case report creates an interesting field of investigation with respect to the so-called synthetic psychosis. This has led to a great diffusion in recent years and, thus, has made it important for knowledge to be acquired on the phenomenon to enable its differentiation from non-exotoxic psychiatric disorders (13, 14).

The emerging worldwide misuse of phenibut (an NPS inaccurately marketed as a dietary supplement) requires major attention from clinicians in order to recognize both its intoxication and abstinence syndromes, which are two clinical conditions that can be characterized by initial slow response to multiple treatments and several serious life complications. Finally, given its various pharmacological actions with potential for tolerance and withdrawal, phenibut should be considered a substance requiring close medical supervision, and its prescription should be regulated by competent medical authorities.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

AF and PB conceived the presented idea. CE and GM wrote the manuscript in consultation with GD. PB supervised the project. All authors contributed to the article and approved the submitted version.

FUNDING

This study was partially supported by funds from ERANET NEURON JTC2018 Mental Disorders UNMET project (Neuron-051).

ACKNOWLEDGMENTS

We thank Dr. R. Aronica for the contribution to create the figure and Dr. M. Ariyo to revise the English language.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 06 August 2021
doi: 10.3389/fpsyt.2021.646206

A Global Survey on Changes in the Supply, Price, and Use of Illicit Drugs and Alcohol, and Related Complications During the 2020 COVID-19 Pandemic

*Ali Farhoudian[1], Seyed Ramin Radfar[2,3], Hossein Mohaddes Ardabili[4,5], Parnian Rafei[6,7], Mohsen Ebrahimi[7], Arash Khojasteh Zonoozi[5], Cornelis A. J. De Jong[8], Mehrnoosh Vahidi[1], Masud Yunesian[9], Christos Kouimtsidis[10], Shalini Arunogiri[11], Helena Hansen[12], Kathleen T. Brady[13], ISAM Global Survey Consortium (ISAM-GSC), Marc N. Potenza[14], Alexander Mario Baldacchino[15] and Hamed Ekhtiari[16]**

[1] Department of Psychiatry, Tehran University of Medical Sciences, Tehran, Iran, [2] Department of Neuroscience and Addiction, School of Advanced Technologies in Medicine (SATiM), Tehran University of Medical Sciences, Tehran, Iran, [3] Integrated Substance Abuse Programs Department, University of California, Los Angeles, Los Angeles, CA, United States, [4] Psychiatry and Behavioral Sciences Research Center, Faculty of Medicine, Ibn-e-Sina Hospital, Mashhad University of Medical Sciences, Mashhad, Iran, [5] Student Research Committee, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran, [6] Department of Psychology, Faculty of Psychology and Education, University of Tehran, Tehran, Iran, [7] Iranian National Center for Addiction Studies, Tehran University of Medical Sciences, Tehran, Iran, [8] Behavioral Science Institute, Radboud University, Nijmegen, Netherlands, [9] School of Public Health, Tehran University of Medical Sciences, Tehran, Iran, [10] Surrey and Borders Partnership National Health Service Foundation Trust, Leatherhead, United Kingdom, [11] Turning Point, Eastern Health, Box Hill, VIC, Australia, [12] Departments of Anthropology and Psychiatry, New York University, New York, NY, United States, [13] Department of Psychiatry and Behavioral Sciences, Medical University of South Carolina, Charleston, SC, United States, [14] Yale School of Medicine, Connecticut Council on Problem Gambling and Connecticut Mental Health Center, New Haven, CT, United States, [15] Division of Population and Behavior Sciences, Medical School, University of St Andrews, St Andrews, United Kingdom, [16] Laureate Institute for Brain Research, Tulsa, OK, United States

OPEN ACCESS

Edited by:
Ornella Corazza, University of Hertfordshire, United Kingdom

Reviewed by:
Diana Martinez, Columbia University, United States
Elisabeth Prevete, Sapienza University of Rome, Italy

***Correspondence:**
Hamed Ekhtiari
hekhtiari@laureateinstitute.org

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 25 December 2020
Accepted: 15 June 2021
Published: 06 August 2021

Citation:
Farhoudian A, Radfar SR, Mohaddes Ardabili H, Rafei P, Ebrahimi M, Khojasteh Zonoozi A, De Jong CAJ, Vahidi M, Yunesian M, Kouimtsidis C, Arunogiri S, Hansen H, Brady KT, ISAM Global Survey Consortium (ISAM-GSC), Potenza MN, Baldacchino AM and Ekhtiari H (2021) A Global Survey on Changes in the Supply, Price, and Use of Illicit Drugs and Alcohol, and Related Complications During the 2020 COVID-19 Pandemic. Front. Psychiatry 12:646206. doi: 10.3389/fpsyt.2021.646206

Background and Aims: COVID-19 has infected more than 77 million people worldwide and impacted the lives of many more, with a particularly devastating impact on vulnerable populations, including people with substance use disorders (SUDs). Quarantines, travel bans, regulatory changes, social distancing, and "lockdown" measures have affected drug and alcohol supply chains and subsequently their availability, price, and use patterns, with possible downstream effects on presentations of SUDs and demand for treatment. Given the lack of multicentric epidemiologic studies, we conducted a rapid global survey within the International Society of Addiction Medicine (ISAM) network in order to understand the status of substance-use patterns during the current pandemic.

Design: Cross-sectional survey.

Setting: Worldwide.

Participants: Starting on April 4, 2020 during a 5-week period, the survey received 185 responses from 77 countries.

Measurements: To assess addiction medicine professionals' perceived changes in drug and alcohol supply, price, use pattern, and related complications during the COVID-19 pandemic.

Findings: Participants reported (among who answered "decreased" or "increased") a decrease in drug supply (69.0%) and at the same time an increase in price (95.3%) globally. With respect to changes in use patterns, an increase in alcohol (71.7%), cannabis (63.0%), prescription opioids (70.9%), and sedative/hypnotics (84.6%) use was reported, while the use of amphetamines (59.7%), cocaine (67.5%), and opiates (58.2%) was reported to decrease overall.

Conclusions: The global report on changes in the availability, use patterns, and complications of alcohol and drugs during the COVID-19 pandemic should be considered in making new policies and in developing mitigating measures and guidelines during the current pandemic (and probable future ones) in order to minimize risks to people with SUD.

Keywords: COVID-19, addiction, substance use disorder, global survey, behavioral addiction, illicit drug market

INTRODUCTION

As of December 23, 2020, the COVID-19 pandemic has around 77 million cases of infection in more than 200 countries with above 1,711,000 overall deaths (1). Approximately 6 months after cases were first diagnosed, there remain few reliable treatments and no vaccines available, and an increasing number of countries are experiencing dangerous COVID-19 transmission (2, 3). Among vulnerable populations to infection and its complications are people with substance use disorders (SUDs) (4). Both comorbid medical conditions in SUDs (such as cardiopulmonary diseases and related risk factors) and drug–drug interactions (between COVID-19 medications and abused substances or SUD treatment medications), along with other factors, may lead to people with SUDs experiencing more complications when encountering COVID-19 infections (4–6).

People with SUDs are vulnerable given marginalization, stigmatization, and poor access to health and social services (7, 8). According to risky behaviors and disadvantaged environments associated with SUDs, people with SUD may not only bear additional risks for COVID-19 but also experience poorer outcomes (4). Therefore, during the pandemic, gathering current information on the status of SUD is critical to support planning and mobilizing timely responses to minimize risks (4). Alterations in alcohol and drug supplies may change prices and availability and therefore use patterns. The COVID-19 pandemic has resulted in quarantines, travel bans, regulatory changes, and social distancing "lockdown" measures globally, with impacts on supply chains. In the setting of COVID-19-related stressors, there may be decreases in drug and alcohol availability, increases in price and use patterns, and possible downstream effects on SUD presentations and treatment demands. Such changes could directly/indirectly affect people with SUDs and give rise to new challenges and additional needs in the field of addiction medicine. Drug shortages, as the United Nation Office for Drug and Crime (UNODC) reports, could have negative health consequences regarding transitioning to consumption of harmful domestically produced substances along with more dangerous patterns of drug use including shifting to injections and using shared drug administration equipment, especially in the case of heroin (9). Additionally, the lack of drug supply may result in higher prices for some substances and bring financial burden to drug users and increase the odds of risky/illegal behaviors (4). Concurrently, as legal liquor shops may remain closed during the lockdown in some countries, multiple problems may occur ranging from alcohol withdrawal to toxicity and death due to shifting to low-quality homemade liquor and accidental methanol ingestion (4, 10).

People with SUDs could be exposed to some indirect risks during the COVID-19 era as well (5). For instance, as healthcare facilities become more difficult to access during lockdowns, people with SUDs may experience more difficulties relating to poor access to treatment centers. Socioeconomically disadvantaged backgrounds and diminished availability of public transportation may exacerbate such concerns (4, 5, 11), especially for individuals receiving daily prescriptions of opioid substitution therapy (4). Professional authorities and health policymakers are expected to proactively address such emerging needs. However, the lack of reliable data complicates the generation and implementation of evidence-based policies.

Although some activities and reports from different worldwide organizations have initially responded to the COVID-19 pandemic, data provided have been limited and, in some occasions, as UNODC has reported, the information base for analyses has been restricted and feasibility of implementation unknown[1] (12–16). Thus, a vacancy exists for a comprehensive report describing the global situation with respect to drug use, drug supply, and related complications.

In order to formulate a comprehensive health response, it is important to understand alcohol and drug markets' situation (availability and price), use patterns and related complications, and how they may have changed during the pandemic. Designing a global in-depth epidemiologic study, apart from questions about its feasibility, is challenging during the pandemic. Therefore, the International Society of Addiction Medicine (ISAM) designed a comprehensive global survey and

[1]https://www.deadiversion.usdoj.gov/GDP/(DEA-DC-028)(DEA084)_Hospital_Clinic_Registration_Exception_(final).pdf

collected expert opinions on perceived changes in substance use situation and health system responses around the 1st week of April 2020 in what aims to be a longitudinal study (17).

Here, we report results from the first round of the ISAM global survey on drug and alcohol use, price, supply, and complications during the COVID-19 pandemic. Data related to the second section of the survey concerning substance use treatment and harm reduction services responses to the pandemic have been published recently (18). We hypothesized that drug and alcohol use would increase, prices would increase, supply would decrease, and complications would increase and that results would differ by region (given the differential spread of COVID-19 and regional responses to the COVID-19 pandemic). We hope that current data will help to address the urgent need for more accurate information about the status of drug and alcohol use in the current pandemic and provide information about appropriate modifications in health system services to respond to the emerging demands in the current pandemic and similar potential pandemics in the future.

METHODS

Sample

The complete study protocol has been previously published (17). The ISAM mailing list (and subsequent snowballing methodologies) comprising addiction medicine professionals across the world were contacted on April 4, 2020 by email with an invitation to participate in the study by clicking on a link to the online survey. The invitees were informed that the survey will ask about their opinions and information toward COVID-19 pandemic impact on SUDs. They also initially consented to be included as an author in the publications following the survey. Those who approved the manuscript and authorship were included among the main authors or the ISAM Global Survey Consortium (ISAM-GSC) based on their contribution in this project. Data collection was concluded on May 8, 2020.

Questionnaire

The questionnaire consisted of 92 questions in two main sections: (1) situational assessment during the pandemic and (2) health response to the pandemic. This paper provides an analysis of data obtained from the situation assessment section of the survey concerning changes in drug use, supply, price, risky behaviors, as well as related measures, namely morbidities, mortalities, and overdose rates during the COVID-19 pandemic period in different countries (17). Questions on the situational assessment section of the survey are available in **Supplementary Method 2**. The questionnaire was distributed in English for all the respondents.

Statistical Analysis

All statistical analyses were conducted using RStudio (v. 1.2.1335). Descriptive data are presented as means and percentages for each country's response, as well as the average of the global responses.

Ethics Approval

The survey protocols and all materials, including the survey questionnaires, received approval from the University of Social Welfare and Rehabilitation Sciences', ethics committee in Tehran, Iran (Code: IR.USWR.REC.1399.061).

RESULTS

Respondents' Global Distribution

Overall, 185 respondents from 77 countries participated. Eight responses were excluded because of insufficient information provided (the "insufficient information" was predetermined as

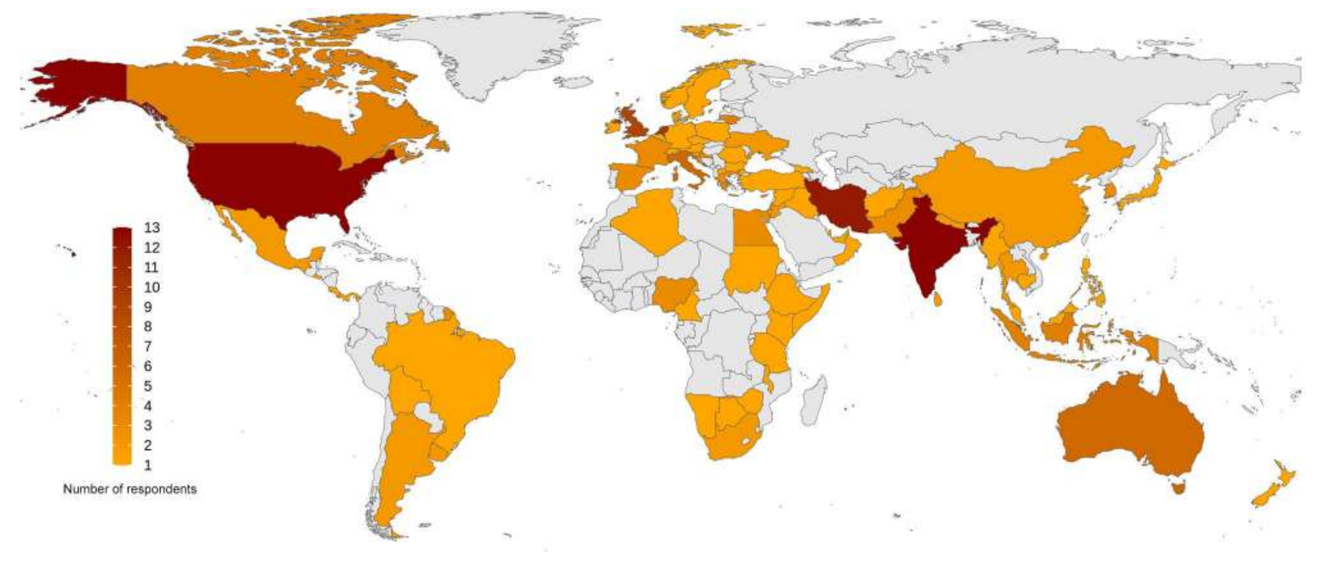

FIGURE 1 | Global distribution of the respondents to the survey. The survey involves 177 respondents from 77 countries around the world, ranging from 1 to 13 participants from each country, demonstrated as a color spectrum from orange to dark red.

TABLE 1 | The demographic and professional information of survey respondents including their gender, age, academic degree, and primary discipline.

		N/Mean (± SD)	Percent (%)
Gender			
	Male	111	62.7
	Female	62	35
	Other/not disclosed	4	2.3
Age in years		46.51 (± 10.78)	
Academic qualification/s			
	BSc	6	3.4
	MSc	13	7.3
	MD	72	40.7
	MD; MSc	13	7.3
	MD; PhD	32	18.1
	PhD	31	17.5
	Others	10	5.6
Primary professional discipline			
	Addiction medicine	19	10.7
	Drug/health policy	8	4.5
	General medicine	17	9.6
	Pharmacology	2	1.1
	Psychiatry	95	53.7
	Psychology/counseling	20	11.3
	Social work	5	2.8
	Other medical specialties	3	1.7
	Others	8	4.5

having more than 50% of "I do not know" responses). Data from the rest of the 177 respondents were analyzed. The list of the countries that provided information for this survey is available as a supplement (**Supplementary Method 1**). **Figure 1** depicts a map of the respondents' global distribution.

Respondents' Demographic Characteristics

Respondents consisted of 111 males (62.7%), 62 females (35%), and 4 people (2.3%) who selected "other" or preferred not to disclose their gender. The mean age of the respondents was 46.51 ± 10.78 years. Most respondents were medical professionals (MDs) (n = 148, 83.6%), and the most frequent primary discipline was psychiatry (n = 95, 53.7%). Information related to the respondents' main disciplines and academic degrees is shown (**Table 1**).

Drug use During Pandemic

Respondents provided information about drug use changes in their countries during the COVID-19 pandemic. Over 63% (n = 49), 42% (n = 32), 64% (n = 50), and 41% (n = 32) of the countries reported that use of alcohol, cannabis, sedatives, and prescription opioids increased, respectively. Conversely, opiates, amphetamine, and cocaine use has seen a decrement in 31% (n = 24), 29% (n = 22), and 29% (n = 23) of the countries, respectively. Perceived drug use changes by country are shown (**Figure 2**, **Table 2**). Details of drug use changes are reported in **Supplementary Material**.

Respondents were also asked to report changes in behavioral addictions (gaming/gambling) in their countries through the following options: Increased, Decreased, No change, I do not know; 85.7% (n = 66) of the countries reported that behavioral addictions rates had increased, whereas 14% (n = 11) of the countries reported that behavioral addictions rates had decreased in their countries during the COVID-19 pandemic (**Supplementary Figure 1**).

Drug Supply

Respondents provided information about perceived drug supply changes in their countries during the COVID-19 pandemic. The drug categories included the following: alcoholic beverages, cannabis (including marijuana and synthetic cannabinoids such as spice, K2, etc.), opiates (including opium, heroin, opium residue, etc.), amphetamine-type stimulants (including amphetamine, methamphetamine, MDMA, etc.), and cocaine (including crack cocaine).

Decreased supply patterns for all substances were noted. A decrement was reported in supply in 34% (n = 26) of the countries for alcohol, 37% (n = 29) for cannabis, 41% (n = 31) for opiates, 38% (n = 29) for amphetamines, and 24% (n = 26) for cocaine (**Figure 3**, **Table 2**). Details of drug supply changes are reported in the **Supplementary Material**.

Drug Price

Respondents provided information regarding perceived drug price changes in their countries during the COVID-19 pandemic. The price of cannabis, opiates, amphetamines, and cocaine increased in 39% (n = 30), 37% (n = 29), 34% (n = 26), and 28% (n = 21) of the countries, respectively. Alcohol price was reported as unchanged in 54% (n = 42) of the countries (**Figure 4**, **Table 2**). Details of drug price changes are reported in the **Supplementary Material**.

The information related to changes in drug price among different countries is shown in **Figure 4** and **Table 2**.

Perceived Morbidity and Mortality (Including Overdose)

Respondents provided information about whether morbidity and mortality, including fatal and non-fatal overdose rates, in their countries had changed during the COVID-19 pandemic. Mortality rates in people with alcohol use disorders (AUDs) and SUDs were reported to have increased in 35% (n = 27) and 36% (n = 28) of the countries, respectively. No changes in fatal and non-fatal overdose rates were reported by 32% (n = 24) of the countries (**Figure 5**, **Table 2**). Details of changes in mortalities and overdose rates are reported in the **Supplementary Material**.

Risky Behaviors

Respondents provided information about changes in risky behaviors among people with SUDs in their countries during the COVID-19 pandemic (**Figure 6**, **Supplementary Table 1**). Information related to risky behaviors consisted of

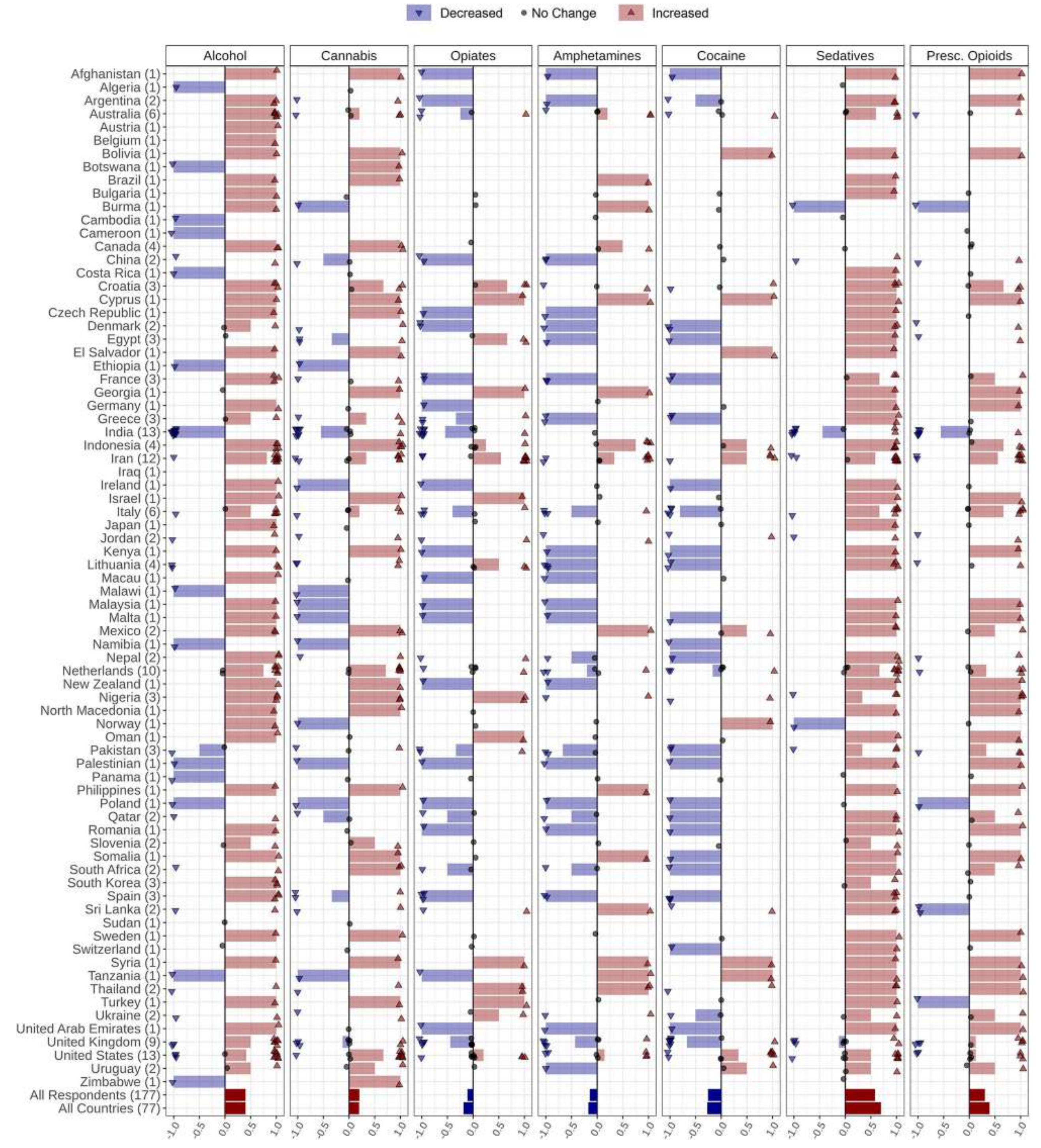

FIGURE 2 | Changes in alcohol and drug use during the COVID-19 pandemic reported by 177 respondents from 77 countries globally. Respondents were asked to report changes in alcohol, amphetamines, cannabis, cocaine, opiates, prescribed opioids, and sedative-hypnotics use with the following options: *Increased, Decreased, Not changed, I do not know,* and *Number of users is very low/none.* Countries' names are sorted in alphabetical order, and the number of respondents from each country is in parentheses following the country name. Each response is indicated as a single dot for *no change* or up and down triangles for *increased* and *decreased* answers, respectively, with a minor jitter for better visualization. The reported answers are represented as −1 for *decreased*, 1 for *increased*, and 0 for *no change. I do not know* and *Number of users is very low/none* answers are not shown in the figure. The mean of all responses, regardless of their originated countries and without considering those who did not know the answer or reported very low/none number of users, alongside the average answers of all countries, regardless of the number of respondents in each country, are addressed in the last two rows below the countries' names (Pres. Opioids: prescription opioids).

TABLE 2 | Summary of the survey responses in different sections related to situational assessment including respondents' information about changes in alcohol and drug use pattern, supply, price, morbidity and mortality, and overdose.

	Responders (177)								Countries (77)							
	Decrease		No change		Increase		Others		Decrease		No change		Increase		Others	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Use																
Alcohol	43	24%	13	7%	**109**	**62%**	12	7%	19	25%	6	8%	**49**	**63%**	3	4%
Cannabis	44	25%	35	20%	**75**	**42%**	23	13%	20	26%	17	22%	**32**	**42%**	8	10%
Opiates	**53**	**30%**	43	24%	38	21%	43	24%	**24**	**31%**	16	20%	14	18%	23	30%
Amphetamines	**49**	**28%**	30	17%	33	19%	65	37%	**22**	**29%**	15	20%	14	18%	26	33%
Cocaine	**52**	**29%**	28	16%	25	14%	72	41%	**23**	**29%**	15	19%	10	14%	29	38%
Sedatives	19	11%	24	14%	**105**	**59%**	29	16%	5	6%	9	11%	**50**	**64%**	14	18%
Presc. Opioids	27	15%	35	20%	**66**	**37%**	49	28%	8	11%	16	21%	**32**	**41%**	21	27%
Supply																
Alcohol	**62**	**35%**	49	28%	52	29%	14	8%	**26**	**34%**	21	28%	24	31%	6	7%
Cannabis	**62**	**35%**	46	26%	33	19%	36	20%	**29**	**37%**	18	24%	15	20%	15	19%
Opiates	**71**	**40%**	34	19%	18	10%	54	31%	**31**	**41%**	14	18%	6	8%	26	33%
Amphetamines	**54**	**31%**	34	19%	19	11%	70	40%	**29**	**38%**	14	18%	7	9%	27	35%
Cocaine	**56**	**32%**	32	18%	15	8%	74	42%	**26**	**34%**	14	18%	7	9%	30	39%
Price																
Alcohol	5	3%	**91**	**51%**	57	32%	24	14%	3	4%	**42**	**54%**	23	29%	10	13%
Cannabis	4	2%	51	29%	**70**	**40%**	52	29%	2	3%	23	30%	**30**	**39%**	22	28%
Opiates	2	1%	33	19%	**75**	**42%**	67	38%	2	2%	14	18%	**29**	**37%**	33	43%
Amphetamines	3	2%	33	19%	**57**	**32%**	84	47%	2	3%	13	17%	**26**	**34%**	35	46%
Cocaine	1	1%	35	20%	**51**	**29%**	90	51%	0	0%	18	23%	**21**	**28%**	37	49%
Morbidity and mortality																
Alcohol	7	4%	34	19%	**72**	**41%**	64	36%	5	7%	16	21%	**27**	**35%**	29	38%
Drug	7	4%	34	19%	**68**	**38%**	68	38%	5	6%	14	18%	**28**	**36%**	30	39%
Overdose	14	8%	**53**	**30%**	35	20%	75	42%	7	9%	**24**	**32%**	14	18%	32	42%

The mean number and percentage of Increased, Decreased, No Change, and "Others" responses, regardless of their originated countries and the average answers of all countries, regardless of the number of respondents in each country. "Others" indicate responses that involved respondents' lack of information or reluctance for responding to the relevant question. The bold values indicates highest rates of responses among respondents and countries.

increased/switching to injection, sharing drug use equipment, needle and syringe sharing, and risky sexual behaviors. Sixteen percent ($n = 29$) of the respondents reported that injection among people with SUDs has increased, while 33% ($n = 58$) reported no change in numbers of people injecting drugs or people switching to injection. Fifty-one percent ($n = 90$) chose the "others" option indicating a lack of information or reluctance in responding to this question. Twenty-three percent ($n = 41$) of the respondents reported that sharing drug use equipment (i.e., paraphernalia) has increased, while 25% ($n = 44$) reported no change. Fifty-two percent ($n = 92$) chose the "others" option indicating a lack of information or reluctance in responding. Twenty-one percent ($n = 38$) reported that sharing needle and syringe has increased, while 24% ($n = 43$) reported no change. Fifty-four percent ($n = 96$) chose the "others" option indicating a lack of information or reluctance in responding to this question. Twenty-three percent ($n = 41$) reported that risky sexual behaviors have increased, while 22% ($n = 39$) reported no change. Fifty-five percent ($n = 97$) chose the "others" option. Respondents reported an increase in behavioral addictions during the pandemic (**Supplementary Figure 1**).

COVID-19 Overall Impact on SUDs

Respondents provided an overall rating of the general impact of the COVID-19 pandemic on people with SUDs in their countries (**Figure 7**). Respondents from Oman, Kenya, and Georgia rated the highest severity of COVID-19 impact on people with SUDs in their countries (ratings of 10/10), while respondents from Botswana and Afghanistan rated the lowest severity for this impact in their countries (ratings of 2/10).

DISCUSSION

According to the results of this first-ever COVID-19 and SUD global survey with the contribution of 177 addiction medicine professionals/policymakers from 77 countries, the majority of respondents believed that in their countries, people with SUDs had been seriously affected by the COVID-19 outbreak. They mostly believed that prices for alcohol and drugs have risen, and they have become less available during the pandemic. In regard with alterations in use patterns, respondents perceived an increase the use of alcohol, cannabis, prescribed opioids, and sedative/hypnotics, and a decrease in the use of amphetamines,

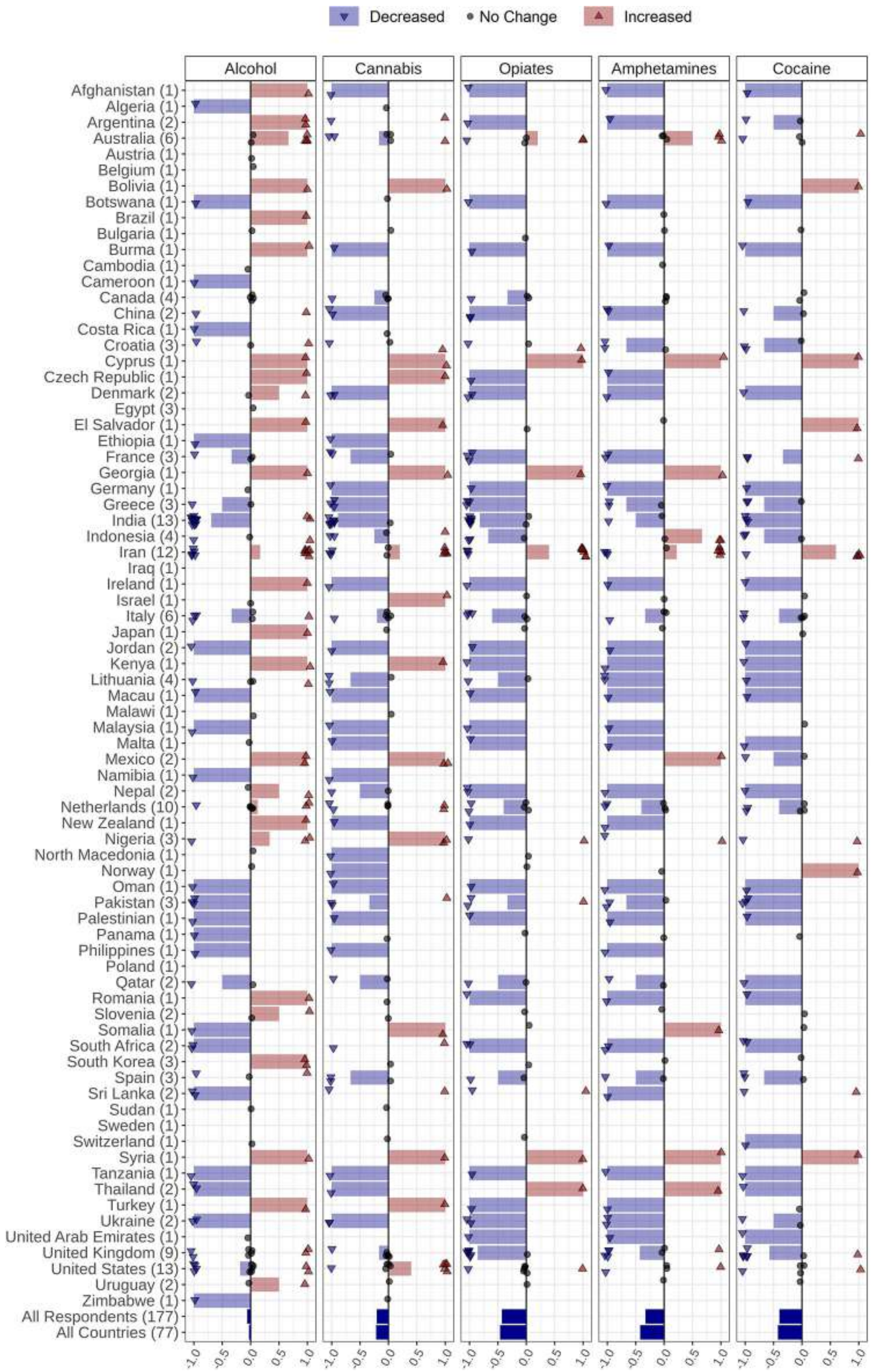

FIGURE 3 | Changes in alcohol and drug supply during the COVID-19 pandemic reported by 177 respondents from 77 countries globally. Respondents were asked to report changes the supply of alcohol, amphetamines, cannabis, cocaine, and opiates through the following options: *Increased supply, decreased supply, no change,* and *I do not know.* Countries' names are sorted in alphabetical order, and the number of respondents from each country is in parentheses following the country name. Each response is indicated as a single dot for *no change* or up and down triangles for *increased* and *decreased* answers, respectively, with a minor jitter for better visualization. The reported answers are represented as −1 for *decreased*, 1 for *increased*, and 0 for *no change; I do not know* answers are not shown. The mean of all responses, regardless of their originated countries and without considering those who did not know the answer, alongside the average answers of all countries, regardless of the number of respondents in each country, are addressed in the last two rows below the countries' names.

FIGURE 4 | Changes in alcohol and drug prices during the COVID-19 pandemic reported by 177 respondents from 77 countries globally. Respondents were asked to report changes in alcohol, amphetamines, cannabis, and opiates prices through the following options: *Price increased, Price decreased, Price did not change,* and *I do not know.* Countries' names are sorted in alphabetic order, and the number of respondents from each country is in parentheses following the country name. Each response is indicated as a single dot for *no change* or up and down triangles for *increased* and *decreased* answers, respectively, with a minor jitter for better visualization. Reported answers are represented as −1 for *decreased*, 1 for *increased*, and 0 for *no change; I do not know* answers are not shown in the figure. The mean of all responses, regardless of their originated countries and without considering those who did not know the answer, alongside the average answers of all countries, regardless of the number of respondents in each country, are addressed in the last two rows below the countries' names.

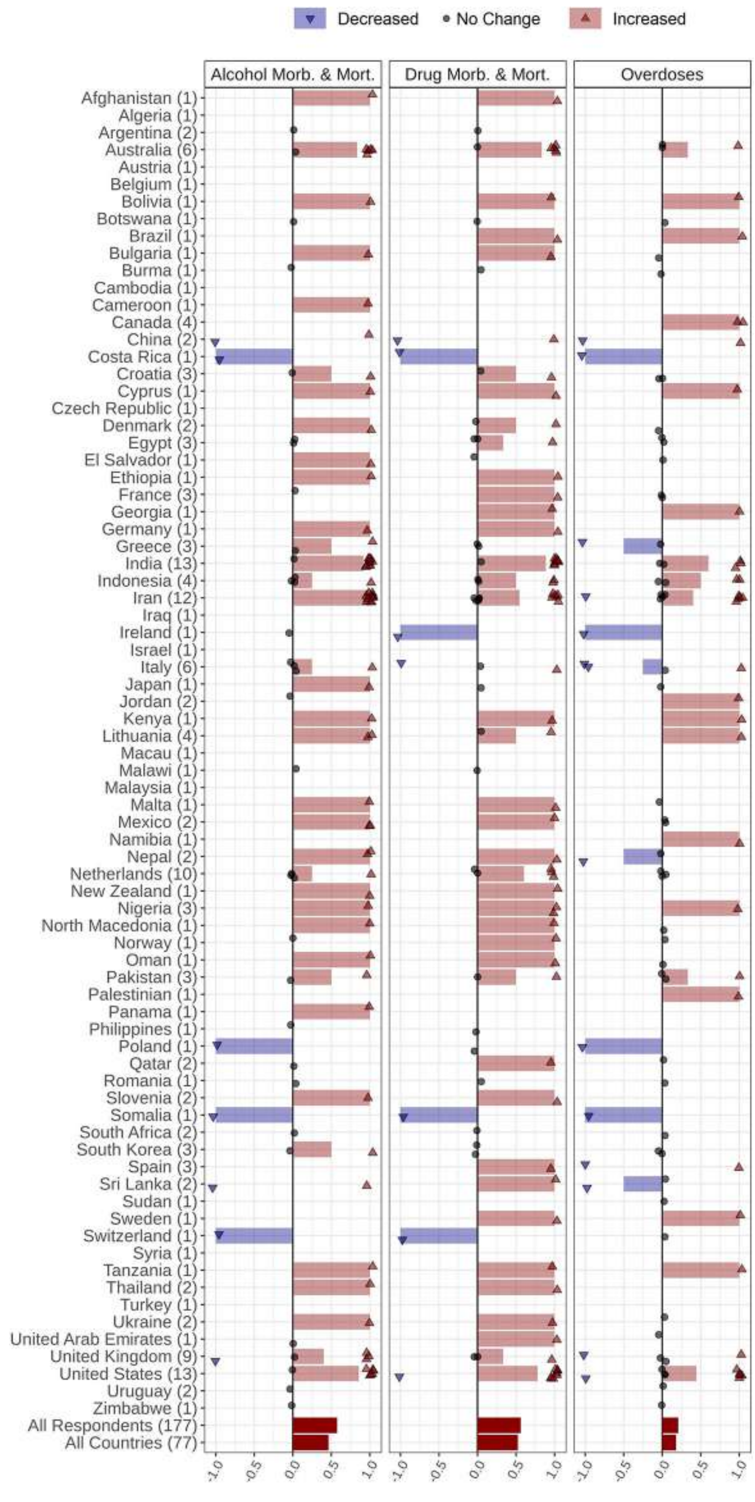

FIGURE 5 | Changes in mortality, morbidity, and overdose in people with SUD during the COVID-19 pandemic reported by 177 respondents from 77 countries around the world. Respondents were asked to report changes in morbidity or mortality rates in people with SUD and changes in fatal and non-fatal overdose episodes through the following options: *Increased, Decreased, I do not know, I do not like to answer,* and *Not applicable.* Countries' names are sorted in alphabetical order, and the number of each country's respondents is mentioned in front of the names. Each response is indicated as a single dot for *no change* or up and down triangles for *increased* and *decreased* answers, respectively, with a minor jitter for better visualization. The reported answers are represented as −1 for *decreased*, 1 for *increased*, and 0 for *no change; I do not know, I do not like to answer*, and *Not applicable* answers are not shown in the figure. The mean of all responses, regardless of their originated countries and without considering those who did not know the answer, alongside the average answers of all countries, regardless of the number of respondents in each country, are addressed in the last two rows below the countries' names (SUD, Substance Use Disorder).

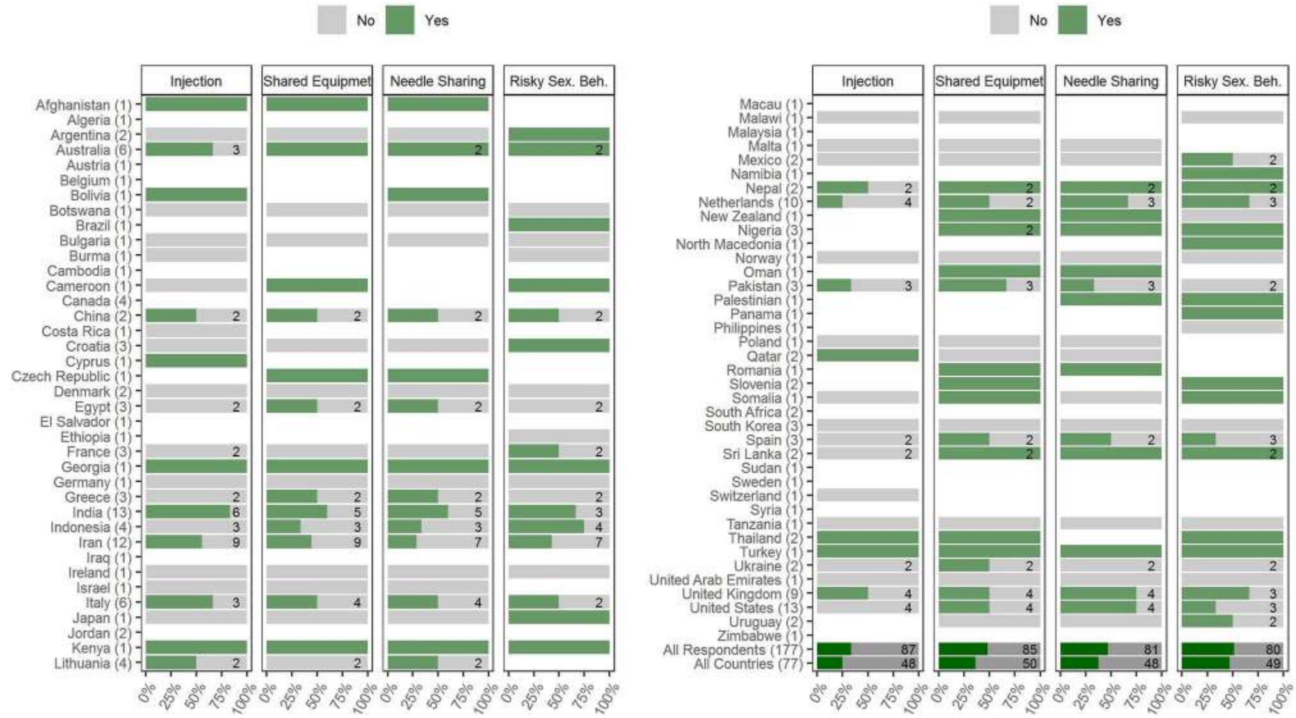

FIGURE 6 | Changes in risky behaviors including shifting to injection, using shared drug use equipment, needle sharing, and risky sexual behaviors during the COVID-19 pandemic period, reported by 177 respondents from 77 countries globally. Respondents were asked to report changes in risky behaviors (injection, shared drug use equipment, needle sharing, and risky sexual behaviors) through the following options: *Yes*, *No*, *I do not know*, *I do not like to answer*, and *Not applicable*. Countries' names are sorted in alphabetical order, and the number of each countries' respondents is mentioned in front of the names. The numbers of respondents who reported *Yes* or *No* answers to each question are demonstrated inside the bars (If nothing is written, it indicates that there was only one response within *Yes* and *No* answers). The percentages shown by the bars are also based on only *Yes* or *No* answers. The mean percentages of all responses, regardless of their originated countries and without considering those who reported other than *Yes* and *No* answers, alongside the mean percentage answers of all countries, regardless of the number of respondents in each country, are addressed in the last two rows below the countries' names (Risky Sex. Beh., Risky Sexual Behaviors).

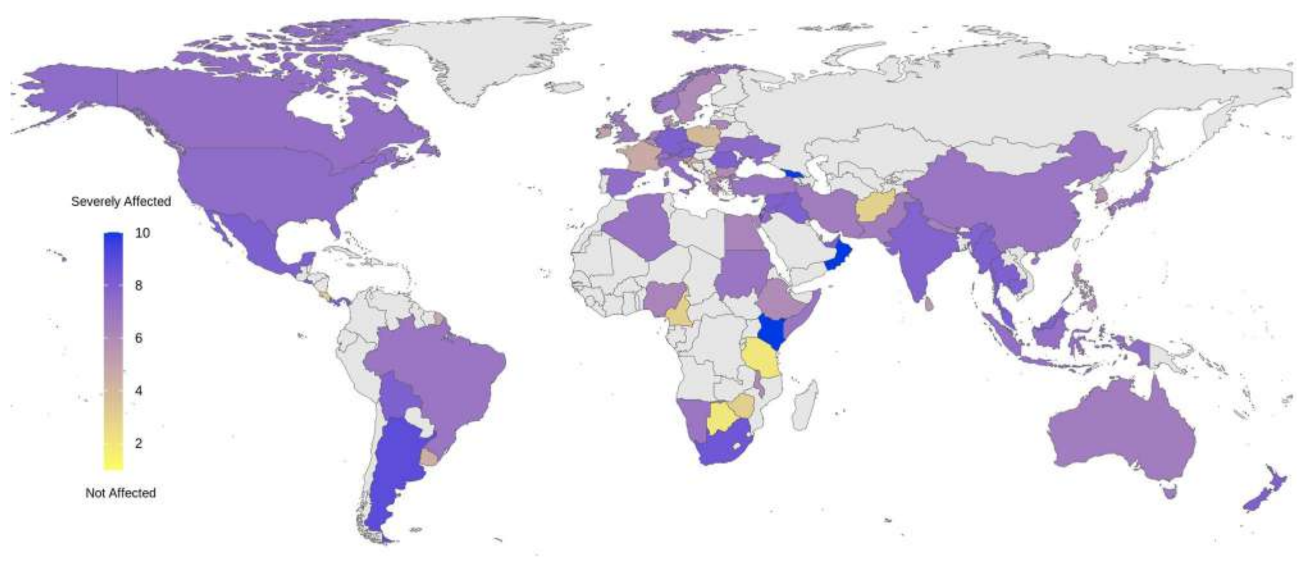

FIGURE 7 | Severity of being affected by COVID-19 outbreak among people with SUDs reported by 177 respondents from 77 countries. Addiction medicine professionals were asked to report how seriously people with SUDs in their countries have been affected by the COVID-19 pandemic using a range of between 1 and 10: 1 representing *Not affected*, demonstrated with yellow at the beginning of the spectrum, and 10 representing *Severely affected* at the end of the spectrum, indicated with blue. Responses were collected beginning April 4, 2020 and through a 5-week period.

cocaine, and opiates. Most respondents reported increases in complications related to drug and alcohol use including increased morbidity and mortality in people with SUDs.

Alterations in levels of alcohol consumption during pandemic are similar to those reported during prior social crises, like the 2008–2009 economic downturn (19). Changes in alcohol consumption may arise from two potentially contradictory, however interacting mechanisms: (1) a problematic increase, usually stemming from distress that is being experienced especially at the beginning of a crisis, or in an attempt to "stockpile"; or (2) a decrease due to the lack of access and financial difficulties, which may lead to withdrawal (20). Current reports from Australia indicate increases in purchases of alcoholic beverages during lockdown potentially due to the first mechanism (21). However, India seems to be encountering a surge in numbers of individuals withdrawing from alcohol (5, 22). These independent reports from Australia and India are in line with our survey findings (**Figure 2**). Initial reports from Australia and the United States indicate overall increases in alcohol sales, especially in online alcohol delivery subsectors (21), although specific data from the industry on alcohol supply are largely lacking. However, there was no consensus among our survey respondents about changes in alcohol supply, as the responses that reported an increase, decrease, and no change were approximately equal. Approximately half of our survey respondents believed that there is no change in alcohol cost during the pandemic. This is while almost another half reported an increase in alcohol prices. We could not find any relevant reports indicating alcohol price alterations. Further data are needed as the pandemic progresses and hopefully resolves.

There are currently concerns about morbidity and mortality spikes within people with AUDs and alcohol-associated liver disease during the pandemic (23). The survey's results support the idea that these spikes can be seen among people with AUDs. Reports from Iran describe methanol poisoning of around 5,000 people with nearly 700 deaths, which may be due to lack of education and illegal and uncontrolled alcohol sales because of alcohol bans in Iran (10, 24, 25). However, to the best of our knowledge, there are yet no specific reports demonstrating the extent of alcohol overdose. The same pattern also applies to drug-related mortalities and morbidities.

Survey results suggest increases in cannabis use in more than half of participating countries. The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) has investigated this matter through three large darknet markets (26) in the first 3 months of 2020 and reported overall increased market activity, mostly in relation to cannabis products (13, 27). This might show the initial effects of the pandemic on the European countries market, particularly before peaks in the number of people infected by COVID-19 and subsequent widespread lockdowns.

Opiates, amphetamines, and cocaine were generally reported to have a decrease or no change in patterns of usage in most countries. During the 2008 global financial crisis, drug use patterns were differentially impacted, with expenditures of money for drugs down 2–44%, termed as the "Great Recession" of drug use (19). Although there are preliminary reports suggesting that opioid use is a risk factor for ICU admission in H1N1 infections and a possible risk factor for mortality following COVID-19 infection, rumors about protective effects of opium use in Iran may have led to increased consumption (28, 29). In the US, an already severe opioid overdose crisis worsened since the COVID-19 pandemic, with 30 out of 50 states reporting increases in overdoses between March and June of 2020, with an increase in high potency synthetic opioids such as fentanyl in street supplies and decreased access to harm reduction and OUD treatment services cited as possible drivers of overdose increase (30–32). While concerns have been also raised regarding probable effects of substances on COVID-19 patients (4, 33, 34), more research is needed on changes in drug use patterns and impacts on SUDs.

More than 80% of the countries reported increased use of sedatives and hypnotics. This rise in the demand for sedatives/hypnotics may be related to the stressful situation of the COVID-19 pandemic and its consequences. Survey results also suggest increased use of prescription opioids, perhaps for similar reasons, and changes in services may be needed (35, 36). Canada, Australia, United Kingdom, and Scotland facilitated pharmacy-based methadone-dispensing programs as prescribing opioid-related medications increased (36). This model may help to manage withdrawal syndromes during lockdown-related periods. In the United States, rapid changes in policies provided support to facilitate service delivery for people in opioid treatment programs, such as larger quantities of dispensed methadone and buprenorphine and relaxed regulations around virtual prescriber visits to initiate and continue medications for OUD in order to help patients access and maintain access to medications (35, 37).

The EMCDDA has reported recent increases in the drug demands in European markets (13). The EMCDDA has also noted that due to increases in the retail prices of cannabis and cocaine, the localized supply shortages may exist during the pandemic (12). The UNODC has reported that across all regions globally, many countries have noted a general shortage of different drugs at the retail level, mostly due to reduction in imports or strict lockdown rules, resulting in fewer personal interactions for drug sales (14). The UNODC has also noted a heterogeneous situation on bulk supply, both across drugs and across different countries (14). The UNODC preliminary data were gathered from governmental authorities and open sources (media and UNODC field officers) (14). Our results agree with multiple aspects of these reports of drug supplies.

The UNODC reported that countries with strict rules on social distancing such as the Czech Republic, United Kingdom, Italy, and Iran have been facing increased street drug prices due to lack of availability (14). Other reports from drug-producing countries suggest drug price decrements perhaps as a result of stockpiling of drugs (14). Subsequently, the EMCDDA along with the UNODC have both noted that COVID-19 restrictions have generally led to increases in drug prices, including cocaine, heroin, amphetamines, and cannabis, at the level of street markets (13, 14). Our survey results support these preliminary data reported by the UNODC and EMCDDA.

Respondents mostly reported increases in behavioral addictions during the current pandemic, which may partly confirm the existing concerns on this matter (38, 39). Other small studies suggest increases in addictive behaviors (39–41).

Some forms of gambling may have decreased due to financial uncertainties, occupational problems, cessation of sporting events, closure of casinos, and other factors (40, 41). Discussing another addictive behavior, gaming has been represented to be a coping mechanism during the current stressful conditions (42). Accordingly, gaming has increased among college students in India, who use gaming as an antistress mechanism (42). Increased gaming has been occurring globally during the pandemic (43), as well as pornography viewing (44). These and other concerns have led to guidance about Internet use during the pandemic (45).

ADVANTAGES AND LIMITATIONS

ISAM conducted the first global survey in the field of addiction medicine and successfully sampled responses from 77 countries and 177 experts globally. This timely and rapid survey was designed in a multistep fashion including literature review, expert communication, professional qualitative appraisal, and finally a pilot study (17) and was able to rapidly and reliably address urgent gaps in knowledge during the current pandemic. However, there are limitations such as heterogeneity the numbers of respondents from different countries and their disciplines and educational levels. The convenience sample also may impact response rates and other factors. The lack of validated measures is a limitation, as is the lack of options for open-ended responses that would provide a window on the mechanisms driving reported trends. The fact that not all the countries across the world are included in the study may question the nature of the word "global," which has been used throughout the survey. Given the dynamic nature of pandemics and lack of multicentric epidemiological studies, the survey is a timely approach to provide a snapshot of global clinical addiction medicine concerns during these unprecedented times.

CONCLUSIONS AND PRACTICAL IMPLICATIONS

The objective of the ISAM survey was to provide initial, rapid preliminary evidence about how COVID-19 has affected different situational aspects experienced by people with SUDs globally in order to help reach a better understanding of the current status. Provision of this information to international organizations and regional policymakers should help authorities plan for addressing urgent needs and providing suitable services not only in the current pandemic but also in future similar situations. To properly respond to the emerging demands and situational shifts during the COVID-19 pandemic in the addiction treatment services across the world, at a **macro (policy) level**, it is critical to recognize the importance of (1) the social safety net and measures used to reduce the social inequality widening gap when such epidemics deteriorate an already vulnerable system, (2) responsive and publicly well-resourced healthcare with adequate supply of appropriate medication, (3) civil liberties, which could help increased participation and a judicious response by law enforcement agencies, and (4) policies that have taken in justifying alcohol sales and cannabis dispensaries as essential services and legislation allowing pharmacists to provide maintenance medications such as benzodiazepines in order to guarantee safe supplies. At a **meso (organizational) level**, it is important that clinical experience and knowledge on localized drug supply, price, and associated morbidities and mortality is shared within the organization in order to respond adequately. This makes it vital that organizations have a responsive continuity plan that can change with the needs of the population throughout the acute stage of the pandemic. It is also important to establish, support, and sustain varied digital platforms to allow better access to treatment for drug and alcohol using populations and minimize morbidities and possibly mortality. Establishing joint advocacy groups of service users and providers is also critical. At a **micro (individual) level**, it is important to (1) establish a mechanism for shared decision making through effective communication channels, (2) build the therapeutic environment that welcomes and encourages participation of peer, third sector, and/or frontline workers who are also involved in the care of the individuals in care, (3) support psychologically informed environments and interventions considering stress, uncertainties, isolation, and mental health, and (4) consider providing harm minimization and/or public protection messages and equipment to all in care and others.

In this unique global survey, experts in addiction medicine provided information on changes in regional alcohol and drug availability, price, usage, and related complications. Reported decreases in alcohol and drug supplies appear partly attributable to lockdowns, import/export limitations, and strict regulations. Reduced availability may have generated increases in prices. Reported increases in the use of alcohol, cannabis, prescribed opioids, and sedative/hypnotics may reflect their legal availability (in online markets, drugstores, and dispensaries), while decreased use of amphetamines, cocaine, and opiates may be related to decreased availability due to social distancing, lockdown regulations, and increased prices. Changed drug use patterns may not only impact people with SUDs but also give rise to risky behaviors and related complications. Most issues may potentially be preventable if future lockdown regulations are accompanied by enhanced service provision for at-risk communities.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the survey protocols and all materials, including the survey questionnaires, received approval from the University of Social Welfare and Rehabilitation Sciences' ethics committee in Tehran, Iran (Code: IR.USWR.REC.1399.061). The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AF, SR, HE, CD, and AB conceived and designed the study. AF, SR, PR, MV, HE, CD, and AB conducted the survey and collected the data. ME and PR analyzed the data and ran the statistical analyses. AF, SR, HE, CD, MY, and AB supervised the analysis and gave conceptual advice. HM, AZ, PR, and HE contributed to drafting the first draft of the manuscript. AB, MP, SA, and CK edited the manuscript. All authors discussed the results, implications, and commented on the final manuscript.

INTERNATIONAL SOCIETY OF ADDICTION MEDICINE—GLOBAL SURVEY CONSORTIUM (ISAM-GSC) MEMBERS

Adrian Octavian Abagiu[1], Franck David Noel Abouna[2], Mohamed Hassan Ahmed[3], Basma Al-ansari[4], Feda Mahmmoud Abu Al-khair[5], Mandhar Humaid Almaqbali[6], Atul Ambekar[7], Sidharth Arya[8],Victor Olufolahan Asebikan[9], Murad Ali Ayasreh[10], Debasish Basu[11], Zoubir Benmebarek[12], Roshan Bhad[7], Mario Blaise[13], Nicolas Bonnet[14], Jennifer Brasch[15], Barbara Broers[16], Anja Busse[17], Jenna L. Butner[18], Moses Camilleri[19], Giovanna Campello[17], Giuseppe Carra[20], Ivan Celic[21], Fatemeh Chalabianloo[22], Abhishek Chaturvedi[23], José de Jesús Eduardo Noyola Cherpitel[24], Kelly J. Clark[25], Melissa Anne Cyders[26], Ernesto de Bernardis[27], Abbas Deilamizade[28], John Edward Derry[29], Naveen Kumar Dhagudu[30], Pavla Dolezalova[31], Geert Dom[32], Adrian John Dunlop[33], Mahmoud Mamdouh Elhabiby[34], Hussein Elkholy[35], Nsidibe Francis Essien[36], Ghandi Ilias Farah[37], Marica Ferri[38], Georgios D Floros[39], Catherine Friedman[40], Clara Hidalgo Fuderanan[41], Gilberto Gerra[17], Abhishek Ghosh[42], Maka Gogia[43], Ilias A. Grammatikopoulos[44], Paolo Grandinetti[45], Amira Guirguis[46], David Gutnisky[47], Paul Steven Haber[48], Peyman Hassani-Abharian[49], Zahra Hooshyari[50], Islam Ibrahim Mokhtar Ibrahim[34], Hada Fong-ha Ieong[51], Regina Nova Indradewi[52], Shelly Iskandar[53], Thahir Noorul Isra[54], Shobhit Jain[55], Sandi James[56], Seyyed Mohammad hossein Javadi[57], Keun Ho Joe[58], Darius Jokubonis[59], Acka Tushevska Jovanova[60], Rama Mohamed Kamal[61], Alexander Ivanov Kantchelov[62], Preethy Kathiresan[7], Gary Katzman[63], Paul Kawale[64], Audrey Margaret Kern[65], Felix Henrique Paim Kessler[66], Sung-Gon Sue Kim[67], Ann Marie Kimball[68], Zeljko Kljucevic[69], Kristiana Siste Kurniasanti[70], Roneet Lev[71], Hae Kook Lee[72], Aiste Lengvenyte[73], Shaul Lev-ran[74], Geni Seseja Mabelya[75], Mohamed Ali El Mahi[76], J. Maphisa Maphisa[77], Icro Maremmani[78], Laura Masferrer[79], Omid Massah[80], Orlagh McCambridge[81], Garrett Gregory McGovern[82], Aung Kyi Min[83], Amir Moghanibashi-Mansourieh[57], Jazman Mora-Rios[84], Indika Udaya Kumara Mudalige[85], Diptadhi Mukherjee[86], Pejic Munira Munira[87], Bronwyn Myers[88], Jayakrishnan Menon T. N.[89], Venkata Lakshmi Narasimha[90], Nkemakolam Ndionuka[91], Ali-Akbar Nejatisafa[92], Kamran Niaz[17], Asad Tamizuddin Nizami[93], Jan H. Nuijens[94], Laura Orsolini[95], Vantheara Oum[96], Adegboyega Adekunle Oyemade[97], Irena Rojnia Palavra[98], Sagun Ballav Pant[99], Joselyn Paredes[100], Eric Peyron[101], Randall Alberto Quirós[102], Rouhollah Qurishi[103], Noor ul Zaman Rafiq[104], Ranjini Raghavendra Rao[105], Woraphat Ratta-apha[106], Karren-Lee Raymond[107], Jens Reimer[108], Eduardo Renaldo[109], Tara Rezapour[110], James Roy Robertson[111], Carlos Roncero[112], Fazle Roub[113], Elizabeth Jane Rubenstein[114], Claudia Ines Rupp[115], Elizabeth Saenz[17], Mohammad Salehi[116], Lampros Samartzis[117], Laura Beatriz Sarubbo[118], Nusa Segrec[119], Bigya Shah[120], Hongxian Shen[121], Tomohiro Shirasaka[122], Steve Shoptaw[123], Fransiskus Muronga Sintango[124], Veronica Andrea Sosa[125], Emilis Subata[126], Norberto Sztycberg[127], Fatemeh Taghizadeh[128], Joseph Brian Tay Wee Teck[129], Christian Tjagvad[130], Marta Torrens[131], Judith Meme Twala[132], Ramyadarshni Vadivel[133], Joseph Robert Volpicelli[134], Jelmer Weijs[135], Steven Michael Wintoniw[136], Apisak Wittayanookulluk[137], Marcin Wojnar[138], Sadia Yasir[93], Yimenu Yitayih[139] and Min Zhao[140]

[1] National Institute for Infectious Diseases, Prof. Dr. Matei Bals-Arena OMT Department, Romania
[2] Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Cameroon
[3] Alamal psychiatric hospital, Dubai, United Arab Emirates
[4] Sydney Medical School, University of Sydney, NSW, Australia
[5] Al Ahliyya Amman University, Amman, Jordan
[6] Ministry of Health, Muscat, Oman
[7] Department of Psychiatry and National Drug Dependence Treatment Centre (NDDTC), All India Institute of Medical Sciences (AIIMS), New Delhi, India
[8] State Drug Dependence Treatment Centre, Institute of Mental Health, Pt BDS University of Health Sciences, India
[9] Department of Psychiatry, College of Medicine, University of Ibadan, Nigeria
[10] Addiction Medicine Clinic, Jordan
[11] Drug De-addiction and Treatment Centre, Department of Psychiatry, Postgraduate Institute of Medical Education & Research, Chandigarh, India
[12] Addiction Medicine Clinic, Mila, Algeria
[13] Centre medical Marmottan, France
[14] Réseau de Prévention des Addictions (RESPADD), France
[15] Department of Psychiatry and Behavioural Neurosciences, Michael DeGroote School of Medicine, McMaster University, Hamilton, Ontario, Canada
[16] Geneva University Hospitals, Switzerland
[17] United Nations Office on Drugs and Crime (UNODC), Vienna, Austria
[18] CUNY School of Medicine, New York, United States
[19] Agenzija Sedqa, Malta
[20] Department of Medicine and Surgery, University Milan-Bicocca, Italy
[21] University Psychiatric Hospital Vrapce - Zagreb, Croatia
[22] Department of Addiction Medicine, Haukeland University Hospital, Bergen, Norway
[23] Department of Biochemistry, Melaka Manipal Medical College, Manipal Academy of Higher Education, Manipal-576104, Karnataka, India
[24] Addiction Medicine Clinic, Mexico

[25] Addiction Crisis Solutions, United States
[26] Department of Psychology, Indiana University Purdue University - Indianapolis, United States
[27] SerT Lentini, ASP Siracusa, Italy
[28] Rebirth Charity Society NGO, Tehran, Iran
[29] Serenity Vista Addiction Treatment Center, Panama.
[30] Department of Psychiatry, ESIC Medical College, Hyderabad, Telangana, India
[31] National Institute of Mental Health, Czech Republic
[32] Collaborative Antwerp Psychiatric Research Institute (CAPRI), Antwerp University (UA), Belgium
[33] Drug & Alcohol Clinical Services, Hunter New England Local Health District, Australia
[34] Ain Shams University, Cairo, Egypt
[35] Department of Neurology and Psychiatry, Faculty of Medicine, Ain Shams University, Cairo, Egypt
[36] Centre for Research and Information on Substance Abuse, Nigeria
[37] Addiction Medicine Clinic, Syria
[38] European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), Italy
[39] Department of Psychiatry, Aristotle University of Thessaloniki, Greece
[40] Brown University and Lifespan Health System, Providence, Rhode Island, United States
[41] Fuderanan Mental Health Clinic, Philippines
[42] Drug De-addiction & Treatment Centre, Department of Psychiatry, Postgraduate Institute of Medical Education & Research, Chandigarh, India
[43] Georgian Harm Reduction Network, Georgia
[44] Organization Against Drugs, Primary Care Health Center, Veria, Greece
[45] Addictions Services (Ser.D.), Department of Territorial Services, ASL Teramo, Italy
[46] Swansea University Medical School, Institute of Life Sciences 2, Singleton Campus, SA2 8PP, Wales, United Kingdom
[47] Universidad de Buenos Aires, Argentina
[48] University of Sydney, Australia
[49] Institutes for Cognitive Science Studies (IRICSS), Brain and Cognition Clinic, Tehran, Iran
[50] Tehran University of Medical Sciences, Tehran, Iran
[51] Department of Anesthesiology, Yale University, United States
[52] Drugs Rehabilitation Center, National Narcotics Board of Indonesia, Indonesia
[53] Department of Psychiatry, Universitas Padjadjaran, Bandung, West Java, Indonesia
[54] National Institute of Education, Sri Lanka
[55] Department of Psychiatry, Heritage Institute of Medical Sciences (HIMS), Varanasi, India
[56] Univeristi Malaysia Sabah, Malaysia
[57] Department of Social Work, University of Social Welfare & Rehabilitation Sciences, Tehran, Iran
[58] National Center for Mental Health of Korea, South Korea
[59] Republican Center for Addictive Disorders, Lithuania
[60] Addiction Medicine Clinic, North Macedonia
[61] Naufar Institute, Doha, Qatar
[62] The Kantchelov Clinic, Sofia, Bulgaria
[63] Mount Sinai Medical Center, New York, United States
[64] African Institute for Development Policy, Malawi
[65] Sobriety Centers of New Hampshire, United States
[66] Federal University of Rio Grande do Sul, Brazil
[67] Pusan National University Yangsan Hospital, Department of Neuropsychiatry, Yangsan South Korea
[68] Chatham House, United States
[69] Institute for Public Health of Split-Dalmatia County, Croatia
[70] Faculty of Medicine, Universitas Indonesia-Ciptomangunkusumo Hospital, Indonesia
[71] Scripps Mercy Hospital, San Diego, United States
[72] Department of Psychiatry, The Catholic University of Korea, Seoul, Korea
[73] Faculty of Medicine, Institute of Clinical Medicine, Psychiatric Clinic, Vilnius University, Vilnius, Lithuania
[74] Israel Center on Addiction, Netanya, Israel
[75] Community Health Work, Tanzania
[76] Hayat Center for Treatment and Psycho-social Rehabilitation, Khartoum, Sudan
[77] University of Botswana, Botswana
[78] V.P. Dole, Dual Disorder Unit, Santa Chiara University Hospital, University of Pisa, Italy
[79] CAS Girona, Department of Psychology, University of Girona, Spain
[80] Substance Abuse and Dependence Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran
[81] Community addiction team, Southern Health and Social Care Trust, Northern Ireland, United Kingdom
[82] Priority Medical Clinic, Dublin, Ireland
[83] Save the Children International Organization, Burma
[84] Dirección de Investigaciones Epidemiológicas y Sociales, Instituto Nacional de Psiquiatría Ramón de la Fuente Muñiz, México
[85] Department of Psychiatry, Faculty of Medicine, Sir John Kotelawala Defence University, Sri Lanka
[86] Centre for Addiction Medicine, NIMHANS, Bangalore, India
[87] Kleopatra Kodric, Irena Nisic, Slovenia
[88] Alcohol Tobacco and Other Drug Research Unit, South African Medical Research Council, South Africa
[89] NIMHANS, Bangalore, India
[90] Centre for Addiction Medicine, Department of Psychiatry, National Institute of Mental Health and Neurosciences, Bengaluru, India
[91] Federal Neuropsychiatric Hospital, Calabar, Nigeria
[92] Department of Psychiatry, Psychosomatic Research Center, Tehran University of Medical Sciences, Tehran, Iran
[93] Institute of Psychiatry, WHO Collaborating Center for Mental Health, Pakistan
[94] Brijder Addiction Care, Zaandam, Netherlands
[95] Department of Clinical Neurosciences/DIMSC, School of Medicine, Polytechnic University of Marche, Ancona, Italy
[96] Koh Kong Provincial Hospital, Cambodia.
[97] Kaiser Permanente, United States
[98] Psychiatric hospital Sveti Ivan, Zagreb, Croatia
[99] Department of Psychiatry and mental health, Institute of Medicine, Tribhuvan University, Nepal

[100] Universidad de El Salvador, El Salvador
[101] AddiPsy, Lyon, France
[102] Addiction Medicine Clinic, Costa Rica
[103] Novadic-Kentron Addiction Care Network, Vught, Netherlands
[104] Phoenix Foundation for Research and Development, Pakistan
[105] Barwon Health, Geelong, Australia
[106] Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand
[107] University of the Sunshine Coast (USC), Queensland, Australia
[108] Center for Interdisciplinary Addiction Research, University Medical Center Hamburg-Eppendorf, Hamburg, Germany
[109] Drugs Rehabilitation Center, National Narcotics Board of Indonesia
[110] Department of Cognitive Psychology, Institute for Cognitive Science Studies, Tehran, Iran
[111] Usher Institute, University of Edinburgh, United Kingdom
[112] Psychiatry Service, University of Salamanca Health Care Complex, Salamanca, Spain
[113] PGIMER, Chandigarh, India
[114] Street Health Centre, Canada
[115] Department of Psychiatry, Psychotherapy, and Psychosomatics, Medical University Innsbruck Austria
[116] Department of Neurosciences and Addiction Studies, School of Advanced Technologies in Medicine, Tehran University of Medical Sciences, Tehran, Iran
[117] Medical School, University of Cyprus, Cyprus
[118] Clínica Psiquiátrica de la Facultad de Medicina, Uruguay
[119] Center for Treatment of Drug addiction, University Psychiatric Clinic, Ljubljana, Slovenia
[120] Department of Psychiatry, Patan Academy of Health Sciences, School of Medicine, Lagankhel, Nepal
[121] Department of Psychiatry, Second Xiangya Hospital, Central South University, China
[122] Department of Psychiatry, Teine Keijinkai Medical Center, Japan
[123] David Geffen School of Medicine at UCLA, Department of Family Medicine, United States
[124] Health Professions Councils of Namibia, Namibia
[125] Addiction Medicine Clinic, Uruguay
[126] Republican Center for Addictive Disorders, Lithuania
[127] Asociasion Programa Andres Argentina, Argentina
[128] Mazandaran University of Medical Sciences, Mazandaran, Iran
[129] MRC/CSO SPHSU, University of Glasgow, United Kingdom
[130] Gladsaxe Substance Use Disorder Treatment Centre, Denmark
[131] Institut de Neuropsiquiatria i Addiccions, IMIM-Hospital del Mar, Medical Research Barcelona, Spain
[132] NACADA, Kenya
[133] Waikato District Health Board (WDHB) Hamilton, New Zealand
[134] Institute of Addiction Medicine, United States
[135] Jellinek, Amsterdam, Netherlands
[136] Addictions Foundation of Manitoba, Canada
[137] Thanyarak Chiangmai Hospital, Thailand
[138] Medical University of Warsaw, Warsaw, Poland
[139] Jimma University, Ethiopia
[140] Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, China

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.646206/full#supplementary-material

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ORIGINAL RESEARCH
published: 23 August 2021
doi: 10.3389/fpubh.2021.709410

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Psychoactive Substance Use and Its Relationship to Stress, Emotional State, Depressive Symptomatology, and Perceived Threat During the COVID-19 Pandemic in Mexico

Nora Angélica Martínez-Vélez [1], Marcela Tiburcio [1], Guillermina Natera Rey [1], Jorge Ameth Villatoro Velázquez [2], Miriam Arroyo-Belmonte [1], Graciela Yazmín Sánchez-Hernández [1] and Morise Fernández-Torres [1]*

[1] Department of Social Sciences in Health, Direction of Epidemiological and Psychosocial Research, Ramón de la Fuente Muñiz National Institute of Psychiatry, Mexico City, Mexico, [2] Direction of Epidemiological and Psychosocial Research, Ramón de la Fuente Muñiz National Institute of Psychiatry, Mexico City, Mexico

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***Correspondence:**
*Marcela Tiburcio
tibsam@imp.edu.mx*

Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: *13 May 2021*
Accepted: *29 July 2021*
Published: *23 August 2021*

Citation:
Martínez-Vélez NA, Tiburcio M, Natera Rey G, Villatoro Velázquez JA, Arroyo-Belmonte M, Sánchez-Hernández GY and Fernández-Torres M (2021) Psychoactive Substance Use and Its Relationship to Stress, Emotional State, Depressive Symptomatology, and Perceived Threat During the COVID-19 Pandemic in Mexico. Front. Public Health 9:709410. doi: 10.3389/fpubh.2021.709410

People can increase their use of psychoactive substances in response to stressful situations as a maladaptive mechanism for reducing negative affective states. It is therefore necessary to examine changes in the use of such substances and their relationship to mental health in light of the COVID-19 pandemic.

Objective: Evaluate the relationship between psychoactive substances and stress, emotional state, and symptomatology during the COVID-19 lockdown in Mexico.

Method: A national survey was conducted, using the free Google Forms platform, of residents of Mexico aged 18 and older. The survey was disseminated through social media.

Results: The sample comprised 4,122 individuals, mostly women (71.8%), with an age range of 18–81 years ($M = 37.08$, $SD = 12.689$), of which 46.8% were single, and 42.9% married. In general, there was a reduction in substance use during the first 2 months of the quarantine; the most commonly used substances were alcohol, tobacco, and tranquilizers. Respondents who described having greater use than before the pandemic presented greater stress, depressive symptomatology, and perceived threat than those who did not use substances.

Conclusions: Respondents who did not use substances reported lower levels of stress, depressive symptomatology, impact of the coronavirus pandemic, and perception of its threat. Women reported greater stress, depressive symptomatology, and emotional intensity than men.

Keywords: substance use, mood, mental health, COVID-19, Mexico

INTRODUCTION

Epidemiological studies of alcohol and other substance use show that the phenomenon varies over time. It is sometimes associated with stressful events such as economic crises (1–3), natural disasters (4), armed conflicts (5), and terrorist attacks (6). These and other studies show that such events play a key role in alcohol and other substance use, as well as mental health problems and somatic disorders (7–10).

The international community today faces a health crisis with the SARS CoV-2 pandemic, which is predicted to have a significant negative impact on the world economy (11) and the mental health of the population (12). In Mexico, the first case of COVID-19 was confirmed on February 28, 2020, and a National Healthy Distance Program was launched on March 23, recommending that the general population stay at home, and suspending in-person classes at all levels of education and non-essential activities in the public, social, and private sectors (13). The unique situation created by the COVID-19 pandemic has affected every country in the world and given rise to stressful phenomena such as depression, fear of the unknown nature of the disease and of being infected, vulnerability, requiring changes in daily life, working from home, anxiety about income, and the fear of losing one's job (14, 15). It has fostered negative emotional states with undesirable results for health and well-being, including changes in the use of alcohol, tobacco, and other drugs (16–18).

Although research addressing substance use in the context of the COVID-19 pandemic has emerged (16–19), earlier studies on other large-scale stressors suggest that substance use increases during exposure to disasters (20, 21). Some models postulate that an increase in negative affect in response to disasters increases the motivation to use substances as a coping mechanism to reduce tension, anxiety, and distress (10, 22, 23). Given the observed increase in anxiety, depression, and stress in response to COVID-19 (24–27), people may be using substances to cope with the negative affect accompanying this pandemic.

The data clearly call for an examination of the impact of highly stressful situations on substance use, and highlight the need to monitor variations in behavior during crises and offer interventions that will contribute to reducing their effects. A systematic review found several issues related to substance use that require special attention during the pandemic. These include an increase in mental health problems, a decrease in social interaction, and situations related to older adults, those aged 21–40 and persons in drug addiction treatment (28).

During stressful events, men and women cope with situations in different ways. Women tend to repress their emotions but seek help, while men attempt to resolve situations without help (29). At the same time, housework and the care of children and the elderly mainly falls to women, who experience a greater impact due to COVID-19 lockdown and stressful events related to the family, illness, and financial uncertainty (30). Other surveys applied during social isolation in the pandemic have found differences by gender, with women reporting a greater psychological impact and displaying higher levels of depression symptoms, anxiety, post-traumatic stress, and perceived loneliness than men in addition to an increase in the use of psychotropic drugs (31).

Differences by sex in the prevalence of substance use and abuse have significantly declined in the past three decades, which can be attributed to social and cultural factors that move women away from more traditional gender roles (such as employment opportunities and access to birth control) rather than biological sex differences (32, 33).

There are demographic, social, and cultural factors that disproportionately affect women and interact with the etiology and maintenance of use and substance use disorders, examples of which are care of children and the elderly and exposure to violence (32, 34).

Given that most research on substance use in the context of disasters has focused on predicting its increase (21, 35), there is also a need for studies that examine the differences in socioemotional factors in a context of fear and uncertainty regarding the pandemic, among those who used substances before it began, those who began use with the outbreak, those who did not change their patterns of use, and even some who reduced their use during the initial lockdown. We therefore sought to evaluate the relationship between stress, emotional state, depressive symptomatology, perception of threat from the coronavirus, and substance use during the first 3 months of lockdown in Mexico.

MATERIALS AND METHODS

The research protocol and data collection for this study were approved by the Ethics Committee of the Ramón de la Fuente Muñiz National Institute of Psychiatry (Approval No. CEI/C/011/2020), and participants gave their consent prior to taking the survey.

Study Design

This was an exploratory, descriptive study using an online survey to explore substance use and the presence of mental health problems from March 23, 2020, the beginning of lockdown in Mexico.

Participants

A total of 4,122 individuals were surveyed. All of them were aged 18 or over, residents of Mexico, and gave consent for their voluntary participation.

Instruments

Although the questionnaire comprised 13 sections, this article only presents data on the following:

Sociodemographic Data

Ten questions on sex, age, education, marital status, occupation, state of origin, income, and family characteristics including total family members, number of children under 12, and number of older adults.

Perceived Threat and Experiences With Coronavirus

Short version of three scales developed by Conway et al. (36) that explore the perceived threat of coronavirus (three items, $\alpha = 0.89$), the impact of coronavirus (six items, $\alpha = 0.84$), and experiences with coronavirus (six items, $\alpha = 0.71$). The scales, translated into Spanish for this study, have seven Likert responses ranging from 1 ("not true of me at all") to 7 ("very true of me").

Adversity and Stress Index

Eleven questions formulated for this study to measure the level of stress caused by the pandemic in different aspects of life during the previous month. The questions were divided into two groups: (a) relational stress, due to the effects on social interactions at school or work, or on leisure management (six items); and (b) contextual stress, associated with changes in a person's social and economic status (five items). There were five response options on a Likert scale, ranging from 0 ("not at all or only slightly stressful") to 4 ("very stressful"). The reliability coefficient for this sample was 0.86.

Patient Health Questionnaire 2

The first two questions from the PHQ-9, which identify depressive symptomatology in the previous 2 weeks. There were four response options, ranging from 0 ("never") to 3 ("almost every day"), and the maximum possible score was 6 (37). In Mexico, the discriminatory power of this questionnaire has been evaluated with indigenous women, and the best cutoff point found was 3, with a sensitivity of 80% and a specificity of 86.8% (38). The reliability coefficient for this sample was 0.78.

Substance Use

Based on the substance classification in ASSIST (39), this section explored the frequency of alcohol, tobacco, and other psychoactive substance use before and during lockdown, "How often did you use these substances BEFORE lockdown? SINCE LOCKDOWN STARTED, How often have you used these substances?" (The response options were never, once a month or less, 2–4 times a month, once a week, and daily or almost daily, for each of the substances.) with questions about experimentation with new substances during lockdown, perceived increase or decrease in substance use during this period, and possible reasons for these changes.

Emotional State

This section presented a list of 12 emotions, six positive and six negative, that may be experienced during quarantine, with five Likert responses ranging from 1 ("not at all") to 5 ("a lot").

Procedure

The national online survey using Google Forms, conducted in May and June of 2020, was aimed at people aged 18 and over resident in Mexico. The link to the questionnaire was disseminated on the official social media accounts (Facebook and Twitter) of the Ramón de la Fuente Muñiz National Institute of Psychiatry, and by the research team using WhatsApp.

Data Analysis

Data were analyzed with the statistical software IBM SPSS version 26. For the description of the sample by sex with the different sociodemographic indicators, the percentages were obtained and χ^2 was used. Four groups were defined using the reports on substance use before and during lockdown: NU, non-users; NC, users who did not change their use during lockdown; DU, users who decreased their use during lockdown; and IU, users who increased their use during lockdown. These four groups, together with sex, were the comparison variables for each of the variables of interest (stress, emotional state, depressive symptomatology, and perceived threat). To control the variations between the groups and the continuous variables of interest, a multivariate analysis of variance was used. Although this statistical test assumes multivariate normality, several authors indicate that its results are valid even though this assumption is not fully met (40, 41). Additionally, in this analysis, the Bonferroni test was used to analyze the *post-hoc* comparisons between the four groups. Interactions were not included in the tables because only one of them was significant, which is indicated where applicable.

RESULTS

Participant Characteristics

The sample consisted of 4,122 respondents, mostly women (71.8%), ranging in age from 18 to 81 years ($M = 37.08$, $SD = 12.689$), of which 46.8% were single, and 42.9% married. A large proportion had completed college (52.6%) or graduate (24.6%) education; 54.5% were employed, 14.6% self-employed, and 16.9% students. As shown in **Table 1**, there were statistically significant differences by sex for all the sociodemographic variables.

The prevalence of substance use before and during lockdown is shown in **Figure 1**. The highest percentages are seen for alcohol (47.6% before and 36% during the pandemic), tobacco (24.3% before and 16.5% during the pandemic), and non-prescription tranquilizers (9.2% before and 8% during the pandemic). The prevalence of other substance use was <8% and was not included in the rest of the analysis.

Table 2 shows the distribution of tobacco, alcohol, and tranquilizer use in the sample before and during the quarantine. The majority of participants were non-users. Among tobacco users, 11% reported no change, 11.3% a decrease, and 3.4% an increase in use. Among people who use alcohol, 18.1% reported no change, 19.7% a decrease, and 12.5% an increase in use. Among tranquilizer users, 3.6% reported no change, 3.7% a decrease, and 4.7% an increase in use.

Relationship of Tobacco Use With Stress, Emotional State, Depressive Symptomatology, and Perceived Threat of Coronavirus

Respondents who did not use tobacco also showed significantly lower scores for relational and contextual stress than the other groups. On the relational stress subscales, there were significant differences between those who either increased or decreased their

TABLE 1 | Sociodemographic characteristics.

	Men (n = 1,160)		Women (n = 2,962)		Total N = 4,122		
	f	%	*f*	%	*f*	%	**Chi square/*df***
Age							
18–20 years	92	7.9	231	7.8	323	7.8	13.908*/4
21–30 years	326	28.1	832	28.1	1,158	28.1	
31–40 years	287	24.7	858	29.0	1,145	27.8	
41–50 years	230	19.8	588	19.9	818	19.8	
51 years or more	225	19.4	453	15.3	678	16.4	
Marital Status							
Single	551	47.5	1,379	46.6	1,930	46.8	18.389*/3
Married/Partnered	525	45.3	1,245	42.0	1,770	42.9	
Divorced/Separated	78	6.7	292	9.9	370	9.0	
Widowed	6	0.5	46	1.6	52	1.3	
Education							
Elementary/Jr. High	40	3.4	84	2.8	124	3.0	14.473*/3
High school	264	22.8	553	18.7	817	19.8	
Bachelor's degree	560	48.3	1,609	54.3	2,169	52.6	
Graduate degree	296	25.5	716	24.2	1,012	24.6	
Occupation							
Homemaker	9	0.8	195	6.6	204	4.9	65.918*/5
Unemployed b/l	52	4.5	118	4.0	170	4.1	
Unemployed s/l	58	5.0	144	4.9	202	4.9	
Employed	640	55.2	1,607	54.3	2,247	54.5	
Student	200	17.2	498	16.8	698	16.9	
Self-employed	201	17.3	400	13.5	601	14.6	

b/l, before lockdown; s/l, since lockdown.
$^*p \leq 0.01$.

use and those who did not change; on the contextual stress subscales there were differences between those who did not change and those who increased their use. The comparison by sex showed that women experienced significantly greater stress than men (**Table 3**).

Although no significant differences were found between these groups with respect to positive emotions, the comparison by sex showed that men experienced these emotions more than women. Respondents who did not use tobacco experienced the fewest negative emotions. Those who increased their tobacco use showed more negative emotions than other groups, while women reported more negative emotions than men. The highest scores for depressive symptomatology were observed in women and in those who increased their tobacco use. The latter also perceived a greater impact of coronavirus than those who did not change their use; those who did not use tobacco perceived lesser impact than the rest. Women reported a greater impact than men. Those who increased and decreased their tobacco use described significantly more experiences and perceived threats of coronavirus than those who did not use tobacco. The comparison by sex only revealed differences with respect to the perceived threat. As for the interactions between sex and groups, none of them was statistically significant (**Table 3**).

Relationship of Alcohol Use With Stress, Emotional State, Depressive Symptomatology, and Perceived Threat of Coronavirus

The group that increased its alcohol use reported significantly greater levels of relational and contextual stress than the other groups. Non-users of alcohol showed the lowest levels of stress, while women displayed more stress than men (**Table 4**). Those who reported no change in use showed a greater number of positive emotions than those who increased their use or did not use alcohol. Men reported significantly more positive emotions than women. Those who increased their alcohol use described more negative emotions than the other groups, while non-users reported the fewest of these emotions. Women experienced more negative emotions than men. Those who increased or decreased their alcohol use showed greater depressive symptomatology than those who did not change their use and those who did not use alcohol, while women showed more of these symptoms than men (**Table 4**). Those who increased their alcohol use showed significantly greater impact and experiences with coronavirus on both subscales than those who did not change their use or those who did not use alcohol. The perceived threat score was greater in

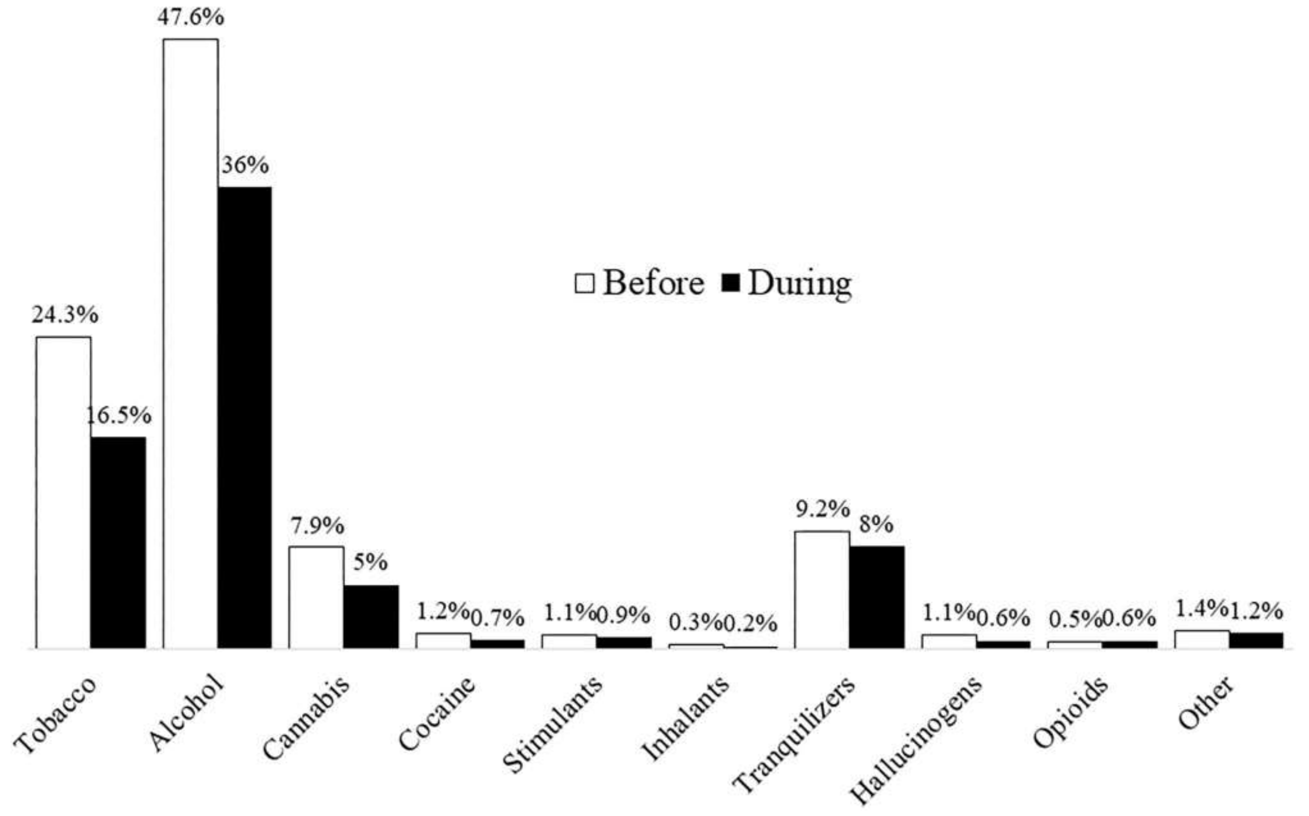

FIGURE 1 | Substance use before and during the quarantine.

TABLE 2 | Distribution of tobacco, alcohol, and tranquilizer users*.

	NU		NC		DU		IU	
	f	%	*f*	%	*f*	%	*f*	%
Tobacco	3,064	74.2	455	11.0	467	11.3	141	3.4
Alcohol	2,050	49.7	748	18.1	814	19.7	515	12.5
Tranquilizers	3,635	88.1	149	3.6	151	3.7	192	4.7

NU, non-user; NC, no change; DU, decreased use; IU, increased use.
**Percentages of total sample.*

those who increased their use than in the other three groups, and it was also greater in women. As for the interactions between sex and groups, only the women who increased their consumption, had a higher mean in the impact of coronavirus scale than the other combinations.

Relationship of Tranquilizer Use With Stress, Emotional State, Depressive Symptomatology, and Perceived Threat of Coronavirus

Respondents who did not use tranquilizers showed significantly lower scores on the global stress scale as well as on the subscales. Those who increased their use had higher scores, as did women (**Table 5**). Non-users and men reported more positive emotions than the other groups. Women and those who increased their use had more negative emotions and depressive symptomatology than the others. Those who increased their use had significantly higher scores for the impact and perceived threat of coronavirus than the other groups. Non-users had significantly lower scores than the other groups. Women described a significantly greater perceived threat than men (**Table 5**). None of the interactions between sex and groups was statistically significant.

DISCUSSION

The purpose of this study was to explore changes in substance use during the COVID-19 lockdown in Mexico and their relationship with stress, depressive symptomatology, emotional state, and perceived threat of coronavirus. The results showed that alcohol, tobacco, and tranquilizers were the substances most commonly used during lockdown, but that there was a reduction in their use. This finding is similar to that reported by Manthey et al. (42) for various European countries, except that in their international survey, marijuana was the third most commonly used substance, after alcohol and tobacco. They believe their results could be partially explained by the reduced availability of substances during the early months of lockdown, as well as a change in the settings where they are used. This hypothesis could also explain

TABLE 3 | Relationship of tobacco use and gender with stress, depressive symptomatology, emotional state, and perceived threat of coronavirus.

Tobacco use	M	F	*F (df = 1)*	NU	NC	DU	IU	*F (df = 3)*
Relational stress scale	6.49	7.82	32.498*	7.07^{NC,DU,IU}	7.81^{DU,IU}	8.91	9.73	22.458*
Contextual stress scale	7.22	8.67	28.826*	7.96^{NC,DU,IU}	8.69^{IU}	9.25	10.19	16.626*
Positive emotions	17.52	16.92	9.654**	17.11	17.12	17.12	16.53	
Negative emotions	16.77	19.58	84.744*	18.29^{NC,DU,IU}	19.88^{IU}	20.15^{IU}	21.80	29.564*
Depressive symptomatology	1.86	2.34	49.915*	2.07^{NC,DU,IU}	2.51^{IU}	2.55^{IU}	3.02	22.888*
Impact of coronavirus	15.97	16.22	7.810**	15.60^{NC,DU,IU}	17.61^{IU}	17.32	19.49	16.891*
Experiences with coronavirus	14.97	14.75	1.013	14.56^{DU,IU}	14.81	15.98	16.31	4.627**
Perceived threat of coronavirus	8.63	9.97	16.450*	8.43^{DU,IU}	9.45	10.40	10.83	7.353*

The analysis used was a multivariate analysis of variance, using the four tobacco groups and gender as factors. The variables in the left column were the criterion variables. M, male; F, female; NU, non-user; NC, no change; DU, decreased use; IU, increased use. Group superscripts represent Bonferroni post-hoc significant differences between the group and the others. Only in the impact of the coronavirus scale was it found that women who increased their use had a higher mean.
*$p \leq 0.05$; **$p \leq 0.01$.

TABLE 4 | Relationship between alcohol use and gender and stress, depressive symptomatology, emotional state, and perceived threat of coronavirus.

Alcohol use	M	F	*F (df = 1)*	NU	NC	DU	IU	*F (df = 3)*
Relational stress scale	6.49	7.82	59.185*	6.55^{NC,DU,IU}	7.29^{DU,IU}	8.60^{IU}	9.42	41.732*
Contextual stress scale	7.22	8.67	63.277*	7.58^{NC,DU,IU}	8.26^{DU,IU}	8.88^{IU}	9.99	29.626*
Positive emotions	17.52	16.92	7.445**	16.90^{NC}	17.72^{IU}	17.20	16.73	3.566**
Negative emotions	16.77	19.58	157.864*	17.76^{NC,DU,IU}	18.77^{DU,IU}	19.95^{IU}	21.11	46.756*
Depressive symptomatology	1.86	2.34	64.736*	1.98^{DU,IU}	2.11^{DU,IU}	2.53	2.70	30.319*
Impact of coronavirus	15.97	16.22	3.636	15.24^{DU,IU}	16.05^{IU}	17.16	18.29	14.109*
Experiences with coronavirus	14.97	14.75	0.658	13.89^{NC,DU,IU}	15.01^{IU}	15.80	16.61	16.070*
Perceived threat of coronavirus	8.63	9.97	47.266*	9.03^{DU,IU}	9.52^{IU}	9.95^{IU}	11.37	21.508*

The analysis used was a multivariate analysis of variance, using the four alcohol groups and gender as factors. The variables in the left column were the criterion variables. M, male; F, female; NU, non-user; NC, no Change; DU, decreased use; IU, increased use. Group superscripts represent Bonferroni post-hoc significant differences between the group and the others. Interactions between sex and groups were not statistically significant.
*$p \leq 0.05$; **$p \leq 0.01$.

TABLE 5 | Relationship between tranquilizer use and gender and stress, depressive symptomatology, emotional state, and perceived threat of coronavirus.

Tranquilizer use	M	F	*F (df = 1)*	NU	NC	DU	IU	*F (df = 3)*
Relational stress scale	6.49	7.82	5.930*	7.07^{NC,DU,IU}	9.71	9.91	11.01	36.138*
Contextual stress scale	7.22	8.67	17.004**	7.91^{NC,DU,IU}	11.19	10.33	11.27	28.700*
Positive emotions	15.52	16.92	4.017*	17.34^{NC,DU,IU}	15.65	15.33	14.73	14.471*
Negative emotions	16.77	19.58	20.731**	18.32^{NC,DU,IU}	21.41^{IU}	21.40^{IU}	23.62	44.113*
Depressive symptomatology	1.86	2.34	9.140*	2.07^{NC,DU,IU}	3.01^{IU}	3.07	3.54	48.240*
Impact of coronavirus	15.97	16.22	1.537	15.73^{NC,DU,IU}	18.26^{IU}	17.88^{IU}	21.01	17.041*
Experiences with coronavirus	14.97	14.75	0.003	14.49^{NC,DU,IU}	16.75	16.38	18.21	13.814*
Perceived threat of coronavirus	8.63	9.97	8.36*	9.35^{IU}	10.55^{IU}	10.05^{IU}	13.03	18.994*

The analysis used was a multivariate analysis of variance, using the four tranquilizer groups and gender as factors. The variables in the left column were the criterion variables. M, male; F, female; NU, non-user; NC, no change; DU, decreased use; IU, increased use. Group superscripts represent Bonferroni post-hoc significant differences between the group and the others. Interactions between sex and groups were not statistically significant.
*$p \leq 0.05$; ** $p \leq 0.01$.

the results of our analysis. In Mexico, substance use, especially by young people, generally occurs outside the home. According to Gómez et al. (43), young people prefer to use alcohol in bars and clubs (33.6%), friends' homes (20.7%), other public places like restaurants and schools (16.7%), and only 11.5% prefer to do so at home. The sale of alcohol has also been limited by the imposition of dry laws in several states, and the pandemic has had significant effects on family income. A study conducted in Spain (44) found that 21.5% of those surveyed reported having used tranquilizers in the previous month, 12% began using them during the pandemic, and one in three took more than the recommended dose or changed to a drug with stronger effects. Total use was greatest in women, similar to our own findings.

Another possible explanation for the increase in tranquilizer use may be related to problems of insomnia, in addition to those of anxiety, stress, and depression, as reported in a study in China (45).

Several studies conducted during the pandemic have focused mainly on the use of alcohol and tobacco and less so on other substance use. Our study found that non-prescription tranquilizers were the third most commonly used substances during lockdown. In Italy, an analysis of hair samples from drug users (46) found that heroin, cocaine, MDMA, and cannabis use dropped significantly, but that use of alcohol and benzodiazepines increased, probably because of their availability. This explanation could also apply to our findings.

Our finding of differences in depressive symptomatology between those who did not use alcohol or did not change their use and those who changed their use in response to lockdown coincides with the findings of studies conducted in the U.K., the U.S., and Australia (47–49). A similar relationship was observed with the perceived threat, impact, and experiences of coronavirus.

We found lower scores on the stress scale among those who did not use substances, while those who reported an increase in their use of alcohol showed significantly higher stress scores than those who reduced their use. Contextual stress factors, like the general social and economic situation, had a major impact on all the groups analyzed, particularly among those who increased their use of alcohol, tobacco, and tranquilizers. Studies in other countries suggest that high levels of stress could be related to increased use of alcohol and other substances as a maladaptive coping strategy (50), but our findings do not point in that direction.

In general, our respondents described experiencing negative emotions with great intensity. This tendency is clearest among those who use alcohol, tobacco, and tranquilizers, although the comparison by sex shows that women experience more negative emotions than men. This was also a finding of Ramos-Lira et al. (51), who investigated emotional responses and coping strategies during lockdown. They suggest that this difference may be the result of men's tendency to talk less about their emotions, part of the social expectations about masculinity that demand strength in the face of adversity, while women feel more freedom to express their feelings and negative emotions. Our findings support this observation.

We found more depressive symptomatology among respondents who used tobacco, as did Stanton et al. (49). As has been documented in research prior to the pandemic (52), tobacco is commonly used to cope with anxiety and depression. Since it is legal, there is a greater tolerance toward its use in the family environment and in crisis situations such as lockdown.

With respect to the limitations of our study, it is important to acknowledge that the design was not probabilistic. The data are drawn from a self-selected sample, which points to a possible bias in the characteristics of respondents and also limits its generalizability. For this reason, our analysis should be taken with caution.

CONCLUSIONS

Non-substance users reported lower levels of stress, depressive symptomatology, impact of the coronavirus pandemic, and perceived threat of coronavirus. At the same time, women reported greater stress, depressive symptoms, and negative emotions than men. As in the surveys conducted during the Covid-19 lockdown, women reported an increase in tranquilizer use.

It is essential to develop mental health programs for early detection, intervention, and follow-up using communication and information technologies. These should actively consider patient opinions and individual traits examined in this study: women, negative emotions, substance use, and perceived threat of coronavirus.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

All procedures followed were in accordance with the standards of the Research Ethics Committee of the National Institute of Psychiatry (Approval No. CEI/C/011/2020). The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NM-V, MT, and GNR contributed to the conception and design of the study. NM-V organized the database. NM-V, JVV, and MA-B performed the statistical analysis. MT and NM-V wrote the first draft of the manuscript. MA-B, JVV, GNR, GS-H, and MF-T wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

FUNDING

The open access publication fee was payed by the Ramón de la Fuente Muñiz National Institute of Psychiatry.

ACKNOWLEDGMENTS

The authors wish to thank those who contributed to the study by responding to the survey, as well as the institutions and individuals who supported its distribution. They are also grateful to the Ramón de la Fuente Muñiz National Institute of Psychiatry for its support in conducting the study.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 14 October 2021
doi: 10.3389/fpsyt.2021.739698

Insights Into Adolescents' Substance Use in a Low–Middle-Income Country During the COVID-19 Pandemic

Lee Thung Sen, Kristiana Siste, Enjeline Hanafi, Belinda Julivia Murtani, Hans Christian, Albert Prabowo Limawan, Adrian and Levina Putri Siswidiani*

Department of Psychiatry, Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital, Jakarta, Indonesia

Introduction: The COVID-19 pandemic and its lockdown have been a significant life event for many individuals, particularly adolescents. The immense psychological pressure could drive risky behavior, e.g., substance use, while lockdown might lead to decreased use. This study aimed to observe the change in substance use among adolescents in Indonesia and the moderating variables to consumption during the COVID-19 lockdown period.

Methods: This study utilized an online survey from April 28, 2020 to June 30, 2020. The hyperlink was disseminated to school administrators and parenting groups through social media and direct messages. A total of 2,932 adolescents (17.4 ± 2.24 and 78.7% females) submitted valid responses. The survey was comprised of a sociodemographic section, substance use details, and psychometric sections, including the Alcohol Use Disorders Identification Test (AUDIT), Cigarette Dependence Scale 12 (CDS-12), Pittsburgh Sleep Quality Index (PSQI), and Strength and Difficulties Questionnaire (SDQ).

Results: Overall, adolescent alcohol use during the pandemic was 5.1%, cigarette smoking was 3.1%, and drug consumption was 0.4%. Over half (53.4%) of alcohol drinkers reported increased drinking, and 33.1% had harmful or dependence-like drinking behavior; in contrast, 44.4% of adolescent smokers disclosed reduced cigarette consumption. Around 37.8% of the drug users indicated increased use. During the pandemic, adolescent alcohol use was associated with higher education [adjusted odds ratio (AOR) = 2.67, 95% confidence interval (CI) 1.02–4.86, $p = 0.04$], higher AUDIT scores (AOR = 1.33, 95% CI 1.25–1.42, $p < 0.001$), and very low prosocial behavior (AOR = 2.46, 95% CI 1.52–3.88, $p < 0.001$). Cigarette smoking was correlated with male sex (AOR = 9.56, 95% CI 5.64–16.62, $p < 0.001$), age (AOR = 1.40, 95% CI 1.14–1.75, $p < 0.001$), and higher CDS score (AOR = 1.17, 95% CI 1.13–1.20, $p < 0.001$).

Conclusions: Rates of adolescent substance use were significant, with sizeable proportions reporting higher usage. This appeared to occur predominantly in specific demographics and those with a lower protective psychosocial attribute, i.e., prosocial behavior, during the lockdown. These findings should urge the strengthening of adolescent addiction care during and after the pandemic.

Keywords: adolescent, alcohol, cigarette, drugs, COVID-19, Indonesia

OPEN ACCESS

Edited by:
Hironobu Fujiwara, Kyoto University Hospital, Japan

Reviewed by:
Marco Di Nicola, Catholic University of the Sacred Heart, Italy
Kosuke Tsurumi, Kyoto University, Japan

****Correspondence:***
Kristiana Siste
ksiste@yahoo.com

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *11 July 2021*
Accepted: *13 September 2021*
Published: *14 October 2021*

Citation:
Sen LT, Siste K, Hanafi E, Murtani BJ, Christian H, Limawan AP, Adrian and Siswidiani LP (2021) Insights Into Adolescents' Substance Use in a Low–Middle-Income Country During the COVID-19 Pandemic. Front. Psychiatry 12:739698. doi: 10.3389/fpsyt.2021.739698

INTRODUCTION

The World Health Organization (WHO) declared the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as a global pandemic on March 11, 2020. As a countermeasure against the pandemic, the Indonesian government implemented a large-scale social restriction (*pembatasan sosial berskala besar*/PSBB) in April 2020. During the large-scale social restriction, public places, including offices and schools, were closed along with a massive reduction of running public transports (1). Despite the effort in reducing further COVID-19 transmission, 4 months later, the drawbacks of this policy rose as several psychological impacts were discovered. According to the survey held by the Indonesian Psychiatrist Association from April to August 2020, around 64% adolescents suffered at least one psychological problem such as anxiety, depression, or posttraumatic complaints during the pandemic (2). A similar trend was found in a Spanish survey, which noted a 34.7% increment in psychopathological problems among adolescents after the pandemic lockdown (3). These mental health problems among adolescents might have emerged due to the implementation of online learning, which limits social interaction with their peers (4–7). Adolescence is a transitional phase of growth and development in which adolescents would consider the relationship with their peers as sources of inclusivity, trust, affection, and self-esteem (8). Thus, they would feel more comfortable sharing their feelings to their peers rather than their parents at home (9, 10). These psychopathological problems would eventually affect adolescent's productivity. Abrupt online learning was believed to a decrease in study motivation, daily activity neglection, and also a rise in drop-outs (11). This stressful event was worsened by the uncertain and ever-changing policies for academic activities, such as exams, graduation, and exchange programs (6). In addition, financial problems have become another stressful event, as the world economy was heavily hit by the pandemic. Some students lost their part-time jobs, while their families were also struggling with unstable income during the pandemic (6, 11, 12).

For some individuals, these burdens may lead to unfavorable coping behavior, such as substance abuse (13). This correlation has been observed with the 2003 SARS outbreak, in which alcohol abuse/dependence symptoms were induced 3 years after being exposed to the outbreak. Unfortunately, the population in this study were hospital employees aged 33–35 years old, and there has been no research accounting for the adolescent population (14).

Before the COVID-19 pandemic, in 2016, among Indonesians older than 15 years old, the prevalence of heavy episodic drinking (pure alcohol consumption of at least 60 g on at least one occasion during the past 30 days) was 6.5%, with the overall prevalence of alcohol use disorders at 0.8% and alcohol dependence at 0.7% (15). Meanwhile, for tobacco smoking, the Indonesian 2018 Basic Health Research stated that the prevalence of tobacco use among Indonesians older than 15 years old was 33.8%, with daily tobacco smoking at 24.3% and e-cigarette use at about 2.8% (16). As for psychoactive drugs, according to the Indonesian Drugs Report 2019, the prevalence of drug abuse among students in 2018 was 3.2%, ∼2 million individuals (17). The current study explored the impact of physical distancing toward psychoactive substance usage, including their related factors, as a response to the concerning number of substance abuse among Indonesian adolescents and the possible emergence of new substitutes, such as new or homemade substances. This study's results would improve our understanding of the management of substance abuse in this "new normal" era. Changes in substance use behavior during the pandemic could be unpredictable, as emotional distress, isolation, and unemployment drove the demand for substance use as a coping mechanism, while reduced availability, escalating prices, and financial limitations decreased substance usage (18).

METHODS

Respondents

School administrators, teachers, and parents were approached, as contact points, through direct correspondences, emails, and social media [e.g., instant messaging applications (WhatsApp or Line)] and the research link was shared. Upon guardian or parental consent, the contact points continued the link to the respondents. The first page of the survey explained the purpose and mechanics of the study, including management of privacy and data, and requested written assent [in line with respecting subjects' autonomy (19) and would be omitted from the study should they reject to participate]. The contact points of each school and parents were urged to pass on the survey link to other parents and teachers. Inclusion criteria for respondents were (i) provided emails (names were not requested) to prevent multiple responses, (ii) aged 10–20 years old, (iii) currently residing in Indonesia, and (iv) capable of understanding Bahasa Indonesia. The selected age range for adolescents in this study was adapted from the WHO definition of 10–19 years old (20) and the Indonesian Pediatric Association of 10–20 years old (21). This study defined early adolescence as 10–14 years old, mid-adolescence as 15–17 years old, and late adolescence as 18–20 years old. Several responses of non-consenting ($n = 30$), duplicates ($n = 23$), and non-Indonesia residents ($n = 10$) were removed. The survey was part of a larger study targeting both adults and adolescents, which separated psychopathology measures between the Symptoms Checklist 90 (for adults) and the Strength and Difficulties Questionnaire (SDQ; for adolescents). However, around 40 respondents mistakenly answered the Symptoms Checklist 90 (SCL-90) and were removed from all analyses. Personal information (e.g., emails) was only accessible to the researcher; they were only inspected for duplicates and deleted prior to further data examination. Overall, a total of 2,932 respondents completed the survey, representing 33 of 34 provinces in Indonesia and all seven main islands (Java 78.5%, Sumatera 8.3%, Kalimantan 0.6%, Sulawesi 9.7%, Nusa Tenggara and Bali 2.6%, Papua 0.1%, and Maluku 0.2%) across Indonesia.

Procedures

The authors designed an online survey employing *Google Form*. A shortened hyperlink was generated and publicized by the research team through social media and direct correspondences to several schools across Indonesia and parenting groups between April 28, 2020 and June 30, 2020. Upon clicking the survey link, the survey started with a title page containing an outline of the study's purpose, respondents' inclusion criteria, and data management. Teachers, guardians, and parents were advised to read through the study's description before allowing their children/students to answer the survey. Each respondent was asked for written informed consent, and an author's email for correspondence was provided for further information and should respondents wish for subsequent clinical assessment/therapy. Those who did not give consent were directed to finish without filling the survey. The survey contained a sociodemographic section (gender, age, monthly household income, education level, occupations, province of residence, and the number of adults currently residing with the participant), followed by quarantine-related questions (the practice of quarantine and physical distancing, location of quarantine, living companion during quarantine, and confirmed/suspected cases within the household) and substance use consumption detail [alcohol, daily cigarette, and drug consumptions since the start of COVID-19 pandemic in Indonesia (March 2, 2020). The option "did not consume" was described as not consuming any substances at all since the beginning of the pandemic, while "consume" was described as having consumed any amount of substances since the beginning of the pandemic. For those who answered having consumed any of the three substances, their perceived change (unchanged, increased, or decreased) of current use compared to before the pandemic was captured]. In the last section, respondents who consumed alcohol were asked to complete the Alcohol Use Disorders Identification Test (AUDIT) and Cigarette Dependence Scale (CDS) for those who consumed cigarettes. There was yet no validated self-report instrument for measuring drug use severity in Indonesia. All respondents were required to complete the Pittsburgh Sleep Quality Index (PSQI) and SDQ. The survey was separated into several sections and span around 14 web pages (since several instruments were divided into multiple sections) and required about 40–50 min for completion. However, response duration could not be evaluated in *Google Form* to prevent reporting bias. All items were marked mandatory; thus, respondents could not continue to the next section or submit the survey if there was an unanswered item.

Physical distancing as an extension of self-quarantine included several practices defined in this study as studying/working from home, alternate studying/working days, and/or other physical distancing practices as per the guideline from the Indonesian COVID-19 Response Acceleration Task Force (GTPP COVID-19). Respondents were asked whether themselves and/or any household member had been declared as COVID-19 suspect cases and/or diagnosed with COVID-19, following the descriptions provided by the GTPP COVID-19, Indonesian Ministry of Health, and World Health Organization. Province of residence was categorized into whether PSBB had been implemented at the commencement of the study (April 28, 2020) based on data from GTPP COVID-19, which included DKI Jakarta, West Java, East Java, Central Java, Banten, West Kalimantan, North Kalimantan, Gorontalo, West Sumatera, Riau, and South Sulawesi. Income levels were divided based on classification by the World Bank.

Psychometric Tools

Alcohol Use Disorders Identification Test

This questionnaire was developed as a screening instrument to identify the effects of dependence and harmful alcohol use, designed to be used in primary health care and applicable for international use. This questionnaire comprises 10 questions focusing on the recent use of alcohol; scoring ranges from 0 to 40 with a score of 8–14 interpreted as harmful alcohol use and $\geq$15 as a possibility for dependence (22). The WHO collaborative study showed that AUDIT is a valid instrument in six countries with a sensitivity of 92% and a specificity of 94% (23). AUDIT had been validated among adolescents (24, 25), with a suggested threshold of 2 for detecting problematic use and 3 for the likelihood of any disorder (25). The Cronbach's alpha in this study was 0.86, among 148 respondents consuming alcohol. The Indonesian version of AUDIT has a Cronbach's alpha = 0.859 (26).

Cigarette Dependence Scale 12

CDS is a self-reported questionnaire that aids in determining the severity of nicotine dependence (27). Each question has five multiple-choice answers. Question number 1 asked cigarette dependency, scoring 0 to 100 and divided into five intervals (0–20, 21–40, 41–60, 61–80, and 81–100). Question number 2 asked the number of cigarettes smoked, ranging from 0 to more than 30 rolls divided into succeeding five intervals (e.g., 0–5 and 6–10). Question number 3 asked about how soon after waking up the respondents smoke his or her first cigarette. This question used a Likert scale with values from 1 to 5, from "very easy" to "impossible." Meanwhile, the Likert scale used in the rest of the questions was from "completely disagree" to "highly agree." The output of this questionnaire is in a numeric form with no determined cutoff number, and a higher score indicates more severe nicotine dependence. Evaluation of the Indonesian version of CDS showed that a modification of the CDS from 12 to 10 (items 3 and 9 were removed) improved the instrument's statistical value with good reliability, Cronbach's alpha = 0.91, and intraclass correlation coefficient = 0.91 (28). The CDS was comparably validated within a population of teenage smokers (27). The reliability in this study was 0.91 among 90 smoking respondents.

Pittsburgh Sleep Quality Index

The PSQI is a commonly used instrument to assess sleep quality in clinical or non-clinical subjects and adolescents with good internal reliabilities of $\alpha = 0.73$–0.85 (29, 30). The questionnaire consists of 24 items, divided into 20 multiple choices and four open-ended questions. About five of 24 items need assessment from a partner or another individual on the subject's sleep pattern. Another 19 items were self-answered questions and can be grouped into seven components, with each being measured between 0 and 3 (maximum 21). A score >5 indicates poor sleep quality. The Indonesian version of the PSQI has been validated with a reliability of $\alpha = 0.79$, content validity of 0.89, and specificity of 81% (31). The Cronbach's alpha in this study was 0.77.

Strength and Difficulties Questionnaire

The SDQ is a questionnaire for children and youths (32–34). The questionnaire consists of 25 items regarding children's behavior in the past 6 months. Those items are divided into five subscales: hyperactivity, emotional symptoms, conduct problems, peer problems, and prosocial behaviors. Each item was marked with "Not True" (=0), "Somewhat True" (=1), and "Certainly True" (=2). Scores of "Not True" and "Somewhat True" are reversed for the prosocial behavior subscale. The total score for each subscale is generated by summing the scores for the five items, thereby resulting in a score ranging from 0 to 10 (32). SDQ scores are divided into four bands, namely, 80% "close to average," 10% "slightly raised/lowered," 5% "high/low," and 5% "very high/very low." The Indonesian version of the SDQ has a sensitivity of 67% and a specificity of 68%, with $\alpha = 0.77$ (33). The reliability in this study was $\alpha = 0.75$.

Data Analysis

Data was analyzed using SPSS version 27.0 (IBM, USA) and R Essentials Statistics for SPSS 27.0 utilizing R version 3.6.3. A descriptive analysis was performed for all data. Categorical data was compared using chi-square and z-test column proportions utilizing Bonferroni correction for multiple pair comparisons. Univariate and multivariate logistic regressions were performed for sociodemographic factors, quarantine and COVID-19-related elements, and psychometric results. Firth's penalized maximum likelihood regression was utilized to overcome the small-event bias for both alcohol and cigarette consumptions (35). Alcohol and cigarette consumptions were categorized into binary (consuming/not consuming) for regression analysis. Reference category was not consuming alcohol or cigarette during the COVID-19 pandemic. Drug consumption had very small frequencies even after dichotomization and was refrained from similar scrutiny. Results were deemed significant if $p < 0.05$ and scrutinizing the 95% confidence interval (CI).

Ethical Approval

This study was approved by the Institutional Ethics Committee of the Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital (KET-413/UN2.F1/ETIK/PPM/00/02/2020). Digital written consents were acquired from all responses.

RESULTS

Sociodemographic and Usage Prevalence

Overall, of the 2,932 respondents, 21.3% were male and the mean age was 17.4 ± 2.24. Around 30.5% attained up to junior high school and 7.1% had reached higher education. The majority, 56.5%, of respondents were non-university students, 84.9% lived in provinces implementing PSBB, and 96.1% practiced physical distancing measures. Around 3.5% ($N = 103$) of respondents reported having positive or suspected cases within their household.

The prevalence of alcohol drinking among Indonesian adolescents during the COVID-19 pandemic and quarantine period was 5.1%, 3.1% for cigarette usage, and 0.4% for drug consumption. The mean age of alcohol drinkers was 17.6 ± 2.30, while among smokers was 18.1 ± 1.76. Of those who consumed alcohol, 25.7% reported unchanged consumption, 53.4% increased drinking, and 20.9% decreased usage. Among the smoking respondents, 37.8% disclosed unchanged cigarette consumption, 17.8% increased smoking, and 44.4% decreased usage. Among those who disclosed drug consumption, 53.8% reported unchanged consumption, 30.8% increased drug use, and 15.4% decreased drug use.

Descriptive Psychometric

This study found that 53.4% of alcohol using respondents perceived heightened alcohol use during the COVID-19 pandemic (see **Table 1**). More late adolescents were found among those with increased alcohol consumption group than the unchanged alcohol consumption group (74.7 and 65.8%, respectively). The greater proportion of respondents with increased alcohol use originated from low-income households (50.6%) compared to the alcohol unchanged group (31.6%).

The proportion of respondents showing very high emotional symptoms were lower in the increased alcohol consumption subgroup than in the unchanged alcohol consumption subgroup (21.5 and 31.6%, respectively). Moreover, the proportion of respondents possessing very low prosocial behaviors were lower in the increased alcohol use subgroup compared to the stable alcohol drinking subgroup (18.4 and 20.3%, respectively).

Across all drinking fluctuations, the AUDIT scores demonstrated that 6.1% (2.8 ± 0.15) had harmful drinking and 27.0% (9.4 ± 0.97) had a likelihood of any alcohol disorder. Based on the AUDIT scores, the proportion of respondents drinking problematically in the stable drinking subgroup [7.9% (3 ± 0)] was higher than that in the increased alcohol consumption subgroup [3.8% (2.7 ± 0.33)]. A greater proportion of respondents having a likelihood to be disordered was also found in the unchanged alcohol consumption group rather than in the increased alcohol consumption group [34.2% (6.9 ± 0.99) and 10.1% (13.1 ± 3.31), respectively]. In addition, sleep problems and emotional problems were also found in both the unchanged alcohol consumption group and the increased alcohol consumption group. Overall, PSQI and emotional symptoms score for respondents who drank alcohol was 5.47 ± 3.04 and 4.04 ± 3.07, respectively (**Table 2**).

Table 3 depicts the descriptive distribution of adolescent smokers. Most of the smokers were male (68.8%) and in their late adolescents (82.2%). More adolescents reported to have less sleep disturbance (37.5%), less emotional symptoms (18.8%), and greater score on prosocial behavior (25.0%) among the increased cigarette consumption group compared to the decreased cigarette consumption group, with around 60.0% reporting a decline in sleep quality, 27.5% had very high scores of emotional symptoms, and 15.0% very low scores on prosocial behavior. CDS score differed significantly between the three groups of smoking consumption changes [$F_{(2,87)} = 4.53$, $p = 0.013$]. The mean CDS score among smokers with unchanged consumption was 16.7 ±

TABLE 1 | Descriptive data stratified by alcohol consumption.

Variables		Did not consume (*N* = 2,784)	Alcohol consumption change						X^2
			Unchanged[a] (*N* = 38)		Increased[b] (*N* = 79)		Decreased[c] (*N* = 31)		
		n	*n*	%	*n*	%	*n*	%	
Sex									
	Male	578	11	28.9	21	26.6	15	48.4	5.07
	Female	2,206	27	71.1	58	73.4	16	51.6	
Age									
	Early adolescent	343	8	21.1	9	11.4	3	9.7	3.05
	Mid adolescent	619	5	13.2	11	13.9	3	9.7	
	Late adolescent	1,822	25	65.8	59	74.7	25	80.6	
Education									
	Up to junior high	858	12	31.6	18	22.8	7	22.6	1.45
	High school	1,734	23	60.5	52	65.8	20	64.5	
	Higher studies	192	3	7.9	9	11.4	4	12.9	
Occupation									
	Non-university students	1,580	24	63.2	48	60.8	12	38.7	11.24
	University students	1,107	12	31.6	24	30.4	17	54.8	
	Employed	96	2	5.3	7	8.9	1	3.2	
	NEET[d]	1	0	0.0	0	0.0	1	3.2	
Household monthly income									
	Low	989	12	31.6	40	50.6	8	25.8	21.09**
	Lower middle	1,242	11	28.9	31	39.2	13	41.9	
	Upper Middle	417	6	15.8	7	8.9	4	12.9	
	High	136	9	23.7	1	1.3[a,c]	6	19.4	
Adults within household									
	0	33	1	2.6	3	3.8	2	6.5	0.67
	1–2	936	14	36.8	26	32.9	8	25.8	
	3–5	1,562	20	52.6	43	54.4	18	58.1	
	>5	253	3	7.9	7	8.9	3	9.7	
Region									
	Implemented PSBB[e]	2,368	34	89.5	68	86.1	20	64.5	5.97
	Has not implemented PSBB[e]	416	4	10.5	11	13.9	11	35.5	
Physical distancing									
	Practiced	2,678	36	94.7	75	94.9	30	96.8	0.2
	Did not practice	106	2	5.3	4	5.1	1	3.2	
Positive/suspect case in household									
	Yes	98	2	5.3	2	2.5	1	3.2	0.59
	No	2,686	36	94.7	77	97.5	30	96.8	
AUDIT cat									
	Normal		22	57.9[b,c]	68	86.1[a,c]	9	29.0[a,b]	35.53***
	Harmful alcohol use		3	7.9	3	3.8	3	9.7	
	Likelihood of any alcohol disorder		13	34.2	8	10.1[a,c]	19	61.3	
PSQI									
	Normal	1,517	20	52.6	53	67.1	14	45.2	5.22
	Poor sleep quality	1,267	18	47.4	26	32.9	17	54.8	
Emotional problems									
	Close to average	1,583	21	55.3	50	63.3	18	58.1	8.81
	Slightly raised	370	1	2.6	9	11.4	2	6.5	
	High	260	4	10.5	3	3.8	5	16.1	
	Very high	571	12	31.6	17	21.5	6	19.4	

(Continued)

TABLE 1 | Continued

Variables		Did not consume (N = 2,784)	Alcohol consumption change						X^2
			Unchanged[a] (N = 38)		Increased[b] (N = 79)		Decreased[c] (N = 31)		
		n	*n*	%	*n*	%	*n*	%	
Conduct problems									
	Close to average	2,510	34	89.5	69	87.3	25	80.6	5.87
	Slightly raised	168	0	0.0	3	3.8	3	9.7	
	High	45	1	2.6	2	2.5	2	6.5	
	Very high	61	3	7.9	5	6.3	1	3.2	
Hyperactivity									
	Close to average	2,124	33	86.8	62	78.5	21	67.7	16.82**
	Slightly raised	359	3	0.8	12	15.2	6	19.4[a,b]	
	High	199	2	1.0	5	6.3	3	9.7	
	Very high	102	0	0.0	0	0.0	1	3.2	
Peer problems									
	Close to average	2,310	31	81.6	62	78.5	26	83.9	8.63
	Slightly raised	254	1	2.6	11	13.9	1	3.2	
	High	162	5	13.2	4	5.1	2	6.5	
	Very high	58	1	2.6	2	2.5	2	6.5	
Prosocial behaviors									
	Close to average	243	7	18.4	16	20.3	6	19.4	2.46
	Slightly decreased	166	4	10.5	5	6.3	1	3.2	
	Low	262	6	15.8	8	10.1	4	12.9	
	Very low	2,113	21	55.3	50	63.3	20	64.5	

*[a,b,c]Significant difference Bonferroni corrected; [d]not in employment, education, or training; [e]large-scale social distancing; **$p \le 0.01$; ***$p \le 0.001$.*

TABLE 2 | Descriptive scores of all psychometric tests across different respondent groups.

Variables	Alcohol drinkers	Cigarette smokers	Drugs consumers
1. AUDIT	2.72 ± 5.21	–	–
2. CDS	–	20.03 ± 8.57	–
3. PSQI	5.47 ± 3.04	6.07 ± 3.54	9.69 ± 3.33
4. Emotional problems	4.04 ± 3.07	4.00 ± 3.04	6.92 ± 2.87
5. Conduct problems	2.80 ± 1.88	2.97 ± 1.97	3.00 ± 2.04
6. Hyperactivity problems	3.67 ± 1.76	3.72 ± 1.81	5.54 ± 1.85
7. Peer problems	3.34 ± 1.64	3.53 ± 1.80	3.15 ± 1.52
8. Prosocial behaviors	6.74 ± 3.07	6.93 ± 2.97	7.77 ± 1.79

Data presented as mean ± SD.

5.75, increased smoking 22.3 ± 10.58, and decreased smoking 22.0 ± 8.98. A *post-hoc* analysis demonstrated a significant difference between decreased and unchanged smoking (p = 0.008); *post-hoc* analyses for other combinations did not yield significant results.

Among those who consumed drugs, about 30.8% (N = 4) consumed at least two types of drugs. Overall, 11.1% used cannabis, 11.1% sedatives or inhalants, 5.6% cocaine, 11.1% other stimulants (e.g., amphetamines), and 61.1% other drugs (e.g., opiates, steroid, and abused prescription). About 84.6% of respondents who reported consuming drugs were female and 76.9% were late adolescents, but were not statistically significant comparing in-between subgroups. About three-fourths (75.0%) of those disclosing increased drug consumption reside in non-PSBB provinces, and all respondents with decreased drug usage were living in PSBB provinces, and similar proportions were reported for sleeping problems in both groups. Half of those reporting increased drug use scored very highly on emotional symptoms, while 71.4% of those having unchanged consumptions also scored very highly on emotional symptoms and 28.6% on hyperactivity trait (**Table 4**). Overall emotional symptoms score was 6.92 ± 2.87 and hyperactivity was 5.54 ± 1.85. Respondents reporting consuming drugs scored the highest on PSQI, 9.69 ± 3.33 (**Table 2**).

Correlates of Substance Consumption

As depicted in **Table 5**, alcohol consumption during the pandemic was correlated to higher-studies education level [adjusted odds ratio (AOR) = 2.67, 95% CI 1.02–4.86, p = 0.04], occupational status [not in education, employment, or training (NEET), AOR = 22.10, 95% CI 1.66–295.37, p = 0.02], higher AUDIT scores (AOR = 1.33, 95% CI 1.25–1.42, $p < 0.001$), and slightly decreased (AOR = 2.09, 95% CI 1.19–3.50, p = 0.01) and very low prosocial behavior (AOR = 2.46, 95% CI 1.52–3.88, $p < 0.001$), compared to non-alcohol consumption. In regard to

TABLE 3 | Descriptive data stratified by cigarette consumption.

Variables		Cigarette consumption change							X^2
		Did not consume (*N* = 2,833)	Unchanged[a] (*N* = 34)		Increased[b] (*N* = 16)		Decreased[c] (*N* = 40)		
		n	*n*	%	*n*	%	*n*	%	
Sex									
	Male	563	20	58.8	10	62.5	32	80.0	4.22
	Female	2,279	14	41.2	6	37.5	8	20.0	
Age									
	Early adolescent	360	1	2.9	0	0.0	2	5.0	1.33
	Mid adolescent	625	4	11.8	3	18.8	6	15.0	
	Late adolescent	1,857	29	85.3	13	81.3	32	80.0	
Education									
	Up to junior high	880	5	14.7	2	12.5	8	20.0	2.16
	High school	1,765	23	67.6	12	75.0	29	72.5	
	Higher studies	197	6	17.6	2	12.5	3	7.5	
Occupation									
	Non-university students	1,621	14	41.2	6	37.5	23	57.5	5.09
	University students	1,122	18	52.9	7	43.8	13	32.5	
	Employed	97	2	5.9	3	18.8	4	10.0	
	NEET[d]	2	0	0.0	0	0.0	0	0.0	
Household monthly income									
	Low	1,018	15	44.1	4	25.0	12	30.0	8.54
	Lower middle	1,258	13	38.2	10	62.5	16	40.0	
	Upper middle	420	5	14.7	0	0.0	9	22.5	
	High	146	1	2.9	2	12.5	3	7.5	
Adults within household									
	0	37	1	2.9	1	6.3	0	0.0	4.18
	1–2	958	8	23.5	6	37.5	12	30.0	
	3–5	1,587	23	67.6	8	50.0	25	62.5	
	>5	260	2	5.9	1	6.3	3	7.5	
Region									
	Implemented PSBB[e]	2,421	25	73.5	11	68.8	33	82.5[a,b]	17.60***
	Has not implemented PSBB[e]	421	9	26.5	5	31.3	7	17.5[a,b]	
Physical distancing									
	Practiced	2,732	33	97.1	16	100.0	38	95.0	0.91
	Did not practice	110	1	2.9	0	0	2	5.0	
Positive/suspect case in household									
	Yes	98	2	5.9	2	12.5	1	2.5	2.19
	No	2,744	32	94.1	14	87.5	39	97.5	
PSQI									
	Normal	1,557	21	61.8	10	62.5	16	40.0	4.31
	Poor sleep quality	1,285	13	38.2	6	37.5	24	60.0	
Emotional problems									
	Close to average	1,618	20	58.8	13	81.3	21	52.5	6.26
	Slightly raised	376	2	5.9	0	0.0	4	10.0	
	High	263	5	14.7	0	0.0	4	10.0	
	Very high	585	7	20.6	3	18.8	11	27.5	
Conduct problems									
	Close to average	2,564	30	96.8	11	100.0	33	94.3	5.85
	Slightly raised	173	0	0.0	0	0.0	1	2.9	

(Continued)

TABLE 3 | Continued

Variables		Cigarette consumption change							X^2
		Did not consume (N = 2,833)	Unchanged[a] (N = 34)		Increased[b] (N = 16)		Decreased[c] (N = 40)		
		n	*n*	%	*n*	%	*n*	%	
	High	49	1	3.2	0	0.0	0	0.0	
	Very high	69	0	0.0	0	0.0	1	2.9	
Hyperactivity									
	Close to average	2,162	30	88.2	14	87.5	34	85.0	2.87
	Slightly raised	370	4	11.8	2	12.5	4	10.0	
	High	207	0	0.0	0	0.0	2	5.0	
	Very high	103	0	0.0	0	0.0	0	0.0	
Peer problems									
	Close to average	2,359	29	85.3	13	81.3	28	70.0	9.45
	Slightly raised	260	2	5.9	1	6.3	4	10.0	
	High	166	3	8.8	2	12.5	2	5.0	
	Very high	57	0	0.0	0	0.0	6	15.0	
Prosocial behaviors									
	Close to average	254	8	23.5	4	25.0	6	15.0	6.21
	Slightly decreased	167	3	8.8	1	6.3	5	12.5	
	Low	271	6	17.6	0	0.0	3	7.5	
	Very low	2,150	17	50.0	11	68.8	26	65.0	

[a,b,c]*Significant difference Bonferroni corrected;* [d]*not in employment, education, or training;* [e]*large-scale social distancing; ***$p \leq 0.001$.*

cigarette, smoking during pandemic was associated with the male sex (AOR = 9.56, 95% CI 5.64–16.62, $p < 0.001$), increasing age (AOR = 1.40, 95% CI 1.14–1.75, $p < 0.001$), and higher CDS score (AOR = 1.17, 95% CI 1.13–1.20, $p < 0.001$).

DISCUSSION

In general, substance use among adolescents in Indonesia during the COVID-19 pandemic showed mixed fluctuations. Although some decreased their usage, a considerable proportion increased or maintained their consumption. The rate of substance use differed for each type of substance, with the highest figure being alcohol use, followed by cigarettes and, lastly, drug consumption. Naturally, adolescence is a transitional phase of autonomy confirmation, peer relevance, and experimentation on life choices (8), which, combined with the financial and social perturbations (6, 11) during the pandemic, might predispose them to greater risks. Additionally, brain development still occurs during the adolescence period; thus, teenagers tend to act impulsively without reflective thinking and more vulnerable to addictive behaviors. Adolescent brain is also sensitive to the effect of psychoactive substances; therefore, it may damage the nervous system and affect brain functioning (36, 37). These composite heightened vulnerabilities were reflected as higher substance use in a past national adolescent survey (17) and resonated in this study. Certain variables, AUDIT and CDS scores, education level, and low prosocial tendencies, were associated with either alcohol or cigarette consumption during the COVID-19 pandemic.

Alcohol

The alcohol consumption among the current sample of adolescents seemed to demonstrate an increase compared to rates before the pandemic. This pattern was also noted to be linked with the male sex, the number of household adults, monthly income band, and scores of conduct problems and prosocial behavior. Past figures prior to the pandemic described a rate of 2.5% (38) for past-month alcohol drinking among Indonesian adolescents, half of the currently detected figure of 5.1%. Although the duration range utilized might also account for the difference, the rate of lifetime drinking was similarly small at 2.2% (38). Another global study among Indonesian school students noted a prevalence of 4.4% on current alcohol use (39), suggesting a potential increase in alcohol consumption during the pandemic. There was, however, a scarcity of data on alcohol abuse or dependence specifically among Indonesian adolescents. In comparison, the number of Canadian adolescents who consumed alcohol did not change significantly pre-and during the COVID-19 era; however, among those who drank alcohol, the frequency of alcohol use increased significantly (40). This resonated with the findings in this study, which elaborated that over half of the respondents reported increased alcohol consumption, 2-fold than those reporting decreased consumption.

The current study discovered a significant relationship between the male sex and alcohol consumption during the COVID-19 pandemic. Other studies during the COVID-19 pandemic noted similar findings (40, 41). Notably, adolescents in higher studies were more prone to consuming alcohol during the

TABLE 4 | Descriptive data stratified by drug use.

Variables		Drugs consumption change							X^2
		Did not consume (*N* = 2,919)	Unchanged[a] (*N* = 7)		Increased[b] (*N* = 4)		Decreased[c] (*N* = 2)		
		n	*n*	%	*n*	%	*n*	%	
Sex									
	Male	623	0	0.0	1	25.0	1	50.0	3.4
	Female	2,296	7	100.0	3	75.0	1	50.0	
Age									
	Early adolescent	361	2	28.6	0	0.0	0	0.0	4.13
	Mid adolescent	637	0	0.0	1	25.0	0	0.0	
	Late adolescent	1,921	5	71.4	3	75.0	2	100.0	
Education									
	Up to junior high	892	2	28.6	1	25.0	0	0.0	0.73
	High school	1,819	5	71.4	3	75.0	2	100.0	
	Higher studies	208	0	0.0	0	0.0	0	0.0	
Occupation									
	Non-university students	1,659	2	28.6	2	50.0	1	50.0	0.63
	University students	1,152	5	71.4	2	50.0	1	50.0	
	Employed	106	0	0.0	0	0.0	0	0.0	
	NEET[d]	2	0	0.0	0	0.0	0	0.0	
Household monthly income									
	Low	1,046	2	28.6	1	25.0	0	0.0	3.14
	Lower middle	1,292	2	28.6	2	50.0	1	50.0	
	Upper middle	432	1	14.3	1	25.0	0	0.0	
	High	149	2	28.6	0	0.0	1	50.0	
Adults within household									
	0	39	0	0.0	0	0.0	0	0.0	0
	1–2	982	1	14.3	1	25.0	0	0.0	
	3–5	1,634	6	85.7	2	50.0	1	50.0	
	>5	264	0	0.0	1	25.0	1	50.0	
Region									
	Implemented PSBB[e]	2,484	3	42.9	1	25.0	2	100.0	1.13
	Has not implemented PSBB[e]	435	4	57.1	3	75.0	0	0.0	
Physical distancing									
	Practiced	2,806	7	100.0	4	100.0	2	100.0	0
	Did not practice	113	0	0.0	0	0.0	0	0.0	
Positive/suspect case in household									
	Yes	75	1	14.3	0	0.0	0	0.0	0.65
	No	2,844	6	85.7	4	100.0	2	100.0	
PSQI									
	Normal	1,602	1	14.3	1	25.0	0	0.0	0.65
	Poor sleep quality	1,317	6	85.7	3	75.0	2	100.0	
Emotional problems									
	Close to average	1,670	1	14.3	0	0.0	1	50.0	7.10
	Slightly raised	380	0	0.0	1	25.0	1	50.0	
	High	270	1	14.3	1	25.0	0	0.0	
	Very high	599	5	71.4	2	50.0	0	0.0	
Conduct problems									
	Close to average	2,627	7	100.0	3	75.0	1	50.0	8.27
	Slightly raised	173	0	0	1	25.0	0	0.0	

(Continued)

TABLE 4 | Continued

Variables		Drugs consumption change							X^2
		Did not consume (*N* = 2,919)	Unchanged[a] (*N* = 7)		Increased[b] (*N* = 4)		Decreased[c] (*N* = 2)		
		n	*n*	%	*n*	%	*n*	%	
	High	50	0	0	0	0	0	0.0	
	Very high	69	0	0	0	0	1	50.0	
Hyperactivity									
	Close to average	2,238	1	14.3	1	25.0	0	0.0	3.14
	Slightly raised	375	2	28.6	2	50.0	1	50.0	
	High	206	2	28.6	1	25.0	0	0.0	
	Very high	100	2	28.6	0	0.0	1	50.0	
Peer problems									
	Close to average	2,418	7	100.0	3	75.0	1	50.0	8.27
	Slightly raised	266	0	0	1	25.0	0	0.0	
	High	172	0	0	0	0.0	1	50.0	
	Very high	63	0	0	0	0.0	0	0.0	
Prosocial behaviors									
	Close to average	272	0	0.0	0	0.0	0	0.0	1.60
	Slightly decreased	174	1	14.3	1	25.0	0	0.0	
	Low	278	1	14.3	1	25.0	0	0.0	
	Very low	2,195	5	71.4	2	50.0	2	100.0	

[a,b,c]Significant difference Bonferroni corrected; [d]not in employment, education, or training; [e]large-scale social distancing.

pandemic. Some recent data on college students suggested they were capable of sourcing hedonic stimulus from solitary use of substances (40, 42), which deviated from the past understanding of the peer contexts of adolescent substance use (43). This would resonate with findings of solitary drinking among adolescents during COVID-19 and speak volumes on the necessity to scrutinize further the source and procurement of substances among underage drinkers (with the legal age of alcohol purchase in Indonesia being 21). The oversight of alcohol sales could be considered loose in some low- and middle-income Asian countries, with a prior study illustrating that at least a third of minors being able to physically purchase alcoholic products (38), which should spur the scrutiny to digital alcohol sales. Astonishingly, there was also a finding on the use of virtual platform among peers for use of substances during COVID-19 (40).

The present study did not observe any correlation between household health status (proximity to COVID-19), the practice of physical distancing, and living in lockdown provinces. The maintenance of alcohol consumption during the pandemic was correlated to higher AUDIT scores, underscoring the vulnerabilities of those with an inclination of dependence, particularly as AUDIT has the predictive capacity of forming and sustaining problematic alcohol use among adolescents (24). Another study, albeit among adults, showed that low social connectedness and depressive symptoms were linked to increased past-month drinking during the pandemic (44), echoing the results of a meta-analysis on adolescents' coping motives and alcohol consumption (45). During the COVID-19 pandemic, individuals experienced decreased emotion regulation and hedonic tone, which could become the predictor factors of depressive symptoms. A common neurobiological pathway is also shared by both affective states and addictive disorder; thus, it may increase the risk for addictive behavior when an individual experiences mood disorders (46, 47). These findings were in line with the present study results, which noted that decreased and very low prosocial behaviors were significantly related to alcohol consumption during the pandemic. Subsequently, a high prosocial activity had been recorded to correlate with lower alcohol use and other antisocial behavior (48), and, vice versa, deviant peer associations were linked to higher rates of alcohol misuse (49).

Interestingly, the activation of the ventral striatum to reward stimuli from prosocial activities was predictive of lower risk-taking behaviors, including illicit substance use (50). More specifically, school attendances (51) and positive prosocial experiences were associated with reduced alcohol use (52), and parental warmth directed adolescents toward more prosocial peers (49). Prosocial attributes are known to correlate with better self-regulatory capacity (53) and could be focused on those who would form a higher belief in moral order (54), in turn mediating the reduction in odds of alcohol misuse. These could be valuable and applicable avenues to explore digitally to enhance prosocial affinity among adolescents and curb alcohol consumption. In light of the shifting psychiatric health provision in many countries (55), these linkages presented the necessity to maintain addiction services, particularly toward the subgroup of vulnerable adolescents.

TABLE 5 | Regression analysis on alcohol and cigarette consumptions.

Variables	Alcohol consumption		Cigarette consumption	
	cOR[a]	aOR[b]	cOR[a]	aOR[b]
Sex (ref: female)	1.78 (1.24–2.54)**	1.74 (1.17–2.55)***	8.96 (5.68–14.14)***	13.81 (8.46–23.11)***
Age	1.04 (0.96–1.12)	1.05 (0.92–1.20)	1.19 (1.07–1.33)***	1.44 (1.19–1.75)***
Education (ref: up to junior high)				
High school	1.27 (0.86–1.87)	1.39 (0.80–2.40)	2.13 (1.21–3.75)**	1.40 (0.65–3.06)
Higher studies	1.93 (1.05–3.55)*	1.87 (0.86–3.94)	3.28 (1.48–7.24)**	2.07 (0.72–5.72)
Occupation (ref: non-university students)				
Employed	1.96 (0.99–3.90)	1.38 (0.63–2.82)	3.50 (1.66–7.38)***	1.50 (0.57–3.67)
NEET[c]	18.81 (1.17–303.34)*	17.37 (1.32–229.43)*	–	4.77 (0.03–72.49)
Adults within household (ref = ≥1)				
0	3.52 (1.45–8.54)**	3.34 (1.26–7.66)*	1.72 (0.41–7.26)	1.01 (0.17–3.84)
Household monthly income (ref: low)				
High	1.94 (1.09–3.46)*	2.21 (1.19–3.91)**	1.35 (0.55–3.29)	1.07 (0.38–2.61)
Conduct problems (ref: close to average)				
Very high	2.89 (1.41–5.96)**	2.84 (1.07–6.99)*	3.85 (1.71–8.69)***	3.10 (0.99–9.06)
Hyperactivity (ref: close to average)				
High	1.57 (0.90–0.275)	1.25 (0.62–2.38)	2.81 (1.57–5.04)***	2.67 (1.23–5.54)**
Peer problems (ref: close to average)				
Very high	1.67 (0.66–4.25)	1.16 (0.39–2.83)	3.55 (1.48–8.50)**	2.65 (0.90–6.90)
Prosocial behaviors (ref: close to average)				
Very low	0.36 (0.23–0.56)***	0.41 (0.26–0.66)***	0.35 (0.21–0.61)***	0.53 (0.29–1.00)

*[a]Crude odds ratio; [b]adjusted odds ratio; [c]not in employment, education, or training; *p < 0.05; **p < 0.01; ***p < 0.001.*

Cigarettes

Overall, the rate of current cigarette smoking during the COVID-19 pandemic, 3.1%, was lower compared to figures prior to the pandemic, 18.8% (56). This could be influenced by multiple factors affiliated to the pandemic; from reduced accessibility, availability, and increased perceived danger, the alternative results presented here could also be attributed to the concentrated education of detrimental correlation between COVID-19 and smoking (57). The disproportionate smoking tendencies between sexes had been recorded worldwide (58). Within the current sample, the male respondents were more likely to maintain cigarette smoking during the pandemic. This finding could be due to a higher rate of male smokers. Previous national surveys (59) and another study described that though higher perceived stress was seen among females, males reported a higher intensity of smoking and neuroendocrine reactivity (60). Secondly, as schools closed and learning shifted digitally, most adolescents were at home, which would present difficulty in continuing cigarette smoking in the presence of their parents. The majority of decreased smoking was reported by those in the high school, while those in the University reported increased smoking. This might have occurred as adolescents in the University could maintain living separately or having more freedom; supportively, older age was associated with higher odds of cigarette smoking during the pandemic. Interestingly, financial status did not present a clear pattern to changes in smoking habits, which could aggravate the economic burden amid the pandemic.

Neither living in lockdown provinces nor the proximity to COVID-19 cases were associated with smoking behavior, and nearly a fifth of the smoking respondents in PSBB provinces reported increased cigarette consumption. In Indonesia, many of the psychiatric and mental health resources were sidelined during the lockdown and pandemic. This should notify the stakeholders to maintain and even strengthen addiction health services in areas hard-hit by COVID-19, particularly toward adolescents. This study demonstrated that adolescents with high scores of CDS were associated with cigarette smoking during the pandemic; thus, identifying the at-risk adolescents and continuous cessation education and health support would be paramount.

Drugs

In this study, less than half a percent of respondents consumed illicit drugs or abused prescriptions during the COVID-19 pandemic. This finding was in accordance with a survey from the Indonesian National Narcotics Board in 2018 that revealed a rate of only 0.44% of regular drug users among Indonesian adolescents (17). Studies assessing the impact of the COVID-19 pandemic on substance use disorder are still scarce in Indonesia. It was particularly notable that the reduced availability of and accessibility to drugs resulted in a stagnant, compared to decreased, use prevalence. A prior national survey (17) found that majority of Indonesian adolescents obtained substances by buying from their friends and just for experimental use, and the survey reported that the most accessible and available substance was cannabis and "tembakau gorilla" (a mixture of tobacco and synthetic cannabis). In the current study, cannabis and sedatives shared a similar proportion of usage. This finding resonated with the latest national survey that showed cannabis as one of the leading substances used by Indonesian adolescents, along with inhalants and analgesics (17). In this study, most substance users were female, unlike prior data, which noted the proportional prevalence of substance use in both sexes among junior high school students and male propensity among senior high school and University students. Concordantly, a prior Japanese post-disaster study highlighted that females were more inclined to resort to drug use (61). This could suggest a gendered proclivity of substance misuse under immense stressor. A study examining stress exposure and sex interaction revealed that greater responses were observed in the limbo-striatal and bilateral hippocampal regions for females than males (62), which could manifest as distinct stress-related complaints and impetus for substance use. This phenomenon could also be partially motivated by some biased views for female complaints resulting in higher sedative accessibility (63). However, the fact that a large proportion of the respondents in this study was female would bias this finding, and thus, further scrutiny is warranted.

The main strength of this study was being the first sizeable independent study on Indonesian adolescent substance use patterns and the first Indonesian study to analyze the patterns' changes during the COVID-19 pandemic. The responses gathered represented 33 out of 34 provinces in Indonesia, with response patterns resonating to real-world population density distribution. Some of the findings showed consistency with the national survey data, and relevant changes were recorded in this study.

However, there were some limitations in this study. First, some specifics of substance use attributes (e.g., history of use or disorder, detailed categories, procurement sources, and context of use) were not captured, thus requiring further research. Second, the study could not employ probability sampling or match to national census data due to the fast unraveling of the pandemic and limited available resources. Third, the digital and self-report surveys would pose response bias, e.g., social desirability and recall bias. Overall, the authors hoped that these findings provide preliminary insights for refining mental health and addiction policies and guidance for further research during and post-pandemic.

To conclude, the COVID-19 pandemic has given tons of impacts to humanity, including psychological well-being among adolescents. Our study showed that during the COVID-19 pandemic, rates of adolescent substance use in Indonesia were significant, with sizeable proportions reporting higher usage. In addition, our study showed a lower protective psychosocial attribute, i.e., prosocial behavior, during the lockdown. Therefore, early recognition of substance use is crucial, particularly during the COVID-19 pandemic. These findings also should urge the strengthening of adolescent addiction care during and after the pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Ethics Committee of the Faculty of Medicine, Universitas Indonesia–Dr. Cipto Mangunkusumo General Hospital. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

KS and EH designed and supervised the study. KS, EH, LTS, BM, and HC contributed data or analysis tools. KS, EH, LTS, BM, HC, AL, A, and LPS collected the data and wrote the initial manuscript. KS, EH, and LTS performed the data analysis. KS, EH, LTS and BM revised the manuscript. KS secured funding for the study. All authors contributed to the article and approved the submitted version.

FUNDING

This study received funding from the Ministry of Research and Technology/National Research and Innovation Agency of Republic of Indonesia through the Konsorsium Riset dan Inovasi Untuk Percepatan Penanganan Corona Virus Disease 2019 (COVID-19) (Ref: 106/FI/PKS-KCOVID-19.F/VI/2020). The funders had no role in the design, data collection, analysis and interpretation of data, write-up, and/or publication of this study.

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BRIEF RESEARCH REPORT
published: 28 October 2021
doi: 10.3389/fpsyt.2021.703685

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Buprenorphine Induction in a Rural Maryland Detention Center During COVID-19: Implementation and Preliminary Outcomes of a Novel Telemedicine Treatment Program for Incarcerated Individuals With Opioid Use Disorder

*Annabelle M. Belcher, Kelly Coble, Thomas O. Cole, Christopher J. Welsh, Anna Whitney and Eric Weintraub**

Division of Addiction Research and Treatment, Department of Psychiatry, University of Maryland School of Medicine, Baltimore, MD, United States

Over 10 million individuals pass through U.S. detention centers on an annual basis, with nearly two-thirds meeting criteria for drug dependence/abuse. Despite proven efficacy, treatment with medications for opioid use disorder (MOUD) is underutilized in jail settings—a gap that could be addressed using telemedicine. Here we describe a new program of telemedicine-based clinical provision of new/continuing buprenorphine treatment for individuals detained in a rural jail. Implementation objectives were completed between January and August 2020, and patient encounters were conducted between August 2020 and February 2021. We established (i) telemedicine hardware/software capability; (ii) a screening process; (iii) buprenorphine administration methods; (iv) necessary medical release procedures; (v) telemedicine encounter coordination and medication prescription procedures; and (vi) a research platform. Seven incarcerated patients have been treated, two of whom were referred from community treatment. Patients were mostly male (71%), non-Hispanic White (86%), and averaged 33 years old. All patients tested positive for an opioid upon intake and began/continued buprenorphine treatment in the jail. Average time to first MOUD appointment was 9 days and patients were maintained in treatment an average 21 days. Referrals for continuing community treatment were offered to all patients prior to discharge. We report successful implementation of telemedicine MOUD in a rural detention center, with treatment engagement and initiation occurring prior to the high-risk period of discharge. The fact that this program was launched during the height of the pandemic highlights the flexibility of telemedicine-based buprenorphine treatment. Challenges and obstacles to implementation of buprenorphine treatment in a correctional system are discussed.

Keywords: correctional settings, medications for opioid use disorder (MOUD), jail, carceral treatment, medications for addiction treatment (MAT), buprenorphine, opioid agonist therapy (OAT), telemedicine

OPEN ACCESS

Edited by:
Giuseppe Bersani,
Sapienza University of Rome, Italy

Reviewed by:
Alireza Noroozi,
Iranian National Center for Addiction Studies (INCAS), Iran
Seyed Ramin Radfar,
Tehran University of Medical Sciences, Iran
Nelson Feldman,
Geneva University Hospitals (HUG), Switzerland

****Correspondence:***
Eric Weintraub
Eweintra@som.umaryland.edu

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: *30 April 2021*
Accepted: *04 October 2021*
Published: *28 October 2021*

Citation:
Belcher AM, Coble K, Cole TO, Welsh CJ, Whitney A and Weintraub E (2021) Buprenorphine Induction in a Rural Maryland Detention Center During COVID-19: Implementation and Preliminary Outcomes of a Novel Telemedicine Treatment Program for Incarcerated Individuals With Opioid Use Disorder. Front. Psychiatry 12:703685. doi: 10.3389/fpsyt.2021.703685

INTRODUCTION

The United States is entrenched in an opioid epidemic that has disproportionally impacted rural areas of the United States (1, 2). Health care challenges that are endemic to non-metropolitan areas, such as geographic constraints, resource limitations and limited availability of specialty treatments, have been exacerbated by negative perceptions of medications for opioid use disorder (MOUD). Resultingly, the rural opioid problem is greater in scope and scale than that of urban areas (3, 4). Methadone, buprenorphine, and long-acting naltrexone are FDA-approved frontline treatments in community and hospital settings for opioid use disorder (OUD); but in rural areas of the U.S., their availability and uptake is limited (5, 6).

This lack of access poses a particularly acute problem for treatment within the criminal justice system. More than 10 million individuals pass through U.S. detention centers on an annual basis, and it has been estimated that as much as two-thirds of this population meet criteria for drug dependence or abuse (7)—a gross over-representation of the incidence rate observed in general (non-incarcerated) populations. With conservative estimates that up to 36% of all individuals with an opioid problem pass through U.S. corrections systems each year (8), OUD is highly prevalent in justice-involved populations. An estimated 15% of incarcerated individuals have an OUD (9, 10). Overdose risks associated with transition from prison to the community is particularly high in the 2 weeks following release and has been shown to be the leading cause of death for recently discharged individuals (11–13). Randomized controlled studies have shown that prison-initiated MOUD treatment greatly improves post-release outcomes on a host of measures, including retention in treatment, social function, and recidivism (14). In the United States, jails and detention centers serve as temporary confinement spaces for individuals who commit minor offenses, or who are awaiting trial for more serious offenses. Jail and detention center settings not only oversee individuals struggling with substance use disorders and withdrawal but are also in a unique position to initiate treatment in a controlled, safe environment. Unfortunately, criminal justice detainees have the least access to MOUD treatment (15)—particularly in rural areas (16).

Telemedicine provides a viable solution for health care and treatment gaps. Capitalizing on technological advances and secure Health Insurance Portability and Accountability Act (HIPAA)-compliant videoconferencing, telemedicine involves remote therapeutic encounters with “doctors on the screen” who interact directly with their patients to provide assessments, psychiatric care, and medication prescription. This method of healthcare provision has broken the significant barrier of geographic distance to promote equitable access to healthcare (17). Although reports of its use in carceral settings is limited, the available literature suggests that as a cost-effective and acceptable method of mental health service provision, telemedicine should be more widely adopted as a tool to increase healthcare access for confined populations (18). More recently, its utility has been underscored by the COVID-19 pandemic. No longer simply a solution to rural health care access, telemedicine has taken center stage as a major health care delivery platform during the COVID-19 public health emergency (19, 20).

Our Division of Addiction Research and Treatment within the Department of Psychiatry at the University of Maryland School of Medicine has been providing MOUD *via* telemedicine to a variety of substance use disorder treatment programs throughout the state of Maryland since 2015. With partnership programs across the state, the presence and variety of telemedicine models we provide is strongest in underserved rural counties in Maryland (21, 22). The overlap of OUD and criminal justice involvement drove our team to look for ways in which to access vulnerable jail populations to provide OUD treatment prior to the risky period of discharge. In the United States, methadone can only be dispensed through federally regulated Opioid Treatment Programs and is not a practical option in rural county jails; thus, our program focuses on providing treatment with buprenorphine.

Here we describe implementation and pilot evaluation of a novel jail telemedicine program to provide buprenorphine treatment to individuals who are incarcerated in rural Maryland detention centers. In the United States, jails and detention centers serve to temporarily confine pre-trial suspected offenders or individuals accused of minor crimes. Detention centers and jails usually do not keep individuals for periods more than 18 months. Considering differences in individuals’ length of stay and readiness to accept treatment, a goal of our program is to initiate treatment as close as possible to an individual’s intake into the jail to maximize the impact of our telemedicine-based buprenorphine clinical intervention as well as the potential for early and sustained engagement prior to release. Program implementation began in January 2020, the same month as Federal and local declarations of an infectious disease outbreak and public health emergency. We provide a description of the implementation process and integration into standing jail procedures, *de novo* build-out of the hard and software for the telemedicine platform and data collection, and procedures for screening and referral for treatment. Further, we report pilot results of the initial cohort of telemedicine-based buprenorphine treatment initiates, describe patient demographic and drug use history characteristics, and report on buprenorphine treatment within the jail setting. Finally, we describe our experience with the challenges and barriers to telemedicine-based buprenorphine implementation in a rural jail.

MATERIALS AND METHODS

Results are reported following the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines (23).

Setting

With a population of ∼38,000, Talbot County is classified by the Federal Office of Rural Health Policy as a rural area. The Talbot County Detention Center is a 148-person-rated facility with an average daily pre-COVID census of ∼60–80 individuals and serves as the designated central booking center for the county. The average length of stay is 6 months, but individuals

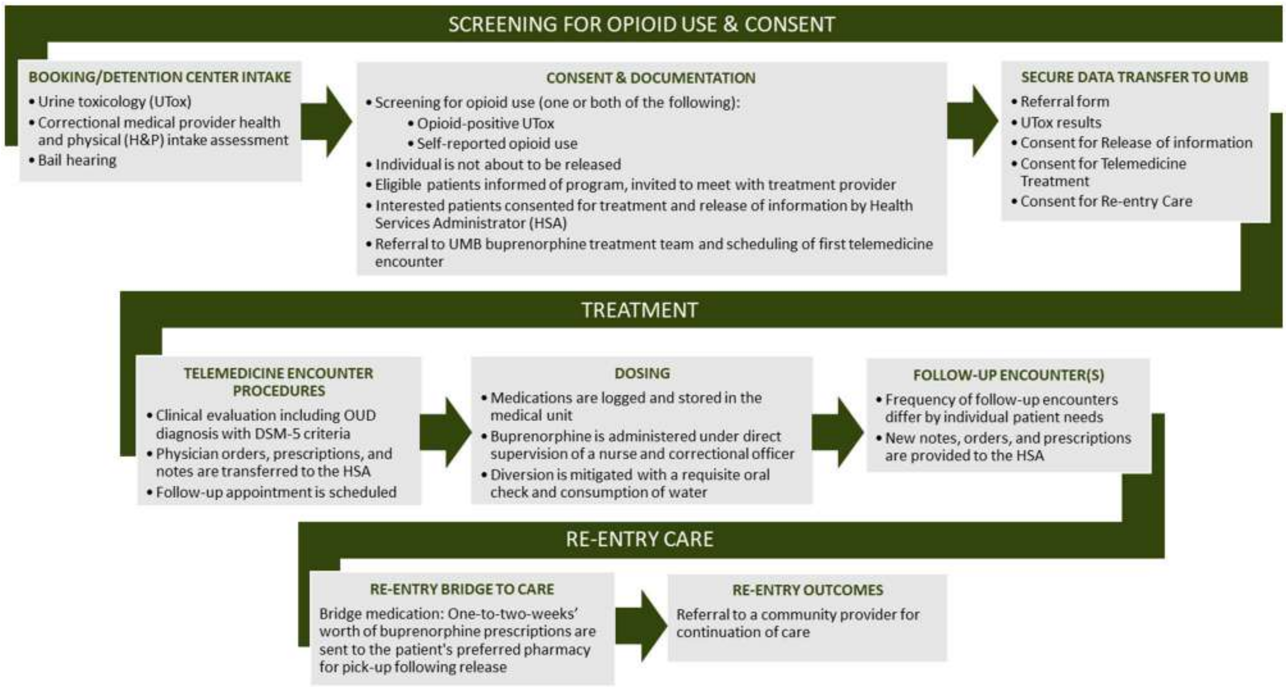

FIGURE 1 | Flow diagram depicting coordination and provision of clinical telemedicine-based buprenorphine care.

awaiting trial can be held for up to 18 months. Prior to our program, the only individuals who were offered MOUD within the jail were pregnant women who were already engaged in treatment within the community; otherwise, supervised withdrawal management with medications for symptom relief (e.g., loperamide, acetaminophen, meclizine) was the standard operating procedure for individuals presenting with an opioid use disorder at jail intake. Data reported were obtained on incarcerated individuals enrolled into the telemedicine-based buprenorphine program from August 15, 2020 to February 15, 2021.

Project Development Activities

Meetings With Detention Center and Health Department Staff

In order to ensure seamless contact with key individuals involved in the program and to address concerns prior to telemedicine-based buprenorphine implementation, regular meetings were established that included the Talbot County Detention Center leadership and correctional staff, the health officer and local addictions authority, and contracted jail health care providers (WellPath nursing staff and medical directors). The first several of these meetings were held in person, but subsequent to the onset of the pandemic, have been held as bi-monthly or monthly virtual (Zoom) teleconference meetings. These meetings allowed us to identify a point-person for the delivery of medications, release of healthcare information from the jail records (urine toxicology, withdrawal assessment, etc.) to guide buprenorphine best clinical practices, and coordination of the telemedicine encounters. Through an iterative process, development of a protocol for telemedicine-based buprenorphine clinical care delivery was established, a flow chart for which is depicted in **Figure 1**.

Medications Procurement, Storage, and Dispensation

Buprenorphine mono-product (Subutex) is provided as either 2 or 8 mg tablets once daily. Medications are administered either by the health services administrator (HSA) or other certified personnel. Starting dose blister packs are stored in the facility's double-locked medical cart to which only the jail's authorized medical staff members have access. Following an initial medical evaluation, patient-specific buprenorphine prescriptions are ordered from the correctional pharmacy service provider (CorrectRx) and delivered weekly. All medication administration is recorded in a controlled substances log.

HIPAA-Compliant Communication and Transfer of Electronic Health Information

Clinical encounters are logged into an electronic health record database (Epic [Epic Systems Corporation]), and documentation is maintained at the University of Maryland. Microsoft Teams, a HIPAA-compliant platform that is housed and maintained within the University of Maryland School of Medicine and protected by a firewall to ensure secure transfer of sensitive information, is used to enable confidential exchange of health information from the jail healthcare staff to the treatment team.

Drafting and Finalization of Requisite Telemedicine-Based Buprenorphine Treatment Forms

In order to initiate telemedicine-based buprenorphine services at the detention center, incarcerated individuals must consent to a release of the health and physical form (H&P) that is given to all new jail intakes. Several forms necessary for telemedicine-based buprenorphine treatment were developed; these included Release of Information, consent to telemedicine treatment, consent to treatment with buprenorphine, H&P data extraction (filled by a member of the jail's healthcare nursing provider team upon intake into the jail), buprenorphine prescription pads, and a medical progress note.

Teleconferencing Equipment

All interactive video conferencing sessions are conducted either point-to-point or multipoint using an Advanced Encryption Standard (AES) algorithm via Internet Protocol (IP) connections. Bridging of calls occur either through the multipoint software license of the video conferencing system or using the UMB-sponsored account for Cisco WebEx or Zoom. The UMB-sponsored account has the required security compliance documents that ensure high levels of security for confidential content covered under state and federal laws and regulations (e.g., HIPAA).

Polycom video conferencing devices are supported by internal IT staff and secured by Cisco Video Expressways. All video sessions are secured by AES-256-bit encryption, and all equipment and software used for telemedicine encounters has been deemed HIPAA-compliant by the University of Maryland School of Medicine Information Security Office. All video calls are logged on the Polycom endpoint and the Cisco expressways.

COVID-19 restrictions precluded us from entering the jail and establishing a full DX-80 installation, the standard telemedicine hardware utilized by our telemedicine-based buprenorphine clinical service programs. To circumvent this barrier, we purchased a small, inexpensive laptop on which to hold telemedicine encounters; all encounters described in this report were conducted using this temporary telemedicine infrastructure.

Brief Screening and Referral for Treatment

Briefly, all clinical services that are conducted in-person (consent for treatment, brief screening, referral for treatment, and urine toxicology) are conducted by the HSA, whereas all substance use disorder clinical encounter procedures (diagnosis and prescribing) are conducted remotely (via telemedicine) by physicians based at the University of Maryland. As part of standard intake procedures, individuals who are newly booked into the detention center provide a urine sample and a self-report of lifetime drug use to staff at the detention center, either at the time of correctional intake or at the time of telemedicine-based buprenorphine referral. Individuals with active opioid use prior to arrest are placed on a withdrawal management protocol in which the Clinical Opioid Withdrawal Scale (COWS) is administered by the HSA. The HSA also provides supportive medication treatment for symptoms associated with opioid withdrawal, including non-steroidal anti-inflammatory drugs and anti-emetics. In addition to this palliative acute care by the HSA, treatment for more severe symptoms would be addressable by the detention center's intensive outpatient treatment psychiatrist, who was available in case of emergencies. Individuals who screen positive for OUD, are not released on pre-trial bail, and are interested in hearing about telemedicine-based buprenorphine, are referred by the HSA or behavioral health coordinator (BHC) to the telemedicine-based buprenorphine provider affiliated with the University of Maryland. At this time the HSA/BHC obtains a telemedicine consent and a release of information (ROI) consent. The HSA/BHC then transfers the referral form, urine toxicology results, Clinical Opioid Withdrawal Scale (COWS) assessment results, nursing notes, and the above consent forms to the provider via Microsoft Teams (a secure cloud-based platform). Once received by the provider, the individual is added to a provider's schedule and a medical health record is created at the distant site. Providers review the above documents prior to the telemedicine-based buprenorphine encounter. After the telemedicine-based buprenorphine encounter, and if the provider determines that the individual meets the medical criteria for MOUD, a treatment consent is obtained by the HSA/BHC prior to dosing.

Buprenorphine Induction and Maintenance

Initial buprenorphine dosing is patient-centered and is decided by the individual practitioner based on a thorough history and clinical exam. Given that new patients tend to be opioid-free for more than a week, a starting dose of 4 or 8 mg is used. Both a prescription and administration order for the medication are transmitted electronically through a secure platform. Patients are administered buprenorphine daily between the hours of 8:00 a.m. and 9:00 a.m. within the secured medical unit under directly observed therapy conditions. The HSA/dosing nurse and a correctional officer are both present during dosing procedures. Prior to consuming the buprenorphine medication, patients are instructed to consume a cup of water. The buprenorphine is crushed by the nurse and then placed under the patient's tongue. The patients are instructed to sit on their hands and are monitored by a correctional officer. After the medication is fully dissolved, a subsequent cup of water is consumed. Prior to leaving the medical unit, patients are given a visual mouth inspection to ensure complete consumption of the medication. Additionally, patients' detention center provided clothing pockets are inspected to ensure diversion does not occur. Jail medical staff are provided physicians' after-hours contact information to facilitate ongoing communication at any point during treatment.

Data Collected

Data are collected from detention center health records using the data extraction sheet described above, and from electronic health records logged in Epic. De-identified data are stored on a database created in REDCap, a HIPAA-compliant database for real-time data entry and validation, storage and retrieval (24). Routine data backups are conducted by the Department of Psychiatry Information Technology group. All data are collected as part of a study protocol approved by the University of Maryland's Human Research Protection Office (UMB IRB protocol No. HP-00090980). Data collected and reported include patient demographic characteristics (sex, age, race, ethnicity, other mental health diagnosis, family history of either substance use or mental health disorder and marital status), drug use characteristics [self-reported number of years of opioid use, frequency of use, most recent route of administration, intake toxicology results, withdrawal score as assessed by the COWS (21)], criminal justice data (reason for conviction and whether or not convicted), and telemedicine-based buprenorphine treatment data pre- and post-discharge (transferred from community buprenorphine treatment, buprenorphine doses across treatment, number of days between correctional intake and first telemedicine-based buprenorphine appointment, total number of follow-up in-custody appointments, total number of days in telemedicine-based buprenorphine care, and referral to post-discharge continuing care and type of referral).

Confidentiality

Personal health information, including urine drug screen results, is only accessible by staff providing direct medical care to patients. Further, personal health information is only shared with the necessary detention center, health department, and University of Maryland staff for the purposes of care coordination. This information is protected under the federal regulations governing Confidentiality and Drug Abuse Patient Records, 42 CFR, Part 2, and the Health Insurance Portability and Accountability Act of 1996 ('HIPAA'), 45 CFR. pts 160 & 164. Disclosure of any PHI is provided via written consent for a period of 1 year, per the ROI signed by the patient at the time of telemedicine-based buprenorphine referral. All equipment was registered to the Psychiatry video expressways for HIPPA compliant 128-bit AES security and easier dialing.

Urine Drug Screens

All individuals are tested at one time for drugs (and if female, for pregnancy) on the day of intake into the jail. Analytes measured provide screening for recent use of the following substances: oxycodone, morphine, fentanyl, propoxyphene, amphetamine, methamphetamine, cocaine, 5-methylenedioxymethamphetamine [MDMA], benzodiazepine, methadone, cannabis, barbiturates, PCP, tricyclic antidepressants, and buprenorphine.

Statistical Analysis

Frequencies and proportions are reported for discrete variables and means and standard deviations are reported for continuous data. Statistical analyses were conducted using SPSS v.26.

RESULTS

Patient Baseline Characteristics

A total of seven incarcerated patients with OUD were offered the opportunity to enroll into the telemedicine-based buprenorphine program from December 15, 2020 to February 15, 2021, and all seven patients accepted and consented to treatment. Baseline characteristics are described in **Table 1**; briefly, the treated

TABLE 1 | Characteristics of incarcerated patients (*N* = 7, unless otherwise noted).

Patient characteristics	***n* (%)[a]**
Age [mean (SD)]	33.4 (8.3)
Sex	
Male	5 (71)
Female	2 (29)
Race	
White/Caucasian	6 (86)
Black/African-American	1 (14)
Hispanic/Latin-X Ethnicity	0
Married or significant other (*n* = 6)	2 (29)
Self-reported co-morbid mental health condition (*n* = 6)[b]	
Depression	3 (43)
Anxiety	2 (29)
Other[c]	3 (43)
No other co-occurring	3 (43)
Family history of substance Use (*n* = 6)	4 (57)
Reasons for incarceration	
Assault	2 (29)
Probation violation	3 (43)
DUI/DWI	1 (14)
Driving on suspended license	1 (14)
Convicted of charge	4 (57)
Length of Stay [Mean (SD)]	33 (18)
Years of opioid use [Mean (SD); *n* = 6]	8.4 (3.7)
Route of opioid administration (*n* = 6)	
Insufflation (Intranasal; IN)	3 (43)
Intravenous (IV)	2 (29)
IN and IV	1 (14)
Urine toxicology positive screening	
Opioids[d]	4 (57)
Psychostimulants[e]	2 (29)
THC	3 (43)
Tricyclic Antidepressants	1 (14)
Methadone[f]	3 (43)
Buprenorphine[g]	2 (29)
Days incarcerated prior to first tMOUD encounter [Mean (SD)]	9 (11)
Buprenorphine dose [Median (Range)]	
Induction	8 mg (4–20 mg)
One-week[h]	12 mg (8–16 mg)
Final[i]	16 mg (8–24 mg)
Number of days in tMOUD treatment [Mean (SD)]	21 (9.5)
Discharge outcomes	
Linkage to treatment in the community	3 (43)
Transferred to higher level of care	2 (28.5)
Lost to follow-up	2 (28.5)

[a]*Percentages reported on a total n of 7; percentages not adding to 100% represent missing data.*
[b]*Not mutually exclusive.*
[c]*Other co-occurring diagnoses include bipolar (n = 1), obsessive compulsive (n = 1), panic disorder (n = 1), and ADHD (n = 1).*
[d]*Positive screens included fentanyl (n = 4) and oxycodone (n = 1).*
[e]*Positive screens included amphetamine (n = 1), cocaine (n = 1), and methamphetamine (n = 1).*
[f]*Two patients were verified to have received prescribed methadone from a hospital or other area jail prior to intake.*
[g]*Both patients transferred into care from community buprenorphine treatment programs.*
[h]*One week discharge dose data is not provided for one patient (patient 006 voluntarily withdrew from treatment prior to discharge).*
[i]*Final discharge dose data are not provided for two patients due (patient 004 requested a buprenorphine taper prior to discharge, and patient 006 voluntarily withdrew from treatment prior to discharge; see Discussion for further details).*

population was majority male (71%) and White/Caucasian (86%) with an average age of 33 years old. Reasons for incarceration varied, but the most common booking charge was violation of probation (43%). Average length of stay was 33 days (range = 21–71 days). All subjects self-reported a history of opioid use, with an average of 8.4 years of use. Insufflation was the most commonly reported route of administration (43%).

Urine Toxicology Screening Results

All patients tested positive for at least one substance on the urine drug screen panel, with fentanyl being the most common substance for which patients tested positive (57%). Other positives screens included oxycodone ($n = 1$), amphetamine ($n = 1$), cocaine ($n = 1$), tetrahydrocannabinol (THC, $n = 3$) tricyclic antidepressants ($n = 1$), methadone ($n = 3$), and buprenorphine ($n = 2$).

Buprenorphine Treatment Within the Detention Center

The average number of days that lapsed between jail intake and the initial telemedicine-based buprenorphine encounter with our treatment team was 9 (range = 2–34). All seven patients were prescribed buprenorphine in the jail setting; five patients began a new treatment course, and two patients transferred from buprenorphine treatment in the community to continue treatment within the detention center. The median prescribed dose of buprenorphine on day 1 (induction) was 8 mg. Initial doses of buprenorphine for the five new treatment initiates were 4 mg ($n = 1$) and 8 mg ($n = 4$), and 16 and 20 mg for the two patients transferring from community treatment. The median 1-week post-initiation dose was 12 mg ($N = 6$; range = 8–16). Some patients ($n = 2$) discontinued buprenorphine treatment while incarcerated. Thus, the median final dose (prior to treatment discontinuation or discharge) for the 5 patients was 16 mg (range = 8–24). Except for one patient who had an existing buprenorphine prescription prior to incarceration and refused treatment after the third day of telemedicine-based buprenorphine treatment (patient 006), all patients were retained in treatment within the jail for at least 2 weeks prior to discharge. It is noteworthy that this same patient (006) who refused buprenorphine treatment also refused food or any type of jail-based treatment that was afforded (which included intensive outpatient psychiatric treatment). All patients remained in treatment for an average of 21 days (range = 3–35) and had a median number of 3 telemedicine-based buprenorphine encounters (range = 1–4). One patient (patient 004) had an unscheduled bail review ∼2 weeks after beginning treatment. Due to COVID, the court allowed this patient to be released to an inpatient treatment facility, but the facility's house rules did not accept patients who were receiving methadone or buprenorphine. Further, the facility allowed this patient to receive a naltrexone injection prior to his release from jail; thus, this patient was tapered off buprenorphine for 7 days and was prescribed a single dose of naltrexone 1 week later.

Treatment Upon Discharge

Treatment upon discharge outcomes varied for patients, and were dependent on several factors, including patient willingness to continue treatment in the community and court-ordered mandates surrounding release. Of the seven patients enrolled in the telemedicine-based buprenorphine program, three scheduled an appointment linking them to treatment in the community. These referred patients were provided bridge prescriptions to their preferred pharmacy location to enable continuation of medication in the community following discharge. Two patients were transferred to a higher level of care (inpatient treatment for their substance use disorder), and two patients were discharged and lost to follow-up. Of the two patients with existing buprenorphine prescriptions, one refused treatment while incarcerated and one scheduled an appointment at their previous treatment center located within the community.

DISCUSSION

The extremely high morbidity and mortality associated with overdose upon discharge from incarceration has been underscored in multiple reports across a variety of carceral settings and geographic locations (11–13, 25–29). With meta-analysis findings that the first 2 weeks of discharge carry a three- to 8-fold increased risk of drug-related death (11), it is not possible to overstate the urgent need for interventions that reach individuals prior to their release from jails and prisons. The positive data showing improved outcomes when pharmacotherapies are introduced is unwavering (30): MOUD provision from within correctional facilities prevents overdose upon release (31). Recognizing the need for treatment services for this vulnerable sub-population, in 2019 the state of Maryland passed legislation mandating that all state and local correctional facilities make all three FDA-approved medications for opioid use disorder (methadone, buprenorphine and naltrexone) available by 2023 (HB-116) (32). Although these moves to increase MOUD institutional access are encouraging, this standard of care for OUD is minimally available in Maryland jails, and even less so for jails in vulnerable rural areas (16). Telemedicine offers a viable solution for rural jail MOUD access across the U.S.—particularly in light of the global pandemic.

Our group has initiated several novel telemedicine-based buprenorphine programs since 2015, partnering with addiction behavioral treatment facilities and health departments in rural areas throughout the state of Maryland (22, 33, 34). The goal of these various programs is to fill an important addiction treatment gap in areas hard-hit by the opioid epidemic. At each of these remote sites, the program virtually connects OUD-diagnosed individuals with addiction medicine-trained physicians capable of providing comprehensive evaluations and treatment with buprenorphine. The outcomes from these various telemedicine-based buprenorphine programs are extremely encouraging and demonstrate a clinical benefit, with results comparable to those reported by direct (face-to-face) treatment. Chart reviews of buprenorphine-treated patients enrolled in our telemedicine-based buprenorphine programs demonstrate a 50–60% 3-month retention rate, with only 6–7 of those individuals testing positive for continues opioid use (22, 33, 34). The current initiative to provide treatment from within a detention center located in one of the areas where we have traction represents an important outgrowth of existing programs to reach at-risk incarcerated patients before they are released into the community. Our primary goal in instituting this program is to ensure the availability of medications for OUD pre-release to mitigate overdose risk upon discharge. However, treatment in jail offers several important patient-centered benefits, including the prevention of withdrawal and patient stabilization—factors that increase the individual's chances of beginning the recovery process to benefit from the non-medication treatments that are offered by the jail.

We were able to successfully implement a novel clinical MOUD program in a rural jail that, prior to our program's initiation, was not able to offer medications for OUD to the general census of incarcerated individuals. We established the initial groundwork and logistics and have created a mechanism to offer treatment to newly incarcerated individuals who need it. Initial outcomes from this initiative are favorable, with a 100% acceptance rate: all seven individuals who were offered treatment chose to receive it. With the exception of one patient who refused treatment after 3 days of buprenorphine treatment, the majority of individuals were maintained within our care while incarcerated and were either retained in buprenorphine treatment for the duration of their incarceration ($n = 5$) or were tapered and transitioned to naltrexone at the patient's request ($n = 1$).

COVID-19 Considerations

Slated to begin in the first quarter of 2020, implementation of our telemedicine-based buprenorphine in jail program co-occurred with the emergence of the COVID-19 public health emergency. In response to the pandemic, federal regulations surrounding OUD treatment were eased to allow for the use of telehealth-based platforms (both video and phone) for clinical encounters. These included changes to Medicare/Medicaid allowances, loosened requirements for in-person initiation of buprenorphine, and the easing of restrictions of non-HIPAA-compliant communication platforms (35). The pandemic precluded several planned activities of the program, including in-person visits to the jail, the hiring of on-site staff, and the installation of standard DX-80 telemedicine equipment. Despite these forced alterations, our team was able to implement nimble solutions: meetings with jail and medical staff were held *via* Zoom, responsibilities were distributed among existing team members, and temporary "plug-in and go" telemedicine infrastructure was delivered to the jail. Although we will resume the full range of planned program development once the crisis has passed, it is unclear whether and to what degree the standing emergency OUD telemedicine regulations on the prescribing of controlled substances will return to pre-COVID standards. We and others have argued for the continuation of the relaxed federal policies surrounding MOUD treatment (36–38). Although COVID-19 vaccines are now publicly available as a solution for the global pandemic, the possibility exists that it may take months to years to achieve the vaccination coverage necessary for everyone to be protected (39). Thus, MOUD treatment that employs infection risk mitigation strategies, which include the provision of telemedicine, are indispensable for the foreseeable future.

Throughout the pandemic, efforts have been made at the county and state level to keep individuals out of high-risk environments such as jails and prisons. Thus, the local court system reduced restrictions on criteria for bail, and significantly decreased the number of individuals housed in the detention center. This had a direct impact on our ability to engage and recruit larger numbers of patients into the telemedicine-based buprenorphine program.

Challenges

Beyond those incurred by COVID-19, our team experienced several challenges in the initiation of a telemedicine-based buprenorphine program in a rural Maryland jail. One challenge was in the appreciation of the multiple hierarchical authorities governing jail programs (Detention Center Directorship, Medical Staff Directorship, and local Health Department leadership) as well as the required logistics of obtaining approval for implementation (for example, a requisite memorandum of understanding with pass-through authorizations). Although our team achieved a nuanced understanding throughout the process of implementing our program, information regarding the necessary authorizations and requirements would have streamlined program development.

An ongoing challenge surrounds the unpredictability of individuals' entry and length of stay in the detention center. Our team benefited from a close collaboration with the intake medical staff to anticipate new intakes into the jail. Frequently, however, the outcomes of scheduled bail hearings would change determinations of a given patient's length of stay, which would have major implications for ongoing treatment. Early on, our team realized it was important to receive information from the patients themselves regarding their schedules to appear before the court. As an example of how this uncertainty impacted treatment in the detention center (also mentioned above), one individual initiated buprenorphine treatment while incarcerated. After having a bail-review hearing, this patient decided to take the judge's offer to enter an inpatient facility in lieu of incarceration. Unfortunately, however, this inpatient facility did not accept individuals who were prescribed buprenorphine. With only 1 week until release, the inpatient house rule prohibiting opioid agonist treatment forced the patient to titrate off buprenorphine rather quickly, and to receive a naltrexone injection at the time of release from the detention center—an unfortunate situation that could have been avoided with knowledge of the patient's impending early release.

Another challenge was in the shortage of staffing within the detention center. This limited the capacity of medical staff to provide MOUD care and consequently, limited the number of patients who were able to be referred to telemedicine-based buprenorphine treatment. Additionally, a lack of providers within the community limited the availability of provider options for those released after initiating MOUD care within the detention center. Lastly, providing MOUD care was new to the detention center, requiring the development and refinement of referral, screening, and post release care coordination processes.

LIMITATIONS

One major limitation to this study is the small sample size, limiting the generalizability of our findings. Additionally, we anticipate that implementation will be different from one detention center to another; thus, methods described here that have worked at the Talbot County Detention Center may not be applicable at other sites.

CONCLUSIONS

The ongoing opioid crisis continues to increase demand for addiction medicine provision, particularly in rural areas. Jails represent a unique access point to engage patients, but access to experienced addiction medicine providers is limited. Telemedicine closes this gap. Our successful pilot implementation of jail-based telemedicine-based buprenorphine treatment, with engagement and initiation occurring proximal to jail intake, is an encouraging demonstration of feasibility. The fact that this program was launched during the height of the pandemic highlights the flexibility and sustainability of telemedicine-based buprenorphine.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Maryland, Baltimore Human Research Protections Office. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

AB: conceptualization, writing—original draft, funding acquisition (FORE), investigation (Chart Review), and formal analysis. EW: conceptualization, methodology, investigation (Patient Encounters), writing—reviewing and editing, funding acquisition (FORE), and supervision. KC: funding acquisition (MD Dept. Health), project administration, supervision, and writing—reviewing and editing. TC: data curation, project administration, investigation (Chart Review), visualization, and writing—reviewing and editing. CW: methodology, investigation (Patient Encounters), and writing—reviewing and editing. AW: visualization and writing—reviewing and editing. All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by the Foundation for Opioid Response Efforts (FORE; EW, AB). Medication was subsidized with funds from the Talbot County Health Department (Maryland Department of Health, Talbot Local Addictions Authority). These funding sources had no role in the design of this study and did not have any role during its execution, analyses, interpretation of the data, or decision to submit results.

ACKNOWLEDGMENTS

We would like to thank and acknowledge the following individuals for critical project support, as well as help and guidance with implementation: the staff and employees of the Talbot Detention Center and WellPath: Director Terry Kokolis, Deputy Director Christina Tyler, Erin Smith, Stephanie Ruckman, Michelle Autrey; from the Talbot County Health Department: Sarah Cloxton; the IT Team at the UMSOM Department of Psychiatry: David Flax and Andre Jackson. Finally, the authors thank and acknowledge the patient-participants of this ongoing clinical treatment program.

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frontiers in Psychiatry

ORIGINAL RESEARCH
published: 11 November 2021
doi: 10.3389/fpsyt.2021.689634

Changes in Cannabis Consumption During the Global COVID-19 Lockdown: The International COVISTRESS Study

Juliette Salles[1]*, Antoine Yrondi[2], Fouad Marhar[3], Nicolas Andant[4], Raimundo Avilés Dorlhiac[5], Binh Quach[6], Jiao Jiao[6], Samuel Antunes[7], Ukadike Chris Ugbolue[8], Julien Guegan[9], Karine Rouffiac[10], Bruno Pereira[4], The COVISTRESS Network[†], Maëlys Clinchamps[11] and Frederic Dutheil[11]

[1] University Hospital of Toulouse, CHU Toulouse, Department of Psychiatry, Infinity (Toulouse Institute for Infectious and Inflammatory Diseases), INSERM UMR1291, CNRS UMR5051, Université Toulouse III, Toulouse, France, [2] University Hospital of Toulouse, CHU Toulouse, Department of Psychiatry, Inserm Toulouse NeuroImaging Center, ToNIC, Toulouse, France, [3] Université Clermont Auvergne, CNRS, LaPSCo, Physiological and Psychosocial Stress F-63000 Clermont-Ferrand, France University Hospital of Toulouse, Department of Anaesthesiology and Critical Care, Toulouse, France, [4] University Hospital of Clermont-Ferrand, CHU Clermont-Ferrand, DRCI, Biostatistics Unit, Clermont-Ferrand, France, [5] Universidad Finis-Terrae, El-Carmen, Hospital Dr. Luis-Valentìn-Ferrada, Obstetrics and Gynecology, Maipù, Chile, [6] Sport and Physical Education, Hong Kong Baptist University, Hong Kong, Hong Kong SAR, China, [7] Ordem dos Psicólogos Portugueses, ISPA-Instituto Universitário, Lisbon, Portugal, [8] University of the West of Scotland, Institute for Clinical Exercise & Health Science, School of Health and Life Sciences, Glasgow, United Kingdom, [9] Université Clermont Auvergne, CNRS, LaPSCo, Catech, Clermont-Ferrand, France, [10] University Hospital of Clermont-Ferrand, CHU Clermont-Ferrand, Preventive and Occupational Medicine, Clermont-Ferrand, France, [11] Université Clermont Auvergne, CNRS, LaPSCo, Physiological and Psychosocial Stress, University Hospital of Clermont-Ferrand, CHU Clermont-Ferrand, Preventive and Occupational Medicine, WittyFit, Clermont-Ferrand, France

OPEN ACCESS

Edited by:
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University of Porto, Portugal

Reviewed by:
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United States

***Correspondence:**
Juliette Salles
juliette.salles@hotmail.fr

[†] The COVISTRESS network is headed by Prof. Frédéric Dutheil—CHU Clermont-Ferrand, Occupational and Environmental Medicine, Clermont-Ferrand, France

Specialty section:
This article was submitted to Addictive Disorders, a section of the journal Frontiers in Psychiatry

Received: 01 April 2021
Accepted: 18 October 2021
Published: 11 November 2021

Citation:
Salles J, Yrondi A, Marhar F, Andant N, Dorlhiac RA, Quach B, Jiao J, Antunes S, Ugbolue UC, Guegan J, Rouffiac K, Pereira B, The COVISTRESS Network, Clinchamps M and Dutheil F (2021) Changes in Cannabis Consumption During the Global COVID-19 Lockdown: The International COVISTRESS Study. Front. Psychiatry 12:689634. doi: 10.3389/fpsyt.2021.689634

Introduction: COVID-19 lockdown measures have been sources of both potential stress and possible psychological and addiction complications. A lack of activity and isolation during lockdown are among the factors thought to be behind the growth in the use of psychoactive substances and worsening addictive behaviors. Previous studies on the pandemic have attested to an increase in alcohol consumption during lockdowns. Likewise, data suggest there has also been a rise in the use of cannabis, although it is unclear how this is affected by external factors. Our study used quantitative data collected from an international population to evaluate changes in cannabis consumption during the lockdown period between March and October, 2020. We also compared users and non-users of the drug in relation to: (1) socio-demographic differences, (2) emotional experiences, and (3) the information available and the degree of approval of lockdown measures.

Methods: An online self-report questionnaire concerning the lockdown was widely disseminated around the globe. Data was collected on sociodemographics and how the rules imposed had influenced the use of cannabis and concerns about health, the economic impact of the measures and the approach taken by government(s).

Results: One hundred eighty two respondents consumed cannabis before the lockdown vs. 199 thereafter. The mean cannabis consumption fell from 13 joints per week pre-lockdown to 9.75 after it ($p < 0.001$). Forty-nine respondents stopped using cannabis at all and 66 admitted to starting to do so. The cannabis users were: less satisfied with government measures; less worried about their health; more concerned about the impact of COVID-19 on the economy and their career; and more frightened of becoming infected in public areas. The risk factors for cannabis use were: age (OR = 0.96); concern for physical health (OR = 0.98); tobacco (OR = 1.1) and alcohol consumption during lockdown (OR = 1.1); the pre-lockdown anger level (OR = 1.01); and feelings of boredom during the restrictions (OR = 1.1).

Conclusion: In a specific sub-population, the COVID-19 lockdown brought about either an end to the consumption of cannabis or new use of the drug. The main risk factors for cannabis use were: a lower age, co-addictions and high levels of emotions.

Keywords: cannabis (marijuana), COVID-19, addiction, lockdown, tobacco

INTRODUCTION

The COVID-19 pandemic started in the Chinese city of Wuhan in December 2019 and subsequently spread globally (1). Then without a vaccine or any effective treatments, governments worldwide responded by implementing lockdown measures that aimed to limit the spread of the virus by restricting population movement and social contact (2). The introduction and economic consequences of these measures and uncertainty about the course of the epidemic have been sources of stress and social isolation (3).

In many countries, cannabis is one of the psychotropic drugs consumed the most (4), with research into its use linking it to addictive behaviors (5). Taking psychoactive substances (and consequential addictive behaviors) can be a coping mechanism for individuals experiencing stress or negative moods (6), as well as for those who are unable to face difficult situations and, as a result, reduce their social interactions (7–11). Substance use and addictive behaviors may therefore be seen as a remedy for boredom (12, 13) and social isolation (14).

Cannabis can also be used to reduce emotional reactivity. Indeed, its consumption is associated with the activation of cannabinoid receptors that mediate the neural processes underlying emotional regulation and stress responsivity (15). Moreover, the endocannabinoid system also counteracts the neurochemicals involved in the use of other substances, including those playing a part in emotional regulation. The signals of cannabinoid receptors, for example, might counteract the neurochemical imbalance associated with alcohol withdrawal (16).

These factors are all worthy of consideration when examining the impact of COVID-19 lockdowns on cannabis use. Previous studies have provided interesting data and attested to the effects of these lockdowns on use of the drug, with some of them [e.g., Rolland et al. (17)] reporting an increase in cannabis consumption in lockdown periods. Unfortunately, however, that study was only conducted among a French population and does not analyze changes in consumption levels. In Belgium, meanwhile, Vanderbruggen et al. (11) found no statistically significant differences between the number of joints smoked per day before and during lockdown. Nevertheless, the value of this study is limited by its recruitment of a higher than ideal proportion of educated women and the overrepresentation of healthcare workers. Conversely, a study by Cousijn et al. (18) described an increase in lockdown cannabis use, but only involved a Dutch population. Finally, a survey by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) found that occasional users had either stopped, or at least reduced, their consumption of the drug during lockdown. The levels of consumption by heavy users had, however, increased, with the drug employed to relieve anxiety and boredom (19). Nevertheless, this research mainly involved young respondents, with an average age of 29-years, while participants from Estonia, Spain, Italy and Finland accounted for 50% of the study's population, the majority of which was male (19).

Emotions play a critical role in the use of substances. Indeed, impairments in the regulation of emotion contribute to the development and severity of substance use disorders (SUDs) (and addictive behaviors), and are also associated with neurobiological damage consisting of increased amygdala and insula activation (20) and a weakening of the capacity to recognize emotions (alexithymia) (21, 22). Moreover, substances can be used to regulate emotion. Animal models, for example, have suggested that a moderate intake of alcohol reduces emotionality and facilitates adaptive responses and problem solving (23, 24).

The COVID-19 pandemic induced emotional states that led to people becoming less happy and more anxious, fearful, and angry (25). In addition, studies have reported an increase in alcohol consumption during lockdowns (26, 27), which may be consistent with the theory that substances are used to regulate emotions. Consequently, it could be hypothesized that the changes induced by lockdown measures may have affected the population's use of drugs, with those suffering from an SUD and/or behavioral addictions particularly vulnerable (28) due to the increase in the consequences of, and behavior caused by, consumption (e.g., alcohol could impact emotional and behavioral reactivity) (23, 24).

Despite their interesting results, the aforementioned studies (11, 17–19) provide limited data on the association between emotional changes and cannabis consumption, in particular on the role played by these emotions in the use of substances. In order to remedy this, our research uses quantitative data collected from a population recruited internationally to evaluate changes in the consumption of cannabis during lockdown. It also compares users and non-users of the drug in relation to: (1) sociodemographic differences; (2) emotional experiences; and (3) the information available on and degree of approval of measures introduced during the lockdown period between March and October, 2020.

METHOD

Study Design

We conducted an international, prospective, observational study of a general population in the period March to October, 2020 (hereafter: the lockdown). A computerized, anonymous questionnaire, translated into ten languages, was used for this purpose. The main academic partners in this research form "The COVISTRESS network" and are named at the start of the paper. This list of contributors to the project is regularly updated on the website https://covistress.org/contacts.html and currently comprises 21 main partner-countries and 70 researchers, across five continents. The questionnaire that forms the basis of the study was distributed electronically to facilitate its dissemination. The research has been given the required ethics approval and is registered on ClinicalTrials.gov (NCT04538586) (3, 29).

Inclusion Criteria

The international COVISTRESS network was used to distribute the questionnaire to respondents from the general population, with no country, gender, occupation or disease distinctions made.

Outcomes

We evaluated the consumption of cannabis before and after the introduction of lockdown measures. The primary outcome, i.e., cannabis consumption, was measured based on the number of joints smoked per week. To this end, we asked a single question [how many "joints" (of cannabis) do you smoke per week?] twice (before the pandemic/during the first lockdown).

The secondary outcomes were: sociodemographics (age, sex, level of education, country of origin); alcohol consumption, based on the number of drinks per week; tobacco consumption, i.e., the number of cigarettes smoked a day; worries (about health, the impact of COVID-19 on the economy and the healthcare system); the information available to the respondents and the degree of approval of the measures introduced during the lockdown (distrust of government restrictions or level of confidence); and emotions (peaceful and angry, sad and happy, calm and excited, busy and bored). Sociodemographic data were obtained via multiple-choice questions. Worries and emotions (as above) were retrieved using visual analogue scales (VASs), i.e., a non-calibrated horizontal line ranging from a minimum (0) to a maximum (100) (30–32).

Statistical Analyses

The analyses of the quantitative data were conducted using the means and standard deviations or the median and the interquartiles based on the distribution of the responses to the questionnaire. Parametric tests (T-test) were employed to perform the comparative analyses. The qualitative variables were examined with the Chi-squared test. The significance threshold was set at $p < 0.05$. Pearson correlations were used to measure the associations between the variables. The links between cannabis consumption during the lockdown period and the variables employed in the questionnaire were evaluated using multinomial logistic regression. The responses determined by the comparative analyses to be significantly different between the cannabis users and non-users were then introduced into the model (33). The sociodemographic variables (gender, age, sociodemographic status, level of education, country of origin) were integrated in the analysis as confounding factors. The statistical significance threshold was set at $p < 0.05$. The analyses were carried out with the Jamovi statistical program, version 1.2 (the Jamovi project, 2020) and the R studio software package, version 3.6 (34).

RESULTS

Sociodemographic Data

A total of 7,084 people answered the survey questions and were included in the study (**Figure 1**). Of these respondents, 4,875 (69%) were female and 2,209 (31%) male. The mean ± standard deviation (SD) age was 42.3 ± 13.3 years. The participants lived in 57 countries (6,572 in Europe, 218 in Asia, 167 in America, 57 in Africa, four in Oceania and 65 non-specified). In terms of education: 667 (9%) were educated to a level below a bachelor's degree; 907 (13%) had the equivalent of such a degree; 2,645 (37%) had a license degree; 1,958 (28%) had a master's degree; and 907 (13%) were educated above this level.

Cannabis Consumption

Prior to and during the lockdown, 182 (2.5%) and 199 (2.8%) respondents, respectively, were cannabis users. Men comprised 52% of the pre-lockdown consumers of the drug. The mean ± SD age of the cannabis-using respondents was 35 ± 12.3 years and they had an educational level of 3.9 years (± 1.1). The mean number of joints smoked per week prior to the lockdown was 13 ± 4.1 (median = 13) vs. 9.75 ± 7.1 (median = 13) during it. This difference was significant ($p < 0.001$). The differential between the number of cannabis users before and after the lockdown is due to 49 respondents who ended their cannabis consumption and 66 non-users who started to consume it. The details of the cannabis use of each group, including their levels of consumption of tobacco and alcohol, are set out in **Table 1**.

The mean cannabis consumption before the lockdown was 12.8 joints per week ± 4.0 (median = 13) for the male respondents and 13.3 ± 4.1 (median = 13) for the female ($p = 0.21$). These amounts during the lockdown were 9.5 joints per week ± 7.0 (median = 8) for the men and 10 ± 4.1 (median = 10) for the women ($p = 0.13$). **Figure 2** shows the changes in consumption of each group and the effects these changes had on the male and female participants.

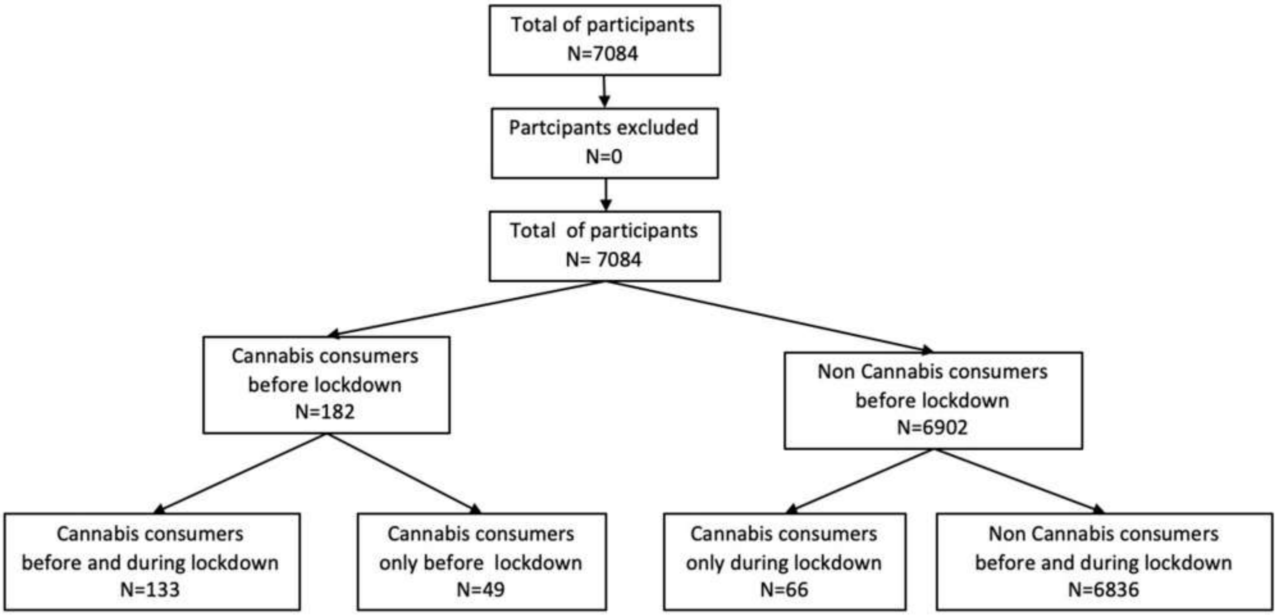

FIGURE 1 | Flow chart on the recruitment of participants.

Comparison of Cannabis Users and Non-users During the Lockdown

The lockdown cannabis users ($n = 199$) were 37.6 years old ± 13.1 vs. 42.6 ± 13.3 years for the non-users ($p < 0.001$). The former were: less satisfied with their government's restrictions ($p < 0.05$); less concerned about their health ($p = 0.03$); more concerned about the impact of COVID-19 on the economy ($p < 0.05$) and their career ($p < 0.05$); and more worried about catching the disease in public areas ($p = 0.04$). Pre-lockdown, the cannabis users consumed, on average, more alcohol (9.6 glasses per week ± 5.5) than the non-users (7.5 glasses per week ± 6.2) ($p < 0.001$). This pattern continued during the lockdown, with the cannabis users drinking more than the non-users: 9.7 units per week ± 5.5 vs. 7.0 ± 6.2. This difference is significant ($p < 0.001$). Similarly, in the pre-lockdown period, the cannabis users consumed, on average, more tobacco than the non-users—6.5 cigarettes per day ± 6.1 vs. 2.3 per day ± 5.3 ($p < 0.001$), respectively. This continued during the lockdown, with the cannabis users smoking 7.2 cigarettes per day ± 6.9 and the non-users 2.3 per day ± 5.4. This difference is also significant ($p < 0.001$). Boredom levels were higher in the cannabis-user group both before and during the lockdown: 21.1 ± 22.3 vs. 19.1 ± 19.2 ($p < 0.001$), respectively; these figures for the non-users were 51.2 ± 30.7 vs. 40.4 ± 30.6 ($p < 0.001$). The study's other parameters did not reveal any further differences between the groups, as reported in **Table 1**.

Multivariate Analysis

The factors that had a significant association with cannabis consumption during the lockdown were: age (OR = 0.96, 95% CI: 0.95–0.98, $p < 0.001$); concern for physical health (OR = 0.98, 95% CI: 0.97–0.99, $p = 0.004$); tobacco consumption during the lockdown (OR = 1.10, 95% CI: 1.07–1.20, $p < 0.001$); alcohol consumption in the lockdown (OR = 1.06, 95% CI: 1.03–1.09, $p = 0.003$); the level of anger pre-lockdown (OR = 1.01, 95% CI: 1.001–1.017, $p = 0.03$); and feeling bored during the lockdown (OR = 1.10, 95% CI: 1.06–1.14, $p = 0.02$) (**Figure 3**).

The factors significantly associated with ending the consumption of cannabis were: smoking tobacco pre-lockdown (OR = 1.1, 95% CI: 1.01–1.14, $p = 0.01$) and concern about the economic impact of the crisis (OR = 0.98, 95% CI: 0.96–0.99, $p = 0.01$). The elements linked to new cannabis use were: consuming alcohol before the lockdown (OR = 1.05, 95% CI: 1.009–1.09, $p = 0.01$) and feeling bored during it (OR = 1.01, 95% CI: 1.003–1.02, $p = 0.006$). Concern for health was negatively associated with starting to consume the drug (OR = 0.98, 95% CI: 0.97–0.99, $p = 0.005$).

DISCUSSION

Our study aimed to document the impact of the COVID-19 lockdown measures in force from March to October 2020 on cannabis consumption in an international population. The study's results revealed that 2.5–2.8% of the respondents were cannabis users, which is consistent with such data globally (35). The factor most associated with cannabis use during the lockdown period was the consumption of other substances (tobacco and/or alcohol). The cannabis users were also younger in age, less concerned about their health, experienced more angry feelings pre-lockdown and were more bored during it.

The results also revealed that the cannabis-using group had greater distrust of government-imposed measures. A link between the degree of suspicion of politics and cannabis

TABLE 1 | Presentation of the data for the overall group and the subgroups of cannabis users and non-users; *n* (%): number of individuals (percentage) or mean ± standard-deviation.

	Cannabis users					Non-users before and during lockdown	Users vs. non-users during lockdown
	Before lockdown	Only before lockdown	During lockdown (*n* = 199)				
			Before & during lockdown	Only during lockdown	Total		
	***n* = 182**	***n* = 49**	***n* = 133**	***n* = 66**	***n* = 199**	***n* = 6,836**	***P*-value**
Gender, *n* male (%)	95 (52%)	25 (52%)	69 (52%)	46 (70%)	115 (61%)	6,836 (69%)	0.61
Age in years	35 ± 12.3	33.8 ± 11.5	35.5 ± 12.6	39.7 ± 13.5	37.6 ± 13.1	42.6 ± 13.3	**<0.001***
Level of education, year postgraduate?	3.9 ± 1.1	3.8 ± 1.2	4 ± 1.1	4.3 ± 1.2	4.15 ± 1.1	4.2 ± 1.2	0.29
Worries about health, VAS (0 to 100)	48.2 ± 30.7	48.6 ± 29.4	48.1 ± 31.3	44.7 ± 33.6	46.4 ± 32.4	54.1 ± 30.4	0.03*
Stress of covid, VAS (0 to 100)	55.5 ± 31.2	55.4 ± 30.9	55.6 ± 31.4	57.8 ± 30	56.7 ± 30.7	57.7 ± 29.9	0.53
Fatigue, VAS (0 to 100)	53.4 ± 31.4	55.0 ± 31.6	52.8 ± 31.5	55.0 ± 32.2	53.9 ± 31.9	51.0 ± 31.8	0.31
Anxiety-fear, VAS (0–100)	53.3 ± 30.9	58 ± 32.4	51.5 ± 30.3	52.4 ± 30.4	51.95 ± 30.4	50.9 ± 30.6	0.79
Good mood, VAS (0–100)	48 ± 29.4	44.3 ± 31.7	49.4 ± 28.5	50.7 ± 31.2	50.05 ± 29.9	53.1 ± 27	0.12
Worries about economic impact, VAS (0–100)	75.0 ± 26	68.9 ± 33.3	77.2 ± 22.5	78 ± 19.8	77.6 ± 21.2	76.9 ± 22.4	0.71
Worries re impact on healthcare system, VAS (0–100)	72.2 ± 27	76.1 ± 25.8	70.7 ± 27.4	66.8 ± 23.4	68.75 ± 25.4	69.2 ± 25	0.87
Satisfaction with government measures, VAS (0–100)	35.9 ± 30.4	29.1 ± 29.8	38.3 ± 30.4	47.5 ± 32.3	42.9 ± 31.4	47.8 ± 30.5	**0.005***
Satisfaction with measures for businesses, VAS (0–100)	65.0 ± 31.1	65.5 ± 27.9	64.9 ± 32.4	66.2 ± 32.9	65.55 ± 32.7	66.2 ± 29	0.13
Smoking, *n* cigarettes/day							
Before lockdown	9.2 ± 6.4	10.9 ± 6.4	8.6 ± 6.3	4.3 ± 5.8	6.5 ± 6.1	2.3 ± 5.3	**<0.001***
During lockdown	9.6 ± 7.1	11.3 ± 7.2	9.0 ± 7.0	5.4 ± 6.8	7.2 ± 6.9	2.3 ± 5.4	**<0.001***
Alcohol, *n* units/week							
Before lockdown	9.3 ± 5.9	8.2 ± 6.4	9.7 ± 5.7	9.4 ± 5.3	9.6 ± 5.5	7.5 ± 6.2	**<0.001***
During lockdown	8.9 ± 6.3	7.2 ± 6.6	9.5 ± 6.1	9.9 ± 4.9	9.7 ± 5.5	7.0 ± 6.2	**<0.001***
Cannabis, *n* of joints/week							
Before lockdown	13.0 ± 4.1	13.2 ± 3.9	13.0 ± 4.1	0.0 ± 0.0	13 ± 2.1	0.0 ± 0.0	**<0.001***
During lockdown	9.7 ± 7.1	0.0 ± 0.0	13.3 ± 4.7	12 ± 2.2	12.7 ± 3.5	0.0 ± 0.0	**<0.001***
Peaceful/angry, VAS from peaceful (0) to angry (100)							
Before lockdown	42.6 ± 25	41.1 ± 24.1	43.1 ± 25.4	43.1 ± 23.7	43.1 ± 24.5	37.9 ± 22.7	**0.02***
During lockdown	60.2 ± 27.1	64.8 ± 24.6	58.5 ± 27.9	58.4 ± 25.0	58.5 ± 26.4	54.5 ± 25.5	0.09
Sad-happy, VAS from sad (0) to happy (100)							
Before lockdown	65.7 ± 23.4	63.3 ± 24.9	66.5 ± 22.9	64.8 ± 19.8	65.7 ± 21.35	68.6 ± 21.0	**0.03***
During lockdown	42.3 ± 26.2	35.8 ± 26.8	44.6 ± 25.6	47.1 ± 24.1	45.9 ± 24.9	47.1 ± 24.8	0.41
Calm-excited, VAS from calm (0) to excited (100)							
Before lockdown	48.0 ± 27.8	51.5 ± 26.1	46.7 ± 28.3	55.6 ± 22	51.2 ± 25.2	43.5 ± 25.0	**0.03***
During lockdown	49.3 ± 27.4	52.1 ± 28.1	48.4 ± 27.2	51.1 ± 26.3	49.8 ± 26.8	46.7 ± 24.8	0.24
Busy-bored, VAS from busy (0) to bored (100)							
Before lockdown	22.3 ± 22.5	24.9 ± 24.1	21.3 ± 21.9	20.8 ± 22.6	21.1 ± 22.3	19.1 ± 19.2	**<0.001***
During lockdown	51.3 ± 31.2	55.7 ± 28	49.6 ± 30.9	52.9 ± 30.4	51.2 ± 30.7	40.4 ± 30.6	**<0.001***

*Bold value indicated the p-value < 0.05. *p < 0.05.*

consumption has already been described in the literature (36). The low level of confidence in this association in our study could be partially explained by the existence of a link between addictive behavior and antisocial-personality traits (37, 38), although we did not collect any data that would enable this hypothesis to be accepted or rejected.

Our cannabis users reported being more worried about the impact of the pandemic on their career and the economy more generally. The association between such a concern and cannabis consumption reinforces the view that occupational physicians have an important role to play in the prevention and management of addictive behavior; indeed, data is already

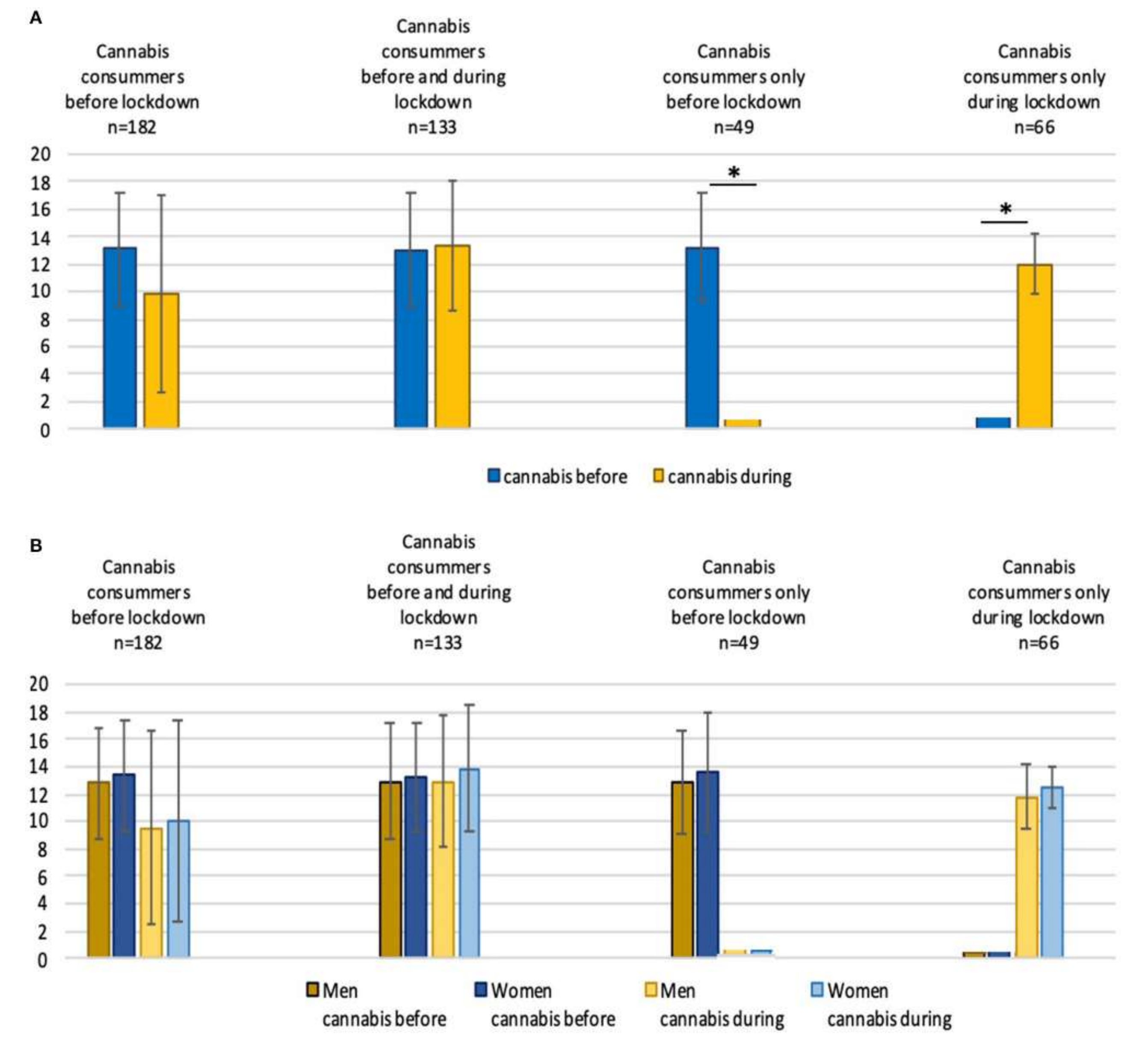

FIGURE 2 | (A) Comparison of the consumption of cannabis before and during the lockdown period in the overall group of cannabis users and the three subgroups. **(B)** Comparison of the consumption of cannabis before and during the lockdown in men and women. The ordinate represents the number of joints consumed per week $^*p < 0.05$.

available on opportunities for motivational management in the workplace (39).

The part played by the environment is important in the development of addictive behaviors, which are defined on the basis of a bio-psychosocial approach (40). The data in the literature reveal a link between social isolation and the risk of developing addictions (41–43). Consequently, in the context of social isolation associated with the lockdown, we expected to see an increase in the amounts of cannabis consumed. In fact, there was a significant reduction in the cannabis-using group. We hypothesized that this could partly be due to less access to the drug, but the reduction was not homogenous, being explained by the actions of a sub-group of 49 individuals who stopped using cannabis at all; meanwhile, the quantities smoked by those who continued to consume the drug remained stable. These outcomes indicate that levels of vulnerability to the effects of lockdown measures differ, with some cannabis consumers having a positive experience. Moreover, the lockdown measures may have affected the availability of cannabis; indeed, social distancing might reasonably be expected to disrupt established methods for supplying and distributing the drug. Nonetheless, some of our users moved to online purchasing (44), while others may not have

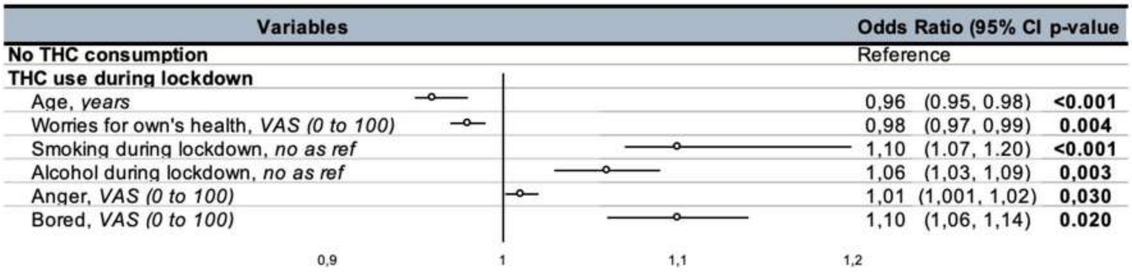

FIGURE 3 | Results of the regression analysis of the use of cannabis during the lockdown. VAS, visual analogue scale.

respected the restrictions as intended. This is, however, only a hypothesis, and its premises could be differentially explained by underlying factors like a change in income levels and/or the use of other/stronger drugs. Differences in the lockdown legislation in force in the countries where the respondents live may also be a factor. Indeed, the legality of cannabis use in some areas may have limited the effects of the lockdown measures on the availability of the drug.

Other studies have demonstrated that bringing an end to cannabis use can have an effect on the consumption of other substances. Consistent with this, our research identified an increase in alcohol use in particular (45, 46). However, there were no changes in the amounts of alcohol or tobacco consumed by the group that stopped using the drug at all. Tobacco use pre-lockdown was associated with an end to cannabis consumption during it: 47 of our cannabis users (26%) did not consume tobacco before the lockdown, and it was these individuals who were less likely to stop their use of the drug in the relevant period. Concern about the economic impact of the health crisis was also a risk factor for continued cannabis use.

Conversely, a sub-group of 66 respondents started to smoke cannabis during the lockdown, corresponding to 1% of those who did not use the drug before it. Drinking alcohol pre-lockdown and feeling bored during it appeared to be risk factors for this. Boredom certainly seems to be associated with use of the drug, but may not be the only explanation.

Despite these interesting results, our study has some limitations. A major issue relates to our lack of screening for the duration of the lockdown, changes in income (before and after lockdown), and the use of addictive drugs other than tobacco, alcohol and cannabis. These factors may therefore also account for our findings. Specifically, controlling for the lockdown duration (as a covariate of non-interest) is important. In addition, the failure to consider the impact of a reduced income and the use of stronger drugs is an important limitation, as these factors may account for why some in the cannabis-user group stopped using the drug during the lockdown. A further limitation relates to the study's design, namely an online survey, which may induce selection bias. Moreover, the design was used to collect data with which to establish associations, but did not permit the identification of causal links. A "multiple time-point" prospective observational study would be valuable for this purpose. Additionally, the natural turnover between being a cannabis user or not is impossible to assess, and reaching robust conclusions about the effects of the lockdown thus warrants further research. Another limitation concerns the fact that the survey was not validated, although most of the other studies on cannabis use ask a comparable question about consumption (47, 48). Similarly, our questionnaire did not produce data about addictive behavior. Indeed, the quantities of cannabis consumed by our respondents did not support such a diagnosis. It would therefore have been interesting to collect data relating to the DSM-5 criteria (49) in order to better characterize our population. Nevertheless, our survey was addressed to the general population and was intended to produce a wide variety of participants. This meant that decisions had to be made about what questions to include in order to limit the amount of time required to answer them. Quality assurance of the COVISTRESS questionnaire was ensured by the fact that only one questionnaire was submitted per IP address. However, it is possible that the same participant submitted several surveys from different IP addresses. Moreover, the study had a greater proportion of females to males, but, unfortunately, it was not possible to control for this gender imbalance. Finally, all of our reported ORs are very close to 1. Even though the analysis did achieve statistical significance, the clinical impact should be confirmed in future research.

CONCLUSION

Our study reveals changes in cannabis consumption during the COVID-19 lockdowns imposed from March to October, 2020. In particular, it highlights the existence of a specific sub-population for whom the lockdown brought about either the end to or the start of cannabis consumption. The results show that cannabis users can be characterized as having features specific to them in terms of their concerns about public policies and work stress. Acknowledging this could lead to a better provision of information and the use of targeted support.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by National CPP. The patients/participants provided their written informed consent to participate in this study.

THE COVISTRESS NETWORK

The members of the research group are: Nicolas Andant, Maélys Clinchamps, Stéphanie Mestres, Cécile Miele, Valentin Navel, Lénise Parreira, Bruno Pereira, Karine Rouffiac—all from CHU Clermont-Ferrand, France; Yves Boirie, Jean-Baptiste Bouillon-Minois, Martine Duclos, Maria Livia Fantini, Jeannot Schmidt, Stéphanie Tubert-Jeannin—all from Université Clermont Auvergne/CHU Clermont-Ferrand, France; Mickael Berthon, Pierre Chausse, Michael Dambrun, Sylvie Droit-Volet, Julien Guegan, Serge Guimond, Laurie Mondillon, Armelle Nugier, Pascal Huguet—all from Université Clermont Auvergne, CNRS, LAPSCO, France; Samuel Dewavrin—WittyFit, France; Fouad Marhar—CHU Toulouse, France; Geraldine Naughton, Amanda Benson—Swinburne University, Australia; Claus Lamm—University of Vienna, Austria; Karen Gbaglo—Ministery of Health, Benin; Vicky Drapeau—Université de Laval, Canada; Raimundo Avilés Dorlhiac—Universidad Finis Terrae, Chile; Benjamin Bustos—Universidad de Los Andes, Chile; Gu Yaodong—Ningbo University, China; Haifeng Zhang—Hebei Normal University, China; Peter Dieckmann—Copenhagen Academy for Medical Education and Simulation (CAMES), Denmark; Julien Baker, Binh Quach, Jiao Jiao, Yanping Duan, Gemma Gao, Wendy Y J Huang, Ka Lai Kelly Lau, Chun-Qing Zhang—all from Hong Kong Baptist University, China; Hijrah Nasir, Indonesia; Perluigi Cocco, Rosamaria Lecca, Monica Puligheddu, Michela Figorilli—all from Università di Cagliari, Italia; Morteza Charkhabi, Reza Bagheri—University of Isfahan, Iran; Daniela Pfabigan—University of Oslo, Norway; Peter Dieckmann—University of Stavanger, Norway; Samuel Antunes, David Neto, Pedro Almeida—all from Ordem dos Psicólogos Portugueses, ISPA-Instituto Universitário, Portugal; Maria João Gouveia—ISPA-Instituto Universitário, Portugal; Pedro Quinteiro—William James Center for Research, ISPA-Instituto Universitário; Constanta Urzeala—UNEFS, Romania; Benoit Dubuis—UNIGE, Switzerland; Juliette Lemaignen—Fondation INARTIS, Switzerland; Andy Liu—University of Taipei, Taiwan; Foued Saadaoui—King Abdulaziz University, Tunisia; Ukadike Chris Ugbolue—University of the West of Scotland, United Kingdom; Keri Kulik—Indiana University of Pennsylvania, USA; Kuan-chou Chen—National Taiwan University of Sport, Department of Sport Management, Taiwan.

AUTHOR CONTRIBUTIONS

JS and AY performed statistical analysis. JS, AY, FM, and FD wrote the article. NA, RD, BQ, JJ, SA, UU, JG, KR, BP, The COVISTRESS Network, MC, and FD designed the study and recruited the participants. FD coordinated the study. All authors contributed to the article and approved the submitted version.

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frontiers in Public Health

ORIGINAL RESEARCH
published: 03 December 2021
doi: 10.3389/fpubh.2021.739068

The Association of Drug-Use Characteristics and Active Coping Styles With Positive Affect in Patients With Heroin-Use Disorder and Methamphetamine-Use Disorder During the COVID-19 Pandemic

Yingying Wang[1,2]*, Jinsong Zuo*[3]*, Long Wang*[4]*, Qianjin Wang*[1,2]*, Xin Wang*[1,2]*, Qian Yang*[1,2]*, Hanjing Emily Wu*[5]*, Colin B. Goodman*[5]*, Dongmei Wang*[6]*, Tieqiao Liu*[1,2]* and Xiangyang Zhang*[6]*

[1] *Department of Psychiatry, The Second Xiangya Hospital of Central South University, Changsha, China,* [2] *National Clinical Research Center for Mental Disorders, The Second Xiangya Hospital of Central South University, Changsha, China,* [3] *School of Life Science and Chemistry, Hunan University of Technology, Zhuzhou, China,* [4] *Sanming Taijiang Hospital, Sanming, China,* [5] *Department of Psychiatry and Behavioral Sciences, The University of Texas Health Science Center at Houston, Houston, TX, United States,* [6] *CAS Key Laboratory of Mental Health, Institute of Psychology, Chinese Academy of Sciences, Beijing, China*

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***Correspondence:**
Tieqiao Liu
liutieqiao123@csu.edu.cn
Xiangyang Zhang
zhangxy@psych.ac.cn

Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: *09 July 2021*
Accepted: *25 October 2021*
Published: *03 December 2021*

Citation:
Wang Y, Zuo J, Wang L, Wang Q, Wang X, Yang Q, Wu HE, Goodman CB, Wang D, Liu T and Zhang X (2021) The Association of Drug-Use Characteristics and Active Coping Styles With Positive Affect in Patients With Heroin-Use Disorder and Methamphetamine-Use Disorder During the COVID-19 Pandemic. Front. Public Health 9:739068. doi: 10.3389/fpubh.2021.739068

Background: Positive affect (PA) is crucial for individuals to cope with the current pandemic and buffer the lingering fears after it, especially for patients with substance-use disorders (SUDs). The current study aimed to explore PA and its related factors during the COVID-19 pandemic in male patients with the heroin-use disorder (HUD) and patients with the methamphetamine-use disorder (MAUD), respectively.

Methods: A total of 325 male patients with SUDs (106 with HUD and 219 with MAUD, all were single-substance users) in a compulsory rehabilitation center underwent semi-structured interviews during the pandemic. The demographic information, drug-use characteristics, active coping styles (ACSs, by Simple Coping Style Questionnaire), and PA (by the Positive and Negative Affect Scale) of participants were collected and recorded.

Results: There were significant differences between the two groups in age, the proportion of full-time workers before the epidemic, duration of drug use, the proportion of patients with long-term withdrawal during the epidemic, cravings, ACS, and PA. Correlation and multiple linear regression analysis showed that duration of drug use, ACS, and stable jobs were significant predictive factors for PA in patients with HUD, while long-term withdrawal, ACS, and stable jobs during the epidemic were significant predictive factors for PA in patients with MAUD.

Conclusions: Our study demonstrated the factors for PA in patients with HUD and MAUD during the pandemic. The results provided a basis for the comprehensive understanding of the PA of patients with SUDs and the development of targeted treatments.

Keywords: COVID-19, substance use disorders, positive affect, withdrawal, craving

INTRODUCTION

The outbreak of COVID-19 has caught people off guard globally (1). General public events, such as the COVID-19 pandemic, have had an impact on the physical and mental health worldwide of people (2, 3). The uncertain prognosis, shortage of testing and treatment resources, increasing economic losses, and negative effects of home confinement on physical health (4) have worked as a cluster of stressors and inevitably brought anxiety and depression to individuals (5–7), with affected populations being the elderlies (8, 9), children (10–12), teenagers with low awareness of risk for infection (13), college students receiving online courses (14), and pregnant women who are unable to access medical care due to home confinement (15). For some of those with existing mental health disorders (16–18), the COVID-19 pandemic has aggravated their conditions (19, 20). Several recent studies have shown that some individuals may resort to addictive behaviors to relieve their stress during the pandemic, particularly alcohol abuse (21) and internet-related addictions (22, 23). Some studies also indicated that the mental problems of patients with the substance-use disorder (SUDs) could relapse (24, 25) or progress (26, 27) during the pandemic due to the social isolation under lockdowns; in some severe cases, the patients take overdoses on their own (28). Moreover, patients with preexisting SUDs are at an increased risk for adverse outcomes following COVID-19 infection (29–32). Thus, these patients are under greater pressure in the face of the pandemic, which needs the attention of health authorities.

Having realized the significant impact of the COVID-19 pandemic, many researchers began to focus on affect problems related to the pandemic, which may provide a basis for timely mental health services during the pandemic (33). However, these studies focused more on negative affect (NA) rather than on positive affect (PA) (34). In fact, it has been demonstrated that PA also plays an important role in coping with chronic stressors through improving social, intellectual, and physical conditions of patients (34, 35). PA also counteracts negative physiological effects of chronic stressors and reduces the likelihood of post-traumatic depression (36, 37), indicating that it may help patients recover from NA related to the pandemic (35, 38). Moreover, PA is involved in information processing (39–41), which also reflects its importance regarding the high information load during the pandemic. PA can also alleviate the negative physiological consequences caused by stress (42, 43), which is beneficial to the physical conditions of individuals to defend against the coronavirus. To sum up, PA plays a more valuable role than most people think in coping with the pandemic (44). Of note, PA is an important factor for treatment outcomes in patients with SUDs (45–47), with suppressed PA associated with poorer outcomes (48) and improved PA associated with a better perception of quality of life (49, 50). In conclusion, clarifying the factors related to PA for patients with SUDs is conducive for them to face the pandemic positively. Some prior studies have shown that active coping styles (ACSs, such as seeking social support from others, engaging in physical activities, and positive reappraisal) are associated with PA in the general population (51–53), which is the same during the COVID-19 pandemic (54–56).

To date, heroin (an opioid substance) and methamphetamine (MA, a stimulant) are the most widely abused illegal drugs across the world, especially in Asia (57). Previous studies have found differences in several clinical aspects, such as demographics (58), personality traits (59), and the process of addiction (60) between patients with the heroin-use disorder (HUD) and patients with the methamphetamine-use disorder (MAUD). However, no studies have compared PA-related factors between the two disorders, especially in the context of COVID-19. Therefore, the present study aims to explore the factors and latent differences of PA between patients with HUD and those with MAUD. In addition to ACS mentioned above, we also included some characteristics of drug use, such as duration of drug use, long-term withdrawal (i.e., with no drug use for at least 3 months), and cravings, as potential factors during the COVID-19. Since the COVID-19 pandemic is a once-in-a-lifetime stressor, we also proposed some key considerations in demographics. In this study, we also aim to explore the differences in demographics and drug-use characteristics between two groups of patients with different SUDs and identify the factors of PA for the two SUDs.

METHODS

Participants and Procedures

From July to September 2020, a total of 733 patients with SUDs (133 women and 600 men) admitted to a compulsory drug rehabilitation center (Changsha, Hunan Province, China) underwent semi-structured interviews by two trained psychiatrists. According to our aim, only 325 male patients with single HUD ($n = 106$) or MAUD ($n = 215$) were retained. The inclusion criteria were as follows: (1) patients diagnosed with HUD or MAUD based on DSM-5 and (2) with at least 2 weeks of withdrawal at the time of recruitment. The exclusion criteria were as follows: (1) patients diagnosed with other mental disorders, (2) with serious physical diseases, (3) with intellectual or cognitive impairment, and (4) who cannot understand the questionnaires.

This study was approved by the Ethics Committee of The Second Xiangya Hospital of Central South University. All the participants in the study provided written informed consent; they were informed that they could withdraw from the study at any time without needing to provide any reason, and all their information was confidential.

Measures

A combination of semi-structured interviews and self-reports of patients were included in this study.

Semi-structured Assessment for Drug Dependence and Alcoholism (SSADDA)

For the screening of SUDs and other mental disorders, SSADDA was originally developed by Yale University (61, 62). It has been translated into different languages and verified for its reliability and validity in the SUDs population (63, 64). SSADDA was translated by our team in 2017 and was tested for psychometric properties, which indicated that the Chinese version of SSADDA had good reliability and validity when applied in patients with

SUDs (65). SSADDA has two main functions: One is to diagnose SUDs based on DSM-5 (66), including the abuse of tobacco, alcohol, MA, ketamine, opioid, and other substance (such as marijuana); and the other function is to screen out other mental disorders, such as schizophrenia (67), ADHD (68), and depression (69). SSADDA also reflects the characteristics of substance use, such as the duration of drug use and frequency of most severe episodes (70), which can help psychiatrists take the drug-use history of subjects.

Self-Reported Characteristics of Drug Use During the COVID-19 Pandemic

The participants were asked two questions about the characteristics of drug use during the pandemic. The first question was "Since the beginning of the COVID-19 outbreak, have you used no substance at all for at least 3 months?" and "a long period of withdrawal" was recorded if the answer was "yes." The model for the assessment of previous long-term withdrawal experience of patients was established after SSADDA. The second question was "Since the beginning of the COVID-19 outbreak, what is the highest level of your craving for the substance you use?" and the level should be reported by the subject with the use of the Visual Analog Scale of Craving (VASC). VASC is a line segment bisected with the numbers of 0–10, with the leftmost number "0" representing "no cravings at all" and the rightmost number "10" representing "very strong and almost uncontrollable cravings" (71, 72).

Active Coping Style

The Simplified Coping Style Questionnaire (SCSQ) was used to evaluate the coping styles of the subjects. SCSQ (73) is an instrument with good reliability and validity and has been widely used in studies in China, especially during the pandemic (74, 75). It consists of two subscales that measure active and negative coping styles of participants with a Likert 4-point scale, with 0 representing "never" to 3 representing "always"; higher scores indicated a higher frequency of adopting the corresponding coping styles. For the purpose of our study, we only analyzed the total score of the ACS subscale, which has a Cronbach coefficient of 0.860.

Positive Affect

The PA of the participants was measured using the Chinese version of the Positive and Negative Affect Scale (73, 76), which is widely used in a variety of populations, including patients with SUDs. The original scale includes two subscales, i.e., subscales for PA and NA, respectively, with each one containing 10 words that describe the corresponding affect (e.g., energetic, cheerful, or pride for PA, and nervous, irritable, or confused for NA) during a certain period. Each item was rated with a Likert 5-point scale, with 0 = hardly and 4 = extremely. As this study was focused on PA, only the PA subscale was used for the analysis; its Cronbach coefficient in this study was 0.887.

Statistical Analysis

Independent-samples t-test was used to analyze the differences in demographic data, drug-use characteristics, ACS, and PA between the two groups of patients with SUDs. Pearson's correlation was then used to analyze the relationship between the above clinical variables and PA. Finally, multiple linear regression analysis was performed for the two groups, respectively. PA was set as the dependent variable, and all variables with $p < 0.1$ in the previous correlation analysis were included as independent variables. Data analyses were performed using the SPSS software (version 23.0), with a significance level of $p < 0.05$ (two-tailed).

TABLE 1 | Demographic information of patients with HUD and patients with MAUD.

Variables	Patients with HUD	Patients with MAUD	χ^2/t	p-value
	$n = 106$	$n = 219$		
Age	48.95 (7.24)	35.08 (6.93)	−16.675	<0.001
Education (years)	9.40 (2.96)	10.21 (3.21)	2.210	0.028
Marital status				
Married	46 (43.4)	102 (46.6)	0.291	0.590
Unmarried/devoiced	60 (56.6)	117 (53.4)		
Employment status				
Enterprises/self-employed	34 (32.1)	76 (34.7)	0.220	0.639
Part-time work/unemployed	72 (67.9)	143 (65.3)		

HUD, heroin-use disorder; MAUD, methamphetamine-use disorder.

RESULTS

Comparison of Demographic Data Between Patients With HUD and Patients With MAUD

The demographic information of the two groups is presented in **Table 1**. Patients with HUD had significantly higher age than those with MAUD ($p < 0.001$) and significantly fewer years of education ($p = 0.028$). There was no significant difference in the marital (i.e., married, unmarried, or divorced) and employment status (i.e., full-time job, part-time job, or unemployed) between the two groups.

Comparison of Clinical Variables Between Patients With HUD and Patients With MAUD

The drug-use characteristics, ACS, and PA of the two groups are presented in **Table 2**. Duration of drug use was significantly longer in patients with HUD than in patients with MAUD ($p < 0.001$). A significantly higher proportion of the patients with HUD had a long-term withdrawal during the COVID-19 pandemic, as compared with those with MAUD ($p < 0.001$); the cravings during the epidemic in patients with HUD were significantly greater than in those with MAUD ($p < 0.001$). The scores of ACS and PA of patients with HUD were significantly lower than those in patients with MAUD (both $p < 0.001$).

TABLE 2 | Clinical variables of patients with HUD and patients with MAUD.

Variables	Patients with HUD	Patients with MAUD	χ^2/t	*p*-value
	n = 106	*n* = 219		
Duration of drug use (year)	23.41 (8.12)	9.47 (4.67)	−16.4111	<0.001
Long-term withdrawal during COVID-19				
Yes	20 (18.9)	160 (73.9)	84.890	<0.001
No	86 (81.1)	59 (26.9)		
Cravings during COVID-19	4.84 (2.93)	2.67 (2.26)	−6.719	<0.001
Total score of ACS	18.29 (5.00)	21.32 (6.46)	4.644	<0.001
Total score of PA	22.02 (5.20)	28.29 (6.78)	9.191	<0.001

HUD, heroin-use disorder; MAUD, methamphetamine-use disorder; ACS, active coping styles; PA, positive affect.

TABLE 3 | Correlation between clinical variables and positive affect in the two groups of patients.

Groups	Positive affect	*p*-value
Patients with HUD (*n* = 106)		
Age	−0.225	0.020
Education	−0.009	0.931
Marital status	−0.177	0.070
Employment status	0.240	0.013
Duration of drug use	−0.300	0.002
Long-term withdrawal	0.105	0.282
Cravings	0.052	0.596
ACS	0.250	0.010
Patients with MAUD (*n* = 219)		
Age	−0.140	0.038
Education	0.077	0.255
Marital status	−0.012	0.863
Employment status	0.199	0.003
Duration of drug use	0.009	0.896
Long-term withdrawal	0.274	<0.001
Cravings	−0.220	0.001
ACS	0.241	<0.001

HUD, heroin-use disorder; MAUD, methamphetamine-use disorder; ACS, active coping style.

Correlation Between Clinical Variables and PA in Patients With HUD and Patients With MAUD

Variables associated with PA for both SUDs are presented in **Table 3**. In patients with HUD, age ($r = -0.225$, $p = 0.020$), employment status ($r = 0.240$, $p = 0.013$), duration of drug use ($r = -0.300$, $p = 0.002$), and ACS ($r = 0.250$, $p = 0.010$) were significantly correlated with PA. In patients with MAUD, age ($r = -0.140$, $p = 0.038$), employment status ($r = 0.199$, $p = 0.003$), long-term withdrawal during COVID-19 ($r = 0.274$, $p < 0.001$), craving during the epidemic ($r = -0.220$, $p = 0.001$), and ACS ($r = -0.241$, $p < 0.001$) were significantly associated with PA.

Multiple Linear Regression of Clinical Variables to PA in Patients With HUD and Patients With MAUD

Multiple linear regression analysis was performed in patients with HUD and MAUD, respectively. PA was set as the dependent variable, and variables with $p < 0.1$ in the previous correlation analysis were taken as independent variables. The results (see **Table 4**) showed that duration of drug use ($\beta = -0.267$, $t = -2.954$, $p = 0.004$), ACS ($\beta = 0.204$, $t = -2.258$, $p = 0.026$), and stable job ($\beta = 0.201$, $t = 2.223$, $p = 0.028$) were significant predictive factors for PA ($F = 7.423$, $p < 0.001$, adjusted $R^2 = 0.155$) in patients with HUD, while long-term withdrawal during the pandemic ($\beta = 0.251$, $t = 3.986$, $p < 0.001$), ACS ($\beta = 0.226$, $t = 3.604$, $p < 0.001$), and stable job ($\beta = 0.165$, $t = 2.612$, $p = 0.010$) were significant predictive factors for PA ($F = 13.240$, $p < 0.001$, adjusted $R^2 = 0.144$) in patients with MAUD.

DISCUSSION

To our knowledge, this is the first study to examine PA in patients with HUD and patients with MAUD during the COVID-19 pandemic. The results showed significant differences in age, education, some drug-use characteristics (i.e., duration of drug use, long-term withdrawal, and cravings during the pandemic), ACS, and PA between the two groups. Correlation analysis showed that age, employment status, duration of drug use, and ACS were significantly associated with PA in patients with HUD, while age, employment status, long-term withdrawal during the pandemic, cravings during the pandemic, and ACS were significantly associated with PA in patients with MAUD. Multiple linear regression analysis indicated that the duration of drug use, ACS, and stable job were significant predictive factors for PA in patients with HUD, accounting for 15.5% of the variation; long-term withdrawal, ACS, and stable job were significant predictive factors for PA in patients with MAUD, accounting for 14.4% of the variation.

With regard to demographics, patients with HUD were at a significantly higher age than those with MAUD, which was consistent with previous studies (59). In our study, the mean age of patients with HUD was nearly 50 years, and the duration of heroin use for this group was 23.41(±8.12) years, which is equivalent to the elderly stage of the life cycle in patients with HUD (77), indicating the advanced age of this group. As a result, they are a vulnerable group to both physical and psychological problems (78) and need the attention of healthcare providers. The level of education in patients with HUD was significantly lower, which might be a barrier for these patients to gain knowledge of COVID-19; this was in line with some previous studies, which showed that people with low education levels scored low in surveys regarding the knowledge of COVID-19 (79). With regard to drug-use characteristics, the duration of drug use in patients with HUD was significantly longer than that in patients with MAUD, which is consistent with the fact that their age was highly correlated with the duration of drug use (59, 80). In general, the older patients were more vulnerable to physical illnesses as they had long-term use of harmful substances

TABLE 4 | Multiple linear regression of clinical variables to positive affect in the two groups of patients.

Predictors	β	t	p-value	F	Adjusted R^2
Patients with HUD ($n = 106$)					
Duration of drug use	−0.267	−2.954	0.004	7.423***	0.155
ACS	0.204	−2.258	0.026		
Stable job	0.201	2.223	0.028		
Patients with MAUD ($n = 219$)					
Long-term withdrawal	0.251	3.986	<0.001	13.240***	0.144
ACS	0.226	3.604	<0.001		
Stable job	0.165	2.612	0.010		

****$p < 0.001$; HUD, heroin-use disorder; MAUD, methamphetamine-use disorder; ACS, active coping style.*

(81, 82), which may increase their risk for infection with COVID-19. During the pandemic, 73.9% of the patients with MAUD had a withdrawal for more than 3 months, while the percentage was only 26.9% in patients with HUD. A possible reason for this significant difference is that MA might be harder to get; according to a survey, the amount of MA seized by the police significantly decreased through April 2020, while the seizure of heroin remained unchanged (83). Furthermore, patients with HUD are often highly addicted to heroin, meaning that they are less likely to withdraw and more likely to relapse (84). Moreover, our study also found that patients with HUD had significantly stronger cravings than those with MAUD during the pandemic, indicating that the level of cravings is also a risk factor for drug withdrawal (85). Patients with HUD had significantly higher ASC scores than those with MAUD, indicating that the former had adopted more ACS during the epidemic. Finally, as compared to patients with HUD, those with MAUD scored higher in PA. A possible reason for this difference is that the patients with HUD were at a higher age. Previous studies have shown that elderlies usually have lower levels of PA than younger people due to their reduced daily activity (86–88) and chronic illnesses (89, 90). This might be related to the reduced ability to perceive PA in patients with HUD due to the damage of corresponding brain regions (91, 92). Our results reflected that the biological mechanisms that produce PA in patients with HUD are even more impaired, i.e., their PA is less likely to be aroused than users of stimulants in the face of stressors. Therefore, treatment with regard to biological mechanisms for such patients is needed in response to the pandemic.

Correlation and multiple linear regression analysis revealed a slight difference in predictive variables for patients with HUD and patients with MAUD. First, the duration of drug use was a predictive factor for PA in patients with HUD only, whereas long-term withdrawal during the epidemic was a predictive factor for PA in patients with MAUD only. This suggested that although drug-use characteristics are important factors for patients with SUDs, their effects may vary on patients using different substances. A significant finding of this study was that long-term withdrawal was a protective factor for PA in patients with MAUD. Prior studies on the mechanism showed that the processing ability of PA recovered with the withdrawal of patients with SUDs (93, 94), which was conducive to their outcomes (95). Although some researchers suggested that lockdown-induced withdrawal might not be voluntary for those patients with SUDs, our results still showed the benefit of passive withdrawal due to inaccessibility to illicit drugs. Of note, the two groups shared two common predictive factors, one of which was the pre-pandemic employment status and the other was their ACS. As lockdowns led to some unemployment, the employment status of patients before the pandemic has become another point worth exploring. Studies showed that people who had long commutes for work or part-time or casual workers, such as migrant workers and retailers, are more likely to lose their jobs (96, 97), suggesting that they might be worse off under the stress of the pandemic compared to those with a secured job. This is in line with our results, which demonstrated that patients with stable jobs (e.g., employees of an enterprise or self-employers) had higher levels of PA than those with unstable jobs (e.g., casual workers or unemployed people). This might be due to the less financial pressure for those with stable jobs and who were more able to afford drugs and medical services they needed.

As mentioned above, ACS is positively correlated with PA (98, 99), which is consistent with our results. Due to the lockdowns, many people were confined to their homes (100, 101) and had to reduce activities and communication with others (102), which had an impact on those who were more dependent on others or circumstances (e.g., seeking social support from others and engaging in physical activities) in coping with stressors. Many public venues, such as public sports facilities and cultural centers, closed down during the pandemic, which also led to the reduction of activities (103, 104). Therefore, our results suggest that patients who are more dependent on external conditions need more help in coping with stressors, one of the approaches being the use of internal-driven active coping strategies, such as positive reappraisal and problem-solving-oriented strategies. Certainly, the whole point of doing this is to help them increase their PA.

Limitations

Despite the strength of this study, it still has some limitations. First, this is a cross-sectional study; thus, the causality of the variables could not be reflected. Longitudinal studies are needed to find the causal relationship between the variables and PA in patients with SUDs. Second, this study is retrospective, and the data for analyses are from self-reports of patients, which might be subjective and limit the generalization of the results. Finally, female patients were not included in this study as female patients in the drug rehabilitation center only accounted for a very small portion at the time of our survey; thus, the gender balance was difficult to achieve with female patients included. Therefore, gender differences in PA of patients with SUDs need to be explored in future works.

CONCLUSIONS

In summary, this study explored the differences and factors of PA between patients with HUD and patients with MAUD during the COVID-19 epidemic. Patients with SUDs are both physically and mentally vulnerable to such infectious diseases and therefore need attention from healthcare providers.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Second Xiangya Hospital of Central South University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

TL and XZ designed and supervised this study. YW, LW, XW, and QY collected data. QW collated the raw data. JZ analyzed and interpreted the data. YW wrote the first draft of the manuscript. XZ, DW, HW, and CG discussed and revised the manuscript. All co-authors approved the version to be published.

FUNDING

This study was supported by the National Natural Science of China (Grant No. 81371465 and 81671324), the National Key R&D Program of China (2017YFC1310400), and the provincial Natural Science Foundation of Hunan (Grant No. 2015JJ2180).

ACKNOWLEDGMENTS

We thank all the staff of the Changsha Compulsory Drug Rehabilitation Center, especially Directors Xin Shen, Li Lu, and Wei Liu. We also express our sincere thanks to all participants. We used the STROBE cross-sectional checklist for our report (105) and thank the researchers for providing good methods for our observational study.

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