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Physical and psychological optimization of tele-exercise programs by establishing guidelines

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Tele-exercise has significant potential as a tool to promote physical activity, particularly for individuals facing barriers to accessing gyms or sports centres due to geographical, physical, or financial constraints. While tele-exercise derives from telemedicine, it remains a less defined field with no established guidelines to regulate or standardize its implementation. This gap highlights the need for structured frameworks to ensure the safety, effectiveness, and accessibility of tele-exercise. This study aimed to establish a consensus on some fundamental aspects of tele-exercise through a structured four-round process. A mixed-method approach combined analyses of scientific literature with a modified Delphi approach of 4 rounds of experts' opinions collected via focus groups and an ad hoc questionnaire. A consensus criterion of ≥ 60% agreement was applied. Experts ($n = 17$ internal, $n = 14$ external) validated 7 thematic areas and 25 operational recommendations, including fitness training design (e.g., 2–10 participants/session in synchronous mode), safety protocols, and technology requirements. In detail, the following fundamental aspects were addressed: (1) operative definitions of tele-exercise, (2) fitness training programs design, (3) requirements for spaces and equipment, (4) safety protocols for remote exercise, (5) the role and impact of technology, (6) relational and communication strategies to enhance engagement, and (7) monitoring methods for asynchronous and synchronous training sessions. Answers were analysed through a manual content analysis. The guidelines provide a comprehensive examination of these aspects, addressing current gaps and limitations while outlining opportunities for improvement. The study underscores the importance of developing standardized practices to ensure safe and effective implementation of tele-exercise. These findings establish a preliminary framework for tele-exercise implementation, highlighting consensus on technical and psychological features critical for scalability and safety in diverse populations.

Keywords Remote training, eHealth, Tele-fitness, Tele-coaching, Home-based exercise, Synchronous and asynchronous mode

Tele-exercise has been long practised with rehabilitation and telemedicine purposes with positive and promising results[1]. The words "tele-exercise" appeared for the first time on PubMed database in the title of a scientific paper in 2006[2], and it spread in the past ten years with a dramatic increase in the last few years. Since the Pandemic of COVID-19 many healthy people started to workout at home[3–6]. While there is quite a corpus of studies on medical use of tele-exercise, the fitness purpose for healthy people has not yet been studied deeply[7]. Only about 10% of clinical trials on tele-exercise (4 out of 44) target healthy populations, with most platforms lacking

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dedicated designs for physical activity[1]. To gain a more comprehensive understanding of the current landscape surrounding tele-exercise, we undertook a systematic review of existing literature in 2024. A total of 240 studies were initially identified (2010–2023), with heterogeneous designs (Interventions varied widely in duration (6 weeks to 6 months), type (e.g., resistance training, yoga, Tai-Chi), and delivery mode (synchronous: live video conferencing; asynchronous: apps, pre-recorded videos) and no consensus on key parameters like real-time feedback requirements or risk mitigation strategies[8].

Literature review

The current literature refers to workouts that are either synchronous or asynchronous[5,6,9–13]. In the first case they mostly used general web-based conferencing software such as Zoom, Skype or Teams[14,15]; in asynchronous tele-exercise researchers delivered customized videos through email or message application[16] or broadcasted them on YouTube[17]. In all these studies, the exercise routine was designed by specialized instructors and in a few cases, it was even tailored to the participant's needs, which is possible in a research context, but harder for a larger audience.

Nowadays, tele-exercise for fitness purposes is based on a multitude of online applications proposing free, as well charged programs but that in most cases do not provide specifics as to the design of their workout programs or their authors, nor have they undergone a scientific validation. Moreover, instructors often did not provide evidence of a specific professional experience in remote coaching. The phenomenon of "tele-exercise" is characterized by significant diversity and inherent complexity. As a whole, it follows that a more systematic and scientific approach to tele-exercise for fitness and healthy individuals, as well as its regulation, is necessary. To date, there is a significant heterogeneity in tele-exercise interventions, including inconsistent definitions of FITT parameters, outcome measures (e.g., SFT vs. SPPB for physical fitness), and technological platforms (synchronous vs. asynchronous).

This study was aimed at exploring a design procedure for tele-exercise. In detail, the study aimed to:

1. Define operative terminology for tele-exercise modalities (synchronous/asynchronous);
2. Establish safety thresholds for remote monitoring;
3. Propose standardized protocols for fitness program design and instructor-participant communication.

Reaching a consensus within the scientific community is the premise for reliable and widespread studies on the efficacy of tele-exercise in different modalities (synchronous and asynchronous) and addressing users with a large spectrum of characteristics as to gender, age group, exercise habits, time availability, etc.

On the other side, there is a social urgence to clear the efficacy of tele-exercise programs for fitness, because they could be representing an asset to prevent sedentary habits, obesity and increasingly widespread unhealthy lifestyles[18,19].

Methods

To gather the larger bases of knowledge we started from the review of the literature and proceeded with a mixed methodology, mostly referred to the Delphi technique[20], aimed at generating consensus through an iterative process of questioning of more rounds. While our approach diverged from classical Delphi (e.g., lack of full anonymity due to collaborative focus groups), the iterative process of expert consultation and consensus-building aligns with its core principles. This hybrid design was chosen to leverage real-time collaboration within the TeleExe4All consortium while maintaining statistical aggregation in the survey phase.

After each round, responses were analysed and redistributed for discussion. The principal pattern of discussion was organized in four rounds of questioning with the following setup:

Round 1 (May - December 2023): Systematic review;
Round 2 (July 2023 - February 2024): 17 internal experts in focus groups;
Round 3 (March 2024): 14 external experts (80% response rate);
Round 4 (April - June 2024): Consensus validation by 12 internal experts.

- *Round one – The documentary analyses*: We started with a review of the scientific literature[8], and a mapping of the web sites (both scientific and popular ones) and web applications[1,21]. The systematic review was conducted following PRISMA guidelines (PROSPERO registration: CRD42024563241). We searched PubMed, Scopus, and Web of Science from inception to December 2023, using keywords: "Tele-exercise," "Remote exercise," "Remote training," "Tele-exercise programs," "Synchronous exercise," and "Asynchronous exercise," separated by the Boolean operator OR, with a filter for "Title/Abstract" and coverage from 2014 to the present. Inclusion and exclusion criteria are fully analyzed inside the systematic review. Briefly: a total of 240 studies were initially identified during the first screening in the databases. Ninety-eight duplicates were identified and removed. The "Title and Abstract" of 142 studies were examined, and 29 were selected for full-text screening. The full text of two studies could not be accessed. An email was sent to the corresponding authors, but no response was received. Of the 27 analysed studies, 5 were excluded for not being randomised or quasi-experimental trials, 6 did not have outcomes of interest, 1 did not involve an adult population, and 1 was considered not to have characteristics of structured tele-exercise. The complete results obtained from the systematic review can be viewed in the recently published paper[8].
- *Round two - Focus groups I*: Interviews and focus groups with the experts from the *TeleExe4All* project were carried out to discuss the literature and the state of art on tele-exercise. The aim was to define the main areas of further investigation. Finally, five areas of analyses were identified: (1) Fitness training design; (2) Spaces and equipment; (3) Technologies; (4) Relational and communication modalities; (5) Monitoring.

- *Round three – Interviewing of external experts*: The five areas of analyses were detailed into questions for the questionnaire by a sub-group of internal experts (the questionnaire is described in The Questionnaire Section below). The number of experts was increased by addressing anonymous external experts who were contacted via email (see "*The experts' profile*" section below). They signed an informed consent and then filled in an in-depth questionnaire that explored detailed specifics of tele-exercise for fitness. The questionnaire was administered via Computer Assisted Web Interviewing (CAWI) and experts were asked to spread the link among their peers using snowball effect sampling[22], where new participants are progressively recruited through social networks, facilitating access to groups that are difficult to reach using traditional methods.
- Round four – Focus group II: mean values of the answers to the closed questions to be evaluated on a 5 points Likert Scale were calculated and the answers to open-ended questions were analysed according to a manual content analyses discussed among the internal experts from the ongoing *TeleExe4All* project to detect the global best level of agreement (see "*Data Analysis*" section below). Analyses resulted in the final document (see Fig. 1).

The study was approved by the Ethics Committee of the University of Trás-os-Montes & Alto Douro protocol Doc73-CE-UTAD-2019 (13 January 2020). The study was conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

The experts' profile

Internal experts from *TeleExe4All* project were seventeen (11 men and 6 women) either academics, or professionals from Croatia, Italy, Latvia and Portugal. Their background was mostly in motor science and sports, but a few were academics in medicine, physics and psychology. Their expertise ranged from children to elderly, from amateur to athletes with or without disabilities. During the focus groups experts were divided into different teams that changed at every round of consultations. A smaller group devised the questionnaire.

The panel of experts external to the project was sought among academics, researchers and instructors with experience in tele-exercise, according to the following criteria:

a. Peers (personal acquaintances).
b. Members of research groups or centres on tele-exercise.
c. Members of training centres.
d. Professional instructors.

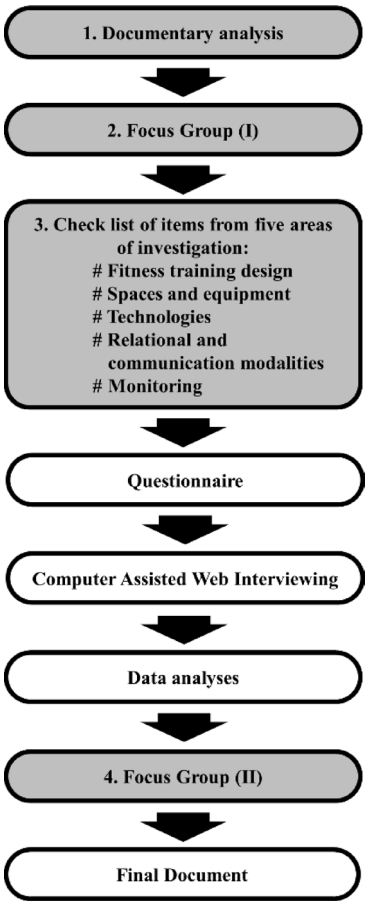

Fig. 1. Graphical illustration of the 4 rounds of the investigation method.

Level of experience (Likert scores)	None (1)	Low/moderate (2/3)	Good/excellent (4/5)	Tot
Fitness and physical improvement	–	2 (14.3%)	12 (85.7%)	14
Athletic-sport training	3 (21.4%)	6 (42.8%)	5 (35.7%)	14
Motor rehabilitation with non-athletes	5 (35.7%)	5 (35.7%)	4 (28.6%)	14
Re-athletization	6 (42.8%)	5 (35.7%)	3 (21.4%)	14
Postural activities	5 (35.7%)	4 (28.6%)	5 (35.7%)	14

Table 1. Percentage of external experts' specific experience in tele-exercise.

Name	Definition	Agreement score Mean (SD)
Tele-exercise	A branch of telemedicine that delivers training programs remotely[23,24], through online media[10,25]	3.79 (1.12)
Activity mode synchronous	A real-time approach, in which the service is provided simultaneously by the instructor to the participant via videoconference or telephone conversations, allowing immediate feedback to be provided on the execution of the exercises[23,26]	4.07 (1.21)
Activity mode asynchronous:	A non-real-time approach in which instructors record educational videos that participants play without direct and simultaneous delivery. This approach allows for greater flexibility in accessing training programs, but not the ability to have immediate feedback on the execution of the exercises[23,26]	4.00 (0.96)
Tele-exercise instructor	A subject with extensive experience in providing training protocols suitable for a virtual environment that instructs participants on how to perform the exercises so that everyone can participate safely[26]	4.36 (1.08)

Table 2. Operative definitions of tele-exercise originally provided in the questionnaire. ^Definition was accepted when agreement score was > 3.00.

Initially, 23 external experts agreed to participate in the survey by signing the informed consent. Five of them dropped out of the study and four were excluded since they did not have an adequate experience profile. The final panel consisted of 14 experts (9 men and 5 women) with an average age of 42 ± 8.6 years. Their experience in tele-exercise as academics and/or instructors varied from 1 to 7 years, with an average experience of 2.7 ± 2.0 years. The specific of their experience is described in Table 1, and ranged among professional athletes, amateur athletes, athletes with disabilities, re-athletization athletes, trained participants, non-athletes, participants with sporadic training, sedentary healthy participants, sedentary participants with disabilities, sedentary participants with pathologies.

The questionnaire

The questionnaire was devised based on the checklist created as outcome of the focus groups and it consisted of seven sections. In order not to lose useful insights from the experts, at the end of each question they could specify or integrate their answers in a free text box. At the end of each area of investigation experts could also evaluate if the questions were exhaustive and eventually suggest further topics of analyses.

The thematic sections consisted of a total of 74 questions on synchronous mode and 80 on asynchronous mode, including closed-ended questions, rating scales (five-point Likert scale) and open questions.

In detail, the Personal data section gathered questions on demographic (sex, age), professional data (education qualification and duration, licenses or specialization in tele-exercise, years and type of experience), and experts' experience (duration, type and purpose of their interventions, target population). According to the mode in which they were more experienced (synchronous, asynchronous or both modes), experts accessed three specific paths.

In the Glossary Section the most recent and quoted operative definitions on tele-exercise, Synchronous tele-exercise mode, Asynchronous tele-exercise mode, tele-exercise instructor (see Table 2) was to be assessed according to the expert's level of agreement. Experts could also propose modifications. This section also explored the main characteristics (major advantages and disadvantages) of the different modes of tele-exercise, the types of users who can most benefit from tele-exercise, and whether tele-exercise may be effective in mixed modes (synchronous and asynchronous; at distance - synchronous or asynchronous modes - and in presence).

The Fitness Training Design Section explored the parameters to be evaluated before starting the training, the ideal number of participants, number of sessions and duration of each session (for both trained and untrained participants). Experts also evaluated the type of activity to perform depending on the type of users (young, adults, elderly) and the phases of each training session.

The Spaces and Equipment Section investigated the characteristics of the environment where exercises are performed, the equipment for amateur and professional users, and the recommended clothing. Recommendations and preventive safety measures were also investigated.

In the Technologies Section experts were asked to evaluate the most suitable devices, their technical specifications, the best framing for both the participant and the demonstration monitor depending on the type of exercise and the position (upright, sitting, or prone - supine), and the position of the instructor's monitor to observe the participants while performing the exercise.

In the Relational and Communication Modalities Section experts evaluated the language, attitude, general relational modalities and communication management respectively at the beginning of the training session,

during the explanation, in the encouragement and motivation phases during physical activity, and at the end of the activity.

Finally, the Monitoring Section dealt with the techniques and tools for the instructor's monitoring and trained and untrained participants' self-monitoring.

Data analysis

Round one (The documentary analyses): Data obtained in the first round were analysed through PRISMA systematic review method[8].

Round two (Focus groups I), and round three – Interviewing of external experts: A manual content analysis[27] of data obtained from the focus groups (I) was performed to identify the thematic areas of the survey and the experts' proposals on the single topics to be explored. Statements that were approved by the majority (minimum 60%) were translated into the items of the questionnaire. Quantitative and qualitative data from the questionnaire were analysed performing the mean of the scores to the 5-point Likert response scale. Items with a mean scoring under 2.5 were not considered; items with a mean scoring of 2.5 to 2.9 were submitted to the experts for reconsideration; items scored above 3 were accepted[20,28–30].

Round four (Focus group II): The qualitative data collected from the open-ended questions by which experts could complete their answers in each section of the questionnaire were also analysed according to manual content analysis methodology.

Results

Glossary section—operative definitions

Experts agreed on the operative definitions from the literature and enriched them with further details. The experts agreed on the following statements: Tele-exercise, which originally started as a branch of telemedicine, delivers training programs through online media, in context of both rehabilitation and health promotion, eventually using supervision tools that allow the collection of participants' personal data. Tele-exercise is designed and managed by expert instructors who provide training protocols suitable for a virtual environment. They organize the exercise schedule, explain how to perform the exercises safely and monitor the participants' progresses. They can also guide participants in the use of new technologies during tele-exercise sessions. Tele-exercise can be approached in Synchronous mode, when provided simultaneously by the instructor to one or more participants via online streaming environments. It can also be approached in Asynchronous mode, when the instructor records educational videos that participants play without direct and simultaneous delivery.

There is not an ideal addressee for tele-exercise, everyone can access this activity, regardless of their status as sedentary (healthy, with pathologies or with disabilities) or trained to different extent (from casual trainees to professional athletes) individuals.

Activities in synchronous mode allow immediate feedback, the direct relationship between instructor and participant, the possibility of training customization and of better guided training and monitoring, together with a sense of comradeship with other participants that enhances motivation. On the other side, streaming sessions may undergo technical issues (need for high Internet connection, device functionality, access to the platform, etc.) and require quite high levels of familiarity with the technologies, resulting in harder efforts for elderly and persons with disabilities. Trainees and trainers may also have limited perspective access according to the monitor they use or their reciprocal positions. Finally, the live monitoring of multiple participants could be difficult for the instructor.

The asynchronous mode generally requires an easier technical management: the trainers provide comprehensive and multimedia video lessons with integrated perspectives, texts, visual effects, etc. and they monitor the participants' performance through direct contact (by phone or email) or through the analyses of video recorded materials. When practising in asynchronous mode, trainees can autonomously schedule their workout sessions, although they cannot share the experience with a group (unless they practice with other people in presence) and are more likely to suffer from lack of motivation and of support from their peers. Moreover, they could perform the exercises not correctly, due to the lack of both supervision and movement correction in real-time. Finally, in the long term, it could be difficult to produce video materials tailored to participants improving skills and needs.

Experts suggest that mixed mode workouts that balance synchronous and asynchronous, or in-person and tele-exercise sessions can be effective, more flexible and less expensive. In addition, participants could catch up missing workout sessions and be more constant in their training, especially during holidays and work travels, or in case of re-athletization after injuries or pathologies. They could also exercise alone, to improve and consolidate new strategies and exercises. Trainers could picture a more complete idea of the participants' level of performance and adapt their practices or correct their executions.

Fitness training design

Experts agreed that ahead of the beginning of the training, regardless of the mode (synchronous or asynchronous), it should be compulsory to gather the following personal data: age, sex, weight, height, waist circumference, medical history and current medication intake, address and emergency contact, lifestyle habits (sleep, type of work, daily stress; movement habits, diet), devices at disposal for the training and internet connection specifics, material and space conditions, training schedules and time available for training.

Attitudes and previous experiences should also be assessed: objectives and expectations, previous (tele) exercise experiences and their history, physical exercise preferences, comforts and discomforts in practicing physical exercise, motivation and self-efficacy, familiarity with technologies.

	Synchronous mode	Asynchronous mode
Participants per session	2 to 10	Maximum 50 (to monitor the group at distance)
Workouts per week	*Not trained participants*: 2–3 times of 45–60 min each *Trained participants*: 3 times of 45–75 min each	3–5 times a week for 45–60 min, regardless of training level.
Workout phases^	Welcoming and explanation phase; warm-up; the real exercise sequence; the cool-down; the closing, with feedback and information on the following steps	
Performable and suggested exercises^	*Regardless of the participants' age and training mode*: Aerobic activity, bodyweight muscle strength improvement activities, Coordination-based activities, Proprioceptive activities, Mixed activities, Joint mobility, flexibility, stretching, recreational activities *Suggested for young and adults*: High-intensity cardiovascular exercise *Suggested for elderly*: Balance activities	

Table 3. Fitness training design in tele-exercise. ^For both synchronous and asynchronous mode.

The duration of the program should depend on the participants' goals, characteristics, levels of ability, preferences, and on the intensity of the training. Details on the number of participants and the number of sessions a week are provided in Table 3.

Technical details on the exercises for the fitness training also should depend on various factors including avoiding expensive or bulky equipment. Some recreational activity during the workout is recommended to keep the participants motivated.

The data presented in Table 3 represent a synthesis of all data obtained from the survey administered to experts. The complete data from the survey, however, can be viewed in the supplementary material. It is appropriate to clarify that "Performable and suggested exercises" in Table 3 refers to all exercises that do not pose significant execution challenges and can thus be readily and effectively carried out via tele-exercise in a safe manner. This does not, however, preclude the integration of other exercise modalities into a tele-exercise program, when additional equipment is available.

Spaces and equipment

Experts highlighted that exercise in a home-based environment requires a space with no potential risk to the individual's safety. The space should be lit and ventilated. Participants also need good Internet equipment and devices to connect to the platform (see next sections).

Not trained and amateur trainees can perform bodyweight exercises with a mat, a chair, weights (or similar objects, e.g., bottles).

A more professional training could benefit from the use of a step platform, resistance bands and fit balls. In synchronous mode, participants should wear form-fitting non-restrictive attire to allow the monitoring of their movements by the instructor. Breathable fabric shirts and shorts are suggested as well as footwear suitable for the type of activity.

Safety

In tele-exercise participants perform the exercises in their homes or in facilities, far from the immediate and direct control of a professional instructor. Experts agreed that regardless of the training mode, elderly trainees and participants with motor difficulties could benefit from another person's presence in the same site, in case of problems during or after the workout. Participants in asynchronous sessions should also provide an emergency contact.

The environment should be spacious and safe, to avoid possible interference from other participants (e.g., roommates) or objects (walls, furniture, etc.). There should also be available attachment points.

A mandatory written consent form and written disclosure of liability must be gathered before starting the training. The need for health certificates for non-competitive or competitive sports practice as well as for specific insurance programs should also be checked since those topics are regulated in different ways throughout different Countries.

In the light of the participants' health and medical history, it should be recommended to monitor or to suggest participants to monitor blood pressure and heart rate before and after the workout.

Technologies

According to the experts, the fundamental criteria as to technologies are portability and easy access and, for the synchronous mode, good wi-fi connection. Big screens (at least 12–13", full HD, such as TV monitors or laptops) and devices with good sound system and cameras are preferable; tablets and smartphones, although often used, provide a less easy access to visual information.

In synchronous mode, for an effective experience devices should be set near to the participant and both participants and instructors should check to have a complete and mutual framing. The camera should be set frontal or lateral, with perspective from 90° and 45° for upright, sitting, or prone workout; exercises in prone position might benefit from a view from above.

In the asynchronous mode the instructor must focus on the quality and completeness of information of the instructional videos, adding texts, notes, visual effects and augmented reality elements through thoughtful video editing. Videos recorded specifically with special editing are more suitable than videos recorded in live sessions, nonetheless, the instructor can add frames from live training sessions for more realistic and immersive effect.

However, for both asynchronous and asynchronous sessions, there was not strong agreement on device placement, as all experts emphasized that positioning is highly dependent on what is necessary to observe during each exercise.

Relation and communication strategies

In tele-exercise, the direct physical interaction is missing, and nonverbal communication may be hard to detect. Experts suggested that communication should be kept simple, clear, friendly and adapt to the groups, according to their age, goals, level of skills, etc. It is also important to share a common technical vocabulary and avoid the use of acronyms and unfamiliar or foreign language.

In the interaction with the participants, the instructor should have an empathetic, engaging, motivating, encouraging attitude, maintaining a professional tone, eventually accompanied by some polite humour.

Regardless of the mode of training, the session should start welcoming the participants and assessing their well-being and psycho-physical conditions (pain, tension, fatigue, restlessness, etc.) since the previous workout. In the asynchronous mode this phase can be suggested as a form of self-assessment. Then, the instructor should provide a brief recap of the aims of the training (referring also to the previous lessons), introduce the goals of the current session, and explain the planned activities. If needed, in the synchronous mode they could reinforce technical information for the Internet connection. In asynchronous mode they could make the explanation clearer by using clips or images of movements.

The explanation of the exercise should start from the objectives and outcomes of the exercise, followed by the demonstration of the movement. This demonstration should be given before or along with its verbal description, because starting from the description would lead to a less effective understanding. The disclosure of possible errors in the movement or of general critical issues in advance may be effective for the participants to avoid them. Instructors should also provide information on timing, repetitions, sequences and describe what psycho-physical reactions to expect during the execution (fatigue, muscle tension, changes in breathing, etc.).

At the end of the session, still regardless of the specific mode of training, the instructor should check (directly or indirectly) the well-being status of the participants, then provide a summary of the workout activities and contextualize it within the perspective of overall goals. Upcoming appointments should be reminded, along with a preview of the objectives for the next workout session or suggestions for future workout. The instructor should also acknowledge the participants' progress and eventual issues.

Participants keep their motivation when they are given realistic goals: they need continuous feedback, encouragement and realistic expectations on their improvements. Their focus should be set on the overall final goal and as they approach it, the instructor should acknowledge their different emotions: their effort, their improvements, but also their fatigue or eventual negative emotions ("I know it may be hard on you but keep going!"). The instructor should reinforce and praise their correct behaviours, fostering a sense of belonging to the group. In the asynchronous settings, feedback and praise could be given through general references in the videos or through the platform, video submission, or other forms of direct contact (phone calls, emails, etc.) and stimulating the participants' self-monitoring abilities.

Monitoring in synchronous mode training

Experts agreed that monitoring is an essential process in tele-exercise that should consist in both monitoring by the instructor and self-monitoring by the participants.

In the synchronous mode, when participants are well trained, live monitoring is more motivating and it provides rapid feedback and control on the commitment, as well as on the effort intensity and movement adjustment to improve the performance and revise the training plans. Open discussions and engagement activities also increase the participants' collaboration, even in the case of untrained participants.

To autonomously correct the technical gesture, regulate the intensity of the execution or sustain one's motivation may be objectively difficult as self-monitoring activity, even for trained participants, the risk to underestimate eventual problems could also occur. Trained participants know their physical reactions and limits, and they might be able to improve their performance and training their effort management skills, which is not the case for untrained participants.

The monitoring process should focus on (a) the satisfaction; (b) the perceived intensity of the workout; (c) the ability to perform movements; (d) participants' reactions during the training (breathing, spatial orientation, emotional reactions); (e) their motivation and self-efficacy; (f) attendance frequency and connection-related data (connection times, etc.). Before starting the training program, it is recommended to assess the familiarity with the device and to administer physical tests to be repeated every now and again.

As to the self-monitoring by the participants, both in synchronous and asynchronous mode, the focus should be put on the ability to perform movements during the training, personal well-being signs before and after the training session, the perceived training intensity and, more generally, the awareness of personal physiological (heart rate, respiratory rate, range of motion, spatial orientation, etc.) and psychological (emotions) reactions.

As to the tools, experts suggested that direct observation might be integrated by grids and measures as field and in-session tests (number of push-ups, crunches, etc.). In addition, while a video shows the repeated projection of the exercise, the instructor could observe and correct the participants, or there could be a second instructor to compare the observations.

Participants could self-monitor their performance through heart rate devices, smartwatches, questionnaires and scales or a register to keep notes of their training log.

Monitoring in asynchronous mode training

Feedback from the instructor improves the participant's efficacy, although in the asynchronous mode training the communication is neither direct nor customised. The instructor should request feedback through survey and questionnaires avoiding direct contact by phone or email to evaluate the fitness level, motivation, self-efficacy and satisfaction. They should also keep track of the attendance frequency and the connection-related data and request periodically the submission of physical test results.

The more trained the participant, the more effective is their self-monitoring to improve their performance autonomously. On the contrary with untrained participants, a post training monitoring by the instructor is preferable. Self-monitoring should detect the already stated aspects; self-reported data and measures detected from devices should complement.

Discussion

This study aimed at defining consensus in guidelines for instructors of tele-exercise for fitness purposes with healthy trainees. To the best of the authors' knowledge, this study represents the first attempt to define a consensus in this field. It can be stated that the guidelines drafted in this paper undoubtedly represent a crucial first step in assisting and guiding all professionals who are approaching or wish to approach the world of tele-exercise.

In fact, nowadays the availability of tele-exercise training programs is widespread, nonetheless there are no formal guidelines as to the way it must be managed and organised by instructors. The diverse applications of tele-exercise, such as in rehabilitation, athletic training, or postural activities, create challenges in establishing clear and consistent parameters for defining the essential aspects of tele-exercise practices because these parameters differ depending on the aim of the tele-exercise and on the trainees.

This new way to exercise has been proving its effectiveness[6,7,25,31] and it is more and more popular. Nonetheless, since technologies are developing continuously, it is difficult to have long term expertise in this field and there is also a lack of certified expertise. Even the experts who took part in the panel of this study were experts in physical exercise who gained experience in remote exercise delivery through direct practice or research. However, despite the difficulties and the limited available literature, the development of guidelines for tele-exercise is necessary to clearly understand the challenges and key aspects to consider when undertaking a physical exercise program in this modality. This is crucial not only to ensure the intervention's maximum effectiveness but also to guarantee the safety of trainees.

On the basis of the information obtained with the present study, (1) fitness training design, (2) space and equipment, (3) technologies, (4) relational and communication modalities, and (5) monitoring were the five main areas of analyses identified. These 5 main areas of analysis represent 5 priority aspects on which it's currently possible to outline guidelines for effective and safe tele-exercise administration. However, it should be considered that further aspects will need to be taken into consideration in future research. In fact, further topics such as insurance and legal issues, could not be considered because of the consistent differences among countries and their still not sufficiently defined status. At the same time, other topics, such as the use of highly advanced technological devices, were only mentioned because of their sudden and continuous evolution which would require specific separate studies. All these areas will require further exploration in order to define specific guidelines.

What's important to consider is that tele-exercise, while a remote method of delivering physical activity, shouldn't be seen as something separate or an alternative to in-person exercise. Crucially, tele-exercise doesn't override or replace existing, physical activity recommendations from prominent bodies such as the WHO or ACSM[32–34]. On the contrary, the guideline within this document complements them: these guidelines represent a tool, enabling trainers and professionals to offer an additional avenue for individuals to embrace an active lifestyle and to attain the minimum physical activity levels suggested by the WHO, all within the framework of best practices for exercise administration and prescription currently endorsed by eminent institutions like the ACSM. Advocating for healthy lifestyles is a significant priority for numerous healthcare systems, especially, but not exclusively, in Western nations[35–37]: sedentary behaviour is strongly correlated with elevated risks of all-cause mortality, as well as cause-specific mortality from cancer, cardiovascular disease (CVD), and respiratory ailments. Conversely, even short durations of substituting sedentary habits with various forms of exercise have demonstrably reduced both overall and cause-specific mortality risks[38]. That's why promoting active lifestyles with every safe and effective tool, especially those that can reach many people, is essential. Tele-exercise fits this goal perfectly. However, any tool must be used carefully and safely, and the guidelines in this paper aim to ensure that purpose. These guidelines are not intended to replace the responsibilities and professionalism of the trainers, but only to assist them in managing what is a rapidly growing exercise delivery system often used for multiple purposes. To date, specific indications for remote exercises are only present for telerehabilitation or for pathological subjects, but in reality, everyone needs training programs that are safe and as effective as possible. This is precisely why, this study focused on healthy subjects, who are often "forgotten" because they are not considered to need specific training methods.

So, this study is not the finish line, but it's the starting line: future research will be necessary to analyse aspects not covered in the current study (such as legal considerations, which often have national variations) and to outline guidelines for the use of new and rapidly emerging technologies in our society (for example, the use of wearable devices for monitoring physiological parameters, or the use of AI for managing training programs). Also, more high-quality studies need to be conducted on tele-exercise to understand any potential issues associated with it (e.g., long-term safety) and to develop more suitable technological devices to support this training modality (e.g., hands-free devices to facilitate communication with instructors or other trainees).

Finally, this study is not without limitations. First, although the consensus process involved both internal and external experts, the sample size ($n = 14$) remains relatively small, which may limit the generalizability of the findings. Additionally, expert selection was purposive, which may introduce bias based on the participants'

specific professional backgrounds. While the mixed-method approach and structured rounds enhanced the credibility of the findings, the qualitative nature of the study means that some subjectivity in interpretation is inevitable. Furthermore, the absence of widely accepted operational definitions and pre-existing guidelines for tele-exercise posed challenges in anchoring the discussions to established standards. While the research showed agreement on crucial points concerning tele-exercise, the theoretical model presented is provisional and needs empirical validation through future high-quality studies that implement and evaluate its effectiveness in different practical situations.

Conclusions

Tele-exercise has several benefits, such as personalized programs, remote monitoring, increased accessibility and low costs, with case studies showcasing its potential to improve wellbeing and wellness among healthy people. It also presents potential benefits and challenges that need to be managed and explored such as the potential impact of integrating Artificial Intelligence, enhancement of data security, mental health support, and the dissemination of its use in schools and workplaces. Also, as tele-exercise continues to evolve, it is important to continue conducting high-quality research to obtain increasingly clear evidence, guiding trainers and users toward the most effective and safe practices. This paper offers a preliminary analysis aimed at establishing effective and safe practices for tele-exercise. While this consensus requires empirical validation, we aspire for tele-exercise to transition from a fitness tool for healthy individuals into a sustainable resource for global health and well-being in the future.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Author contributions

MC, FM, CB, Afu, and EI contribute to the conception of the study; MC, Afu, NDG, VMR and EI designed the work; MC, BM, AS, GCL, RP and EI developed the materials used in the procedures; MC, ADG, MS and JMVA acquired and analysed the data; MC, AFa, AFu, FM and GZ interpreted the data; MC, BM, FM, CB, AFu and EI have drafted the work or substantively revised it; FM and AFu administered the project; MC, CB and EI supervised the project. All authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individuals for the publication of any potentially identifiable images or data included in this article.

Competing interests

The authors declare no competing interests.

Additional information

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