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A Preliminary Randomized Controlled Trial of *My Wise Coach*: A Web App–Based Intervention For Nonsuicidal Self-Injury in Iranian Adolescents

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Abstract

The aim of this study was to develop and validate *My Wise Coach*, a web-based intervention designed to address the treatment needs of adolescents with NSSI in an Iranian sample. After developing the web-based intervention, a preliminary randomized controlled trial with a pretest–posttest design was conducted to investigate the efficacy of the web app–based intervention in reducing NSSI among Iranian adolescents. The participants consisted of 70 students (57.14% females) who were randomly assigned into two groups, and analysis of covariance was used to analyze the data. In this study, we examined key variables such as maladaptive schemas, distress tolerance, rumination, avoidance, impulsivity, trauma history, and NSSI behaviors. The results of MANCOVA indicated that there was a significant improvement in the treatment group across the examined variables, suggesting that the web-based intervention was effective. The results suggested that using the My Wise Coach web app was effective in helping adolescents manage experiential avoidance and rumination, which are considered maladaptive responses to early maladaptive schemas. This, in turn, may reduce schema-driven responses and engagement in NSSI. Generally, these findings extend our understanding of effective interventions for adolescent NSSI and provide preliminary evidence for a scalable digital treatment option; however, further research is needed to determine underlying mechanisms and to refine intervention strategies.

Keywords Non-suicidal self-injury (NSSI) · Web-based intervention · My Wise Coach · Maladaptive schemas · Digital mental health

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Introduction

Nonsuicidal self-injury (NSSI) is defined as direct and deliberate destruction of bodily tissue in the absence of suicidal intent (Nock, 2010). There are various methods of NSSI, including cutting, scratching, and burning (Klonsky et al., 2014). Recently, it has been indicated that the prevalence of NSSI may be increasing (Griffin et al., 2018; Wester et al., 2018). The prevalence rate of NSSI among adults is estimated at 5.5% (Swannell et al., 2014), while among preadolescents, young adults, and adolescents, it has been reported at 6.2% (Liu et al., 2022), 13.4%, and 17.2% (Swannell et al., 2014), respectively. Due to the high prevalence rate of NSSI in adolescents, it has been identified as an ongoing health concern in this population.

NSSI in Adolescents

This behavior is very common among adolescents in the world. Its prevalence among a nonclinical sample of adolescents is 17.2% (Swannell et al., 2014), and among an Iranian nonclinical sample is 6.2% (Marin et al., 2020). In this period, there are also lots of risk factors that different studies have recognized, including female gender, certain ethnic minorities, childhood maltreatment, bullying (victimization and perpetration), internet addiction/high level of internet use, impulsivity, loneliness, high family conflict, low maternal support and warmth, and emotional dysregulation (Kothadia et al., 2022). Since the highest rate of NSSI is seen in adolescence (Swannell et al., 2014), it is very important to investigate the reasons why this behavior is common among adolescents. Moreover, NSSI during adolescence can lead to long-lasting consequences, including anxiety, depression, and suicidal behaviors (Gulbas et al., 2015). It seems that one of the most important functions of NSSI for adolescents is to reduce tensions of life derived from aversive emotions (Hooley et al., 2020), as Nock (2010) has also suggested. Although the main function of these behaviors is to regulate emotions, the injury to body tissues increases the risk of suicidal behavior. So, it seems very important to improve our understanding of the underlying processes that lead adolescents to choose NSSI as a coping strategy. One of the most studied processes is emotion regulation.

Emotion Regulation Models For NSSI

Several theoretical models tried to describe NSSI, with especial focus on emotion regulation. For example, the process model of emotion regulation (Gross, 1998), the difficulties in emotional regulation model (Gratz & Romer, 2004), the experiential avoidance model (Chapman et al., 2006), the emotional cascade model (Selby et al., 2008), and the cognitive–emotional model of NSSI (Hasking et al., 2017). All these models have a focus on emotion regulation as a core process in the development and maintenance of NSSI. So, it seems critical to consider and integrate emotion

regulation skills training into treatment for NSSI. However, there are other transdiagnostic factors that contribute to NSSI, which are discussed below.

Models Points and An Integrated Model

There are some prominent points about the described models. First, all of them have a special focus on emotion and emotional dysregulation. Then, all models tried to consider important processes, i.e., cognitive processes, in the development of NSSI. However, there are some relevant gaps in the previous models that should be considered. First, the role of some transdiagnostic factors in the development of NSSI has not been identified well. For example, there is a large body of evidence showing the link between the early maladaptive schemas (EMS) and NSSI (Pilkington et al., 2021), but this construct, as an important factor in development, has not been considered in previous models. While NSSI behaviors are transdiagnostic in nature (Bentley et al., 2015), it is important to consider transdiagnostic factors too that have a role in developing, moderating, and maintaining these behaviors, but previous models did not address this important point. In addition, the role of cognitive processes in the development of NSSI is not well identified in the previous models, excepting the cognitive–emotional model of NSSI (Hasking et al., 2017). Another matter regarding the gap is the fact that it is not clear whether the previous models are appropriate for community samples of adolescents or not. Trying to overcome these gaps, an integrated model with transdiagnostic factors was developed (Babaeifard et al., 2024). The serial mediation model presented in that study described relationships between some transdiagnostic factors including early maladaptive schemas, distress tolerance, experiential avoidance, and rumination leading to NSSI behaviors and their intrapersonal function. For example, it was indicated that experiential avoidance mediated the mediating role of rumination in association with the schemas of social isolation, insufficient self-control, and NSSI and intrapersonal function. It was shown that experiential avoidance also mediated the mediating role of rumination in the relationship between DT and NSSI and intrapersonal function.

In-Person Treatments Versus Web-Based Treatments

Several interventions have been developed for NSSI. Generally, these interventions can be categorized into two types of either using face-to-face or web-based interventions (Ilagan et al., 2020). To date, there have been several interventions for NSSI including cognitive behavioral therapy (CBT; Taylor et al., 2011); dialectical behavior therapy (DBT; Miller et al., 2006); emotion regulation group therapy (ERGT; Donnelly, 2016); manual-assisted cognitive therapy (Evans et al., 1999); and dynamic deconstructive psychotherapy (Woody et al., 1985). With regard to psychotherapeutic interventions for NSSI in adolescents, we can point to emotional regulation individual therapy for adolescents (ERITA; Bjureberg et al., 2017); cutting down program (CDP; Saxena et al., 2023); developmental group psychotherapy (DGP; Wood et al., 2001); and treatment for self-injurious behaviors (T-SIB;

Andover et al., 2017), among which CDP and T-SIB seem to be more effective than the other mentioned interventions (Calvo et al., 2022).

Besides all these interventions have different efficacy, there are several challenges in how they are used. First, it should be considered that in-person treatments usually are costly and not available to all clients (Iliakis et al., 2019; Sareen et al., 2007), especially for adolescents, so they do not prefer these interventions. In addition, there are some barriers to seeking treatment for adolescents with NSSI, including fear of the fact that others consider them as attention seekers, fear of having problems in relationships, fear of criticism from parents and other important people, fear of being hospitalized, and also their negative attitudes about NSSI (Wang et al., 2023). So, it seems important to present the interventions in a novel way so that it can resolve the discussed challenges.

As an effort to develop new avenues of presenting interventions for NSSI to adolescents, web-based interventions were presented. There is a large amount of research that shows that internet-based treatments can be effective for a wide range of mental disorders, including depression (Cuijpers et al., 2015; Johansson & Andersson, 2012) anxiety (Christ et al., 2020; Etzelmueller et al., 2020); and borderline personality disorder (Ilagan et al., 2020). There are also several studies that demonstrate the effectiveness of Internet and computer-based interventions for NSSI (Bjureberg et al., 2023; Morthorst et al., 2021; Olsen et al., 2021). There are also some studies that have examined the feasibility of web app interventions for NSSI. To date, there have been several web-based apps for NSSI and patients with BPD who have self-harmed, and the effectiveness of these apps is tested in some studies. For example, DBT coach is one of the most famous apps in this field that has been designed based on DBT skills, and the effectiveness of this app has been tested in some studies (Rizvi et al., 2011, 2016). Pocket skills is another app that supports DBT, and its effectiveness for BPD has been tested (Schroeder et al., 2018). TEC is the name of another app that has been designed particularly to control and handle NSSI behaviors using the principles of traditional conditioning (Franklin et al., 2016).

Although these apps were relatively effective, there are some deficits both theoretically and technically. The main important matter is that they do not consider some transdiagnostic factors in developing NSSI in adolescents. Regarding apps' deficits, it can be said that they were not attractive enough, especially for adolescents. So, as it was mentioned above, it seems that there is a need for a new and integrated model of NSSI presented in an attractive way for adolescents.

Current Study: Towards Using An Integrated Model of NSSI In A Web App

Having all this in mind, it can be said that there is a need to develop a new kind of intervention for NSSI presented in a novel way. Thus, the present study aimed at developing a new web app–based intervention according to an integrated model of NSSI (Babaeifard et al., 2024). The intervention was supposed to last 2 weeks, and we expected to see improvements from pre- to posttreatment in NSSI in the treatment group. Cognitive defusion and mindfulness-based techniques were applied as

the main mechanisms. Consequently, a web-based app using the integrated model of NSSI, described above, was developed. The web app provided a platform for adolescents in which they can learn by playing games, which is attractive for adolescents, so they do not give up using the app easily.

We hypothesized that using the app can help reduce NSSI frequency and intensity by increasing other coping styles, building on defusion. Further, we expected that using the web app intervention can help reduce experiential avoidance and rumination as responses to early maladaptive schemas and distress tolerance, along with NSSI.

Method

The study used a pretest and posttest design to investigate the efficacy of a mobile web–based intervention on NSSI in Iranian adolescents in Tehran, Iran. The participants were randomly selected and assigned either to the waitlist control group or an intervention group receiving the psychoeducational intervention via the mobile web app. Recruitment started with participants with NSSI from highschool students who participated in the previous study (Babaeifard et al., 2024), in which 425 participants had a history of NSSI, which in this study was considered as engaging in one or more behaviors in their life that were selected from 12 methods in the Inventory of Statements About Self-Injury (ISAS; Klonsky & Glenn, 2009).

Participants and Procedure

The recruitment was conducted in some of the high schools in Iran, Tehran province. From those participants who had left their contact information in the first study (Babaeifard et al., 2024), 70 participants aged from 13 to 17 ($M = 15.69$, $SD = 1.15$) were randomly selected and assigned into two groups of treatment and control using simple randomization (shuffled deck of cards). All participants had a lifetime history of NSSI. They were asked to report the frequency of NSSI in the 10–500 range, as indicated in the ISAS (Klonsky & Glenn, 2009). The participants also reported their method of NSSI. Here are the methods used in descending order: banging (65.7%), craving (40%), interfering/wound healing (37.1%), cutting (34.3%), severe scratching (34.3%), pinching (28.6%), pulling hair (25.7%), biting (20%), rubbing (20%), burning (14.3%), swallowing dangerous substances (11.4%), and sticking (8.6%). The participants received the link of the approval via a message. After their approval and consent, the parental consent was provided via another link. Finally, they received a link that allowed them to access the web app. Then, they used the web app for 2 weeks.

Ethics Statement

The study followed all ethical guidelines with the subjects. The procedure was conducted in accordance with ethical standards of the Ethics Committee of Kharazmi

University of Tehran. Iran (IR. KHU. REC.1401.054) and with the Declaration of Helinski.

Measures

Young Schema Questionnaire-Short Form (YSQ-SF) the Young Schema Questionnaire-Short Form (YSQ-SF; Young, 1998) is a self-report measure with 75 items developed to assess 15 different maladaptive schemas (emotional deprivation, abandonment, mistrust/abuse, social alienation, defectiveness, incompetence, dependency, vulnerability to harm, enmeshment, subjugation of needs, self-sacrifice, emotional inhibition, unrelenting standards, entitlement, and insufficient self-control). The scale is rated from one (completely untrue for me) to six (describes me perfectly). The psychometric properties of the short form of this instrument also appear to be on par with those of the full (205-item) scale, demonstrating similar levels of reliability, validity, and clinical utility (Hoffart et al. 2005). The internal consistency of the YSQ-SF subscales was found to be acceptable. Cronbach's alpha coefficients were as follows: emotional deprivation ($\alpha = 0.75$), abandonment ($\alpha = 0.70$), mistrust/abuse ($\alpha = 0.69$), social isolation ($\alpha = 0.70$), defectiveness/shame ($\alpha = 0.78$), failure ($\alpha = 0.83$), dependence/incompetence ($\alpha = 0.71$), vulnerability to harm ($\alpha = 0.72$), enmeshment ($\alpha = 0.70$), subjugation ($\alpha = 0.84$), self-sacrifice ($\alpha = 0.75$), emotional inhibition ($\alpha = 0.80$), unrelenting standards ($\alpha = 0.74$), entitlement ($\alpha = 0.72$), and insufficient self-control/self-discipline ($\alpha = 0.72$). The overall internal consistency of the YSQ-SF in this study was excellent ($\alpha = 0.92$).

Distress Tolerance Scale (DTS) the Distress Tolerance Scale (DTS; Simons & Gaher, 2005) is a self-report measure with 15 items assessing one's ability to tolerate emotional distress. DTS has four subscales including tolerance, appraisal, absorption, and regulation. Higher scores indicate a greater ability to tolerate distress. The total DTS and its subscales showed good internal consistency, convergent and divergent validity, and adequate test–retest reliability (Simons & Gaher, 2005). The scale reliability was good in the current sample, $\alpha = 0.79$.

Ruminative Response Scale (RRS) the Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991) is a self-report measure developed to evaluate the tendency to respond to depressed moods. The RRS is composed of 22 items, all rated on a 4-point Likert-type scale, ranging from 1 (almost never) to 4 (almost always). Treynor et al., (2003) identified two main components for rumination, including: reflection and brooding, and reported that the other 12 items are depression-related. The RRS is proven to be a reliable and valid measure of rumination, and Cronbach's alpha has been shown to be above 0.90 (Roelofs et al., 2006). The Cronbach's alpha was 0.71 in our sample.

Fusion Questionnaire for Youth *(*AFQ) The Fusion Questionnaire for Youth (AFQ-Y8; Greco et al., 2008) is the short version of The Fusion Questionnaire, including eight items. The questionnaire is rated on a 5-point scale ranging from 0 (not at all

true) to 4 (very true). Higher scores indicate psychological inflexibility, indicating the tendency to get fused with the content of thoughts and feelings. The measure had excellent internal consistency ($\alpha = 0.83$; Greco et al., 2008). The Cronbach's alpha in our sample was 0.75.

Inventory of Statements About Self-Injury (ISAS) the Inventory of Statements About Self-Injury (ISAS; Klonsky & Glenn, 2009) is a measure with two behavioral and functional sections to assess lifetime frequency and functions of NSSI behaviors. In the "Introduction" section, participants responded to questions regarding NSSI behavior that indicate the used method. The methods represented in this section include (a) banging/hitting, (b) biting, (c) burning, (d) carving, (e) cutting, (f) needle-sticking, (g) pinching, (h) hair pulling, (i) rubbing skin against rough surfaces, (j) severe scratching, and (k) swallowing dangerous substances. The participants indicate the approximate number of times they have performed each behavior (e.g., 0, 10, and 20 times) for each behavior. The behavioral scales have demonstrated good reliability and validity (Klonsky & Olino, 2008). Cronbach's α reliability of the scales was 0.81 in our sample. The total number of lifetime NSSI was obtained by adding the number of acts across all methods. In addition, the statements in the functional section were rated on a 3-point scale: 0 (not relevant), 1 (somewhat relevant), and 2 (very relevant). The functions were categorized into interpersonal and intrapersonal functions.

Intervention

The Process of the Intervention Development and Validation

The process was conducted in the following steps: (1) the important transdiagnostic factors that were associated with NSSI were identified based on the integrated model. (2) The transdiagnostic-based protocols and components related to the identified components of the integrated model were determined based on recent studies. (3) A primary version of the protocol was developed based on the results of the previous steps and under the supervision of Dr. Roediger, who has developed the contextual schema therapy approach (Roediger et al., 2018). (4) The developed protocol was evaluated by five Iranian and foreign clinical psychologists who were experts in NSSI. They were asked to give their opinion on a three-point scale ([1] = not essential [2] = useful but not essential, and [3] = essential) for validation. Then, Lawshe's content validity index (CVI) was calculated. It was 0.99, representing a nearly perfect consistency. (5) Then, the primary prototype of the Web app was developed by IT experts, and it was designed based on the contents of the protocol, and a name was selected for it (*My Wise Coach*). (6) The web-based protocol was first tested for two students. The results showed that using the web app led to a decrease in most of the early maladaptive schemas, experiential avoidance, and rumination, and an increase in distress tolerance, and as a result, the frequency and intensity of NSSI behaviors also decreased. (7) Then, 70 participants of the first study (57% women)

were randomly selected and assigned to the treatment or the control group (35 participants including 20 women and 15 men in each group). They received the link to the web app and were asked to use that for 2 weeks. A 2-week intervention period was chosen to balance feasibility and engagement, aiming to sustain adolescents' interest without overburdening them. Short-duration digital interventions help minimize attrition and align with online attention spans observed in previous youth-focused programs. (8) Finally, participants were asked to fill out the posttest questionnaires found by a link in the last session. (9) The participants could ask their questions or talk about their problems via e-mail or a contact number.

Web-Based Intervention Content

The intervention contents are described in detail in Table 1. The web app (*My Wise Coach*) contained 12 separate sessions, and the participants were supposed to complete the tasks in the web app over 2 weeks. Each session was expected to take one day. The first two sessions addressed psychoeducation about NSSI and underlying mechanisms, and the participants got familiar with NSSI and the way they might choose it as a coping strategy. In the following sessions, defusion techniques were presented in order to distance themselves from internal experiences. Defusion techniques are derived from acceptance and commitment therapy (ACT) and aim to reduce the literal fusion with distressing thoughts by encouraging adolescents to observe thoughts as passing mental events rather than truths. For example, participants practiced 'leaves-on-a-stream' visualizations, labeling thoughts (e.g., *'I'm having the thought that…'*), and using metaphorical distancing exercises to see thoughts as objects (Hayes et al., 2006). Then, they learned how to choose other techniques (mindfulness, distress tolerance, and positive self-talk) in order to substitute them for the first unpleasant experiences. Finally, they were led to the last sessions where they could complete the posttreatment questionnaires and give feedback about the web app.

Control Group

Control group consisted of 35 participants (including 20 women and 15 men). They were asked to complete the questionnaires at the two points of time. Following completion of the study, they were provided with access to the web app.

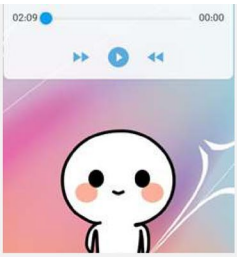
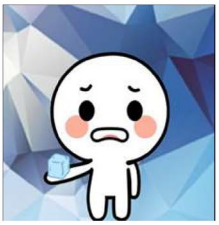
Data Analysis

The data in this study was analyzed using SPSS (version 26). Effect sizes (partial eta-squared) were calculated for all analyses. No imputation was required as missing data were absent. Multiple comparisons were addressed using the Bonferroni correction to control for inflated Type I error rate; all p values reported have been adjusted accordingly. Given the exploratory scope of the study, these corrections were conservative, and this approach is acknowledged as a limitation. Changes in

Table 1 Protocol Content in *My Wise Coach*, A Web-Application

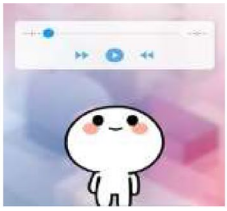
Session	Content
Session 1	The descriptions about the protocol and NSSI are presented using a voice message. 
Session 2	The descriptions about Early maladaptive Schemas, Distress tolerance, experiential avoidance, rumination and their relationship with NSSI are presented using voice message. 
Session 3	An image, that can be the representative of the user, is presented. Then they are asked to look at the picture in which thoughts and emotions are separated from the person. (defusion).
Session 4	First, participants are led to a page in which they can see a picture of a person that can be a representative of themselves. Then they are told to write or imagine their schema driven emotions and thoughts and to put them on the chair while they stand above it. 
Session 5	The instructions of breath meditation were loaded using a voice message. In the video message an image of a person who is doing the exercise is presented.

Table 1 (continued)

	
Session 6	In this session an ice cube exercise is presented in order to tolerate distress. An image of a person who is doing the exercise is presented.
	
Session 7	In this session, visual mindfulness technique is presented. The user is asked to just look at the screen and describe what is seeing. The instruction is presented through a message.
	
Session 8	The instruction of mindful listening is presented. The user is asked to just listen to the different voices and describe what is listening. The instruction is presented through a message.

pretest and posttest were analyzed using analysis of covariance. Prescores were considered as covariates. The MANCOVA was used to assess the main effect of the intervention on a set of variables of interest. In order to assess the main effect of the intervention on each variable, the ANCOVA was applied.

Table 1 (continued)

	
Session 9	In this session the user learns about self- talk. The instruction is loaded using message. Then the image of a Hero is presented. where they can write their own self-talk. 
Session 10	Here there is an exercise for thoughts. The user is asked to look at a white room in a web application in which they should only watch their thoughts coming into the room from one door and going out through the other. 
Session 11	The techniques are reviewed in a sequential order and the user is invited to do the games.
Session 12	The description about the last session and generally about the protocol and the ways in which they can continue to use the techniques in real life situations is presented using a voice message. Then the user is asked to answer the post test questionnaires using a link.

Results

Preliminary Analysis

The diagram of the participants through the trial based on the CONSORT statement (Hopewell et al., 2025) is represented in Fig. 1. Mean scores and standard deviations of variables are presented in Tables 2 and 3. In addition, all participants completed the entire intervention and all measures. Before conducting covariance analysis, we

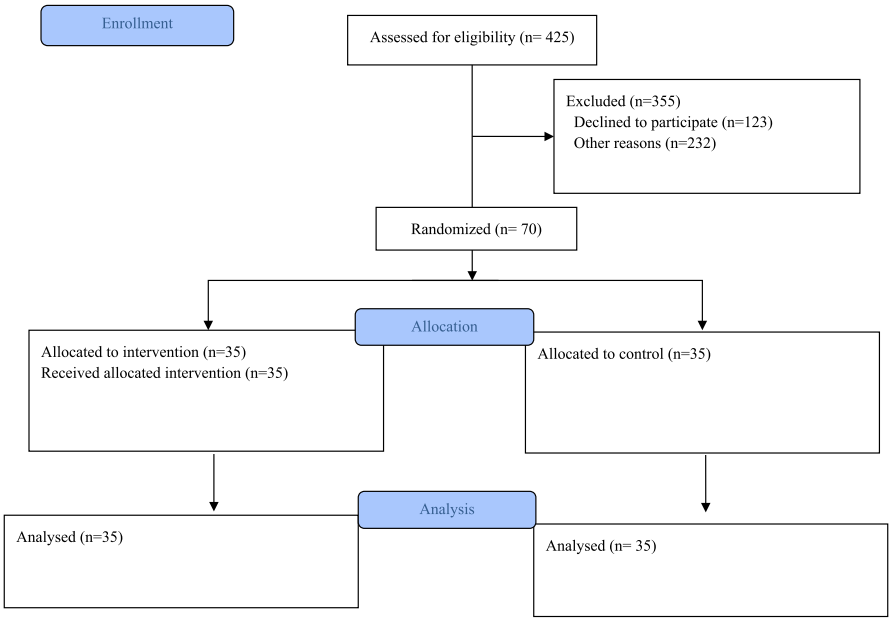


Fig. 1 Flowchart of the participants through the study

examined the normality of the distribution using the Kolmogorov–Smirnov test. As presented in Appendices 1 and 2, the p value for most of the variables was higher than 0.05, suggesting that the variables, including experiential avoidance, distress tolerance, and NSSI functions, are all normally distributed; thus, this assumption was met. However, the significance level of the Kolmogorov–Smirnov test for some of the schemas was not higher than 0.05. As Wickens and Keppel (2004) suggest, because the sample size is more than 12, it can be ignored. On the other hand, for NSSI behaviors, the Wilcoxon rank sum test was used because the behaviors scale was different. In addition, other tests for considering the assumptions of MANCOVA, including Leven's test for homogeneity of variance and the test of homogeneity of regression slopes, were conducted, and the results are presented in Appendices 3 and 4. Leven's test for homogeneity of variance is used to investigate whether the samples have the same variance, and since the obtained value of most of the variables was less than 0.05, this assumption was met. Finally, the results of the test of homogeneity of regression slopes revealed that this assumption was met ($p < 0.05$).

Analysis of Covariance

After examining the assumptions, the results of MANCOVA showed that controlling the scores of pre-tests, the main effect of treatment on early maladaptive schemas was significant (F (15,39) = 25.798, $p < 0.05$, $\eta^2 = 0.908$). In addition, the results indicated that the treatment had a significant effect on distress tolerance, experiential

Table 2 Means and standard deviations (SD) of early maladaptive schemas, experiential avoidance, distress tolerance, and rumination

Variable		Control group		Treatment group	
		M	SD	*M*	SD
Emotional deprivation	Pre	94.2	1.32	3.09	1.43
	Post	3.18	1.43	2.45	1.10
Abandonment	Pre	2.61	1.11	2.45	0.91
	Post	2.92	1.28	2.07	0.78
Mistrust	Pre	2.27	0.98	2.54	0.98
	Post	2.48	1.09	2.28	0.97
Social isolation	Pre	2.30	1.00	2.69	1.18
	Post	2.50	1.05	1.96	1.06
Defectiveness/shame	Pre	1.07	0.94	2.21	1.31
	Post	1.89	1.06	1.99	1.08
Failure	Pre	2.01	0.98	2.22	1.15
	Post	2.30	1.06	2.04	0.97
Dependence/incompetence	Pre	1.94	0.70	1.94	0.93
	Post	2.13	0.80	1.67	0.83
Vulnerability to harm/illness	Pre	2.06	0.99	2.41	1.17
	Post	2.37	1.00	1.48	0.79
Enmeshment/undeveloped self	Pre	2.09	0.85	2.17	0.88
	Post	2.30	0.91	1.87	0.93
Subjugation	Pre	1.81	0.62	1.99	1.98
	Post	2.09	0.72	1.67	0.84
Self-sacrifice	Pre	2.78	1.06	2.89	1.18
	Post	2.98	1.18	2.19	1.07
Emotional inhibition	Pre	2.69	1.09	2.97	1.35
	Post	3.01	1.08	2.25	0.94
Unrelenting standards	Pre	3.49	1.25	3.49	1.18
	Post	3.75	1.35	2.62	1.14
Entitlement/grandiosity	Pre	3.23	1.19	3.12	0.90
	Post	3.50	1.14	2.36	1.04
Insufficient self-control Distress tolerance Experiential avoidance	Pre	2.59	1.03	2.56	0.87
	Post	2.83	1.18	1.57	0.68
	Pre	38.57	7.66	36.20	8.06
	Post	36.34	7.57	39.14	8.48
	Pre	4.0510.37		13.06	5
	Post	4.0511.77		9.14	5.81
Rumination	Pre	47.57	12.54	51.57	13.59
	Post	50.51	12.95	39.80	13.45

Relevant *F* statistics, *p* values, and effect sizes analyses are presented in Tables 5, 6, and 7

Table 3 Means and standard deviations (SD) of NSSI behaviors and functions

Variable		Control group		Treatment group	
		M	SD	*M*	SD
Cutting	Pre	0.69	0.83	0.60	1.06
	Post	0.69	0.83	0.34	0.84
Sever scratching	Pre	0.14	0.43	0.43	1.04
	Post	0.20	0.53	0.3	0.96
Biting	Pre	0.34	0.64	0.74	1.15
	Post	0.46	0.78	0.40	0.81
Banging	Pre	0.71	0.57	1.23	1.29
	Post	0.86	0.81	0.71	1.02
Burning	Pre	0.26	0.74	0.34	1
	Post	0.31	0.80	0.20	0.58
Interfering	Pre	0.29	0.52	0.57	0.92
	Post	0.34	0.68	0.40	0.77
Craving	Pre	0.37	0.73	0.54	0.74
	Post	0.31	0.63	0.14	0.49
Rubbing	Pre	0.11	0.40	0.31	0.68
	Post	0.17	0.57	0.11	0.32
Pinching	Pre	0.29	0.62	0.37	0.65
	Post	0.29	0.57	0.14	0.43
Sticking	Pre	0.11	0.40	0.09	0.28
	Post	0.09	0.37	0.03	0.17
Pulling hair	Pre	0.69	0.93	0.60	1.19
	Post	0.94	0.97	0.31	0.76
Swallowing dangerous substances	Pre	0.29	0.71	0.14	0.43
	Post	0.17	0.62	0.00	0.00
Interpersonal boundaries	Pre	1.97	1.36	1.71	1.53
	Post	1.89	1.28	1.17	1.22
Autonomy	Pre	2.23	1.54	2.11	1.62
	Post	2.20	1.64	1.31	1.35
Interpersonal influence	Pre	1.60	1.46	1.46	1.63
	Post	1.94	1.49	0.80	1.28
Peer-bounding	Pre	1.86	1.65	1.60	1.54
	Post	2.03	1.50	0.74	0.92
Revenge	Pre	1.54	1.27	1.60	1.50
	Post	1.71	1.34	0.86	1.00
Self-care	Pre	1.66	1.53	1.54	1.58
	Post	1.83	1.69	0.89	1/16
Sensation-seeking	Pre	2.17	1.69	2.03	1.56
	Post	2.29	1.06	0.97	1.12
Toughness	Pre	1.97	1.54	2.17	1.69
	Post	2.14	1.54	1.17	1.15
Self-punishment	Pre	1.89	1.43	1.71	1.45

Table 3 (continued)

Variable		Control group		Treatment group	
		M	SD	*M*	SD
	Post	2/09	1.62	0.69	0.83
Antidissociation	Pre	1.43	1.36	1.86	1.70
	Post	1.63	1.55	0.80	1.05
Antisuicide	Pre	2.06	1.67	2.83	1.60
	Post	2.63	1.77	1.46	1.09
Marking distress	Pre	1.69	1.30	1.86	1.60
	Post	1.77	1.26	1.34	1.61
Affect regulation	Pre	3.11	1.23	3.3	1.72
	Post	3.83	1.56	1.66	1.37

Relevant *F* statistics, *p* values, and effect sizes analyses are presented in Tables 4, 5, and 6

Table 4 Multivariate tests use the MANOVA for early maladaptive schemas, distress tolerance, experiential avoidance, rumination, and NSSI functions

Variable		Value	*F*	*df1*	*df2*	*p*	η
Early maladaptive schemas	Pillai's trace	0.908	25.798	15	39	0.001	0.908
	Wilks' lambda	0.092	25.798	15	39	0.001	0.908
	Hotelling's trace	9.92	25.798	15	39	0.001	0.908
	Roy's largest root	9.922	25.798	15	39	0.001	0.908
Distress tolerance, experiential avoidance, rumination	Pillai's trace	0.737	58.806	3	63	0.001	0.737
	Wilks' lambda	0.263	58.806	3	63	0.001	0.737
	Hotelling's trace	2.8	58.806	3	63	0.001	0.737
	Roy's largest root	2.8	58.806	3	63	0.001	0.737
NSSI functions	Pillai's trace	0.887	26.091	13	43	0.001	0.887
	Wilks' lambda	0.113	26.091	13	43	0.001	0.887
	Hotelling's trace	7.888	26.091	13	43	0.001	0.887
	Roy's largest root	7.888	26.091	13	43	0.001	0.887

avoidance, and rumination (F (3,63) = 58.806, $p < 0.05$, $\eta^2 = 0.737$). The MANCOVA results also showed that the main effect of the treatment on NSSI functions was significant (F (13,43) = 26.091, $p < 0.05$, $\eta^2 = 0.887$). The results are presented in the tables below. In addition, the ANCOVA for all of the variables of interest was conducted, and the results are presented in Tables 4, 5, 6, and 7. As shown in Table 8, for NSSI behaviors, the Wilcoxon rank sum test was used because the behaviors scale was different. The results showed a significant difference in all variables of interest excluding burning, sticking, interfering/wound healing, and swallowing dangerous substances.

Table 5 ANCOVA for early maladaptive schemas

Variable	Sum of squares	*df*	Mean of squares	*F*	*p*	*η*
Emotional deprivation	6.918	1	6.918	20.105	0.001	0.275
Abandonment	10.106	1	10.106	34.084	0.001	0.391
Mistrust	2.768	1	2.768	9.782	0.003	0.156
Social isolation	9.742	1	9.742	55.394	0.001	0.511
Defectiveness/shame	1.1666	1	1.1666	4.86	0.032	0/084
Failure	2.523	1	2.523	9.792	0.003	0.156
Dependence/incompetence	2.996	1	2.996	26.015	0.001	0.329
Vulnerability to harm/illness	17.223	1	17.223	69.739	0.001	0.568
Enmeshment/undeveloped self	3.316	1	3.316	22.443	0.001	0.297
Subjugation	3.942	1	3.942	20.349	0.001	0.227
Self-sacrifice	13.201	1	13.201	47.818	0.001	0.474
Emotional inhibition	12.826	1	12.826	72.016	0.001	0.576
Unrelenting standards	20.444	1	20.444	53.048	0.001	0.05
Entitlement/grandiosity	14.28	1	14.28	29.049	0.001	0.354
Insufficient self-control	18.431	1	18.431	71.466	0.001	0.574

Table 6 ANCOVA for distress tolerance, experiential avoidance, and rumination

Variable	Sum of squares	*df*	Mean of squares	*F*	*p*	*η*
Distress tolerance	451.762	1	451.762	**39.444**	0.001	0.378
Experiential avoidance	511.456	1	511.456	**89.543**	0.001	0.579
Rumination	2989.848	1	2989.848	**90.544**	0.001	0.582

Table 7 ANCOVA for NSSI functions

Variable	Sum of squares	*df*	Mean of squares	*F*	*p*	*η*
Interpersonal boundaries	4.317	1	4.317	19.56	0.001	0.262
Autonomy	10.22	1	10.22	15.935	0.001	0.225
Interpersonal influence	17.115	1	17.115	23.504	0.001	0.299
Peer bounding	19.673	1	19.673	41.786	0.001	0.432
Revenge	13.476	1	13.476	30.029	0.001	0.353
Self-care	9.85	1	9.85	16.036	0.001	0.226
Sensation seeking	21.052	1	21.052	35	0.001	0.389
Toughness	20.336	1	20.336	42.786	0.001	0.438
Self-punishment	26.213	1	26.213	59.349	0.001	0.519
Antidissociation	23.872	1	23.872	44.249	0.001	0.446
Antisuicide	27.359	1	27.359	41.338	0.001	0.429
Marking distress	4.827	1	4.827	8.454	0.005	0.133
Affect regulation	77.112	1	77.112	83.398	0.001	0.0603

Table 8 Wilcoxon rank sum test for comparison between NSSI behaviors in the control and treatment groups

Group	Variable	Rank mean	Rank sums	*Z*	*p*
Control	Cutting	1.5	1.5	0	1
	Sever scratching	2.5	2.5	−1	0.317
	Biting	0	0	−1.633	0.102
	Banging	8	8	−1.508	0.132
	Burning	0	0	−1.414	0.157
	Interfering	3.5	7	−0.816	0.414
	Craving	1.5	3	−1.414	0.157
	Rubbing	1.5	1.5	−1.816	0.141
	Pinching	1.5	1.5	0	1
	Sticking	1	1	−1	0.317
	Pulling hair	5	5	−2.496	0.013
	Swallowing dangerous substances	2	6	−1.633	0.102
Treatment	Cutting	5	45	−3	0.003
	sever scratching	2.5	10	−2	0.046
	Biting	6	66	−3.327	0.001
	Banging	9	1533	−4.025	0
	Burning	3.25	13	−1.518	1.129
	Interfering	4.5	31.5	−2.121	0.034
	Craving	6.5	78	−3.276	0.001
	Rubbing	4	28	−2.646	0.008
	Pinching	4	28	−2.53	0.011
	Sticking	1.5	3	−1.414	0.157
	Pulling hair	3.5	21	−2.232	0.029
	Swallowing dangerous substances	2.5	10	−1.89	0.059

User's Satisfaction

The study assessed users' satisfaction by some questions regarding the design, usability, and the contents of the app's tasks. Analyzing participants' responses to the questions, it was shown that 85.71% of them reported their satisfaction with the app.

Discussion

The main aim of this study was to investigate the efficacy of an app-based protocol for NSSI in adolescents. Generally, the findings suggested that the use of the web app–based protocol led to reduced NSSI in the intervention group. This general finding is in line with previous findings regarding the effectiveness of web-based treatments in reducing NSSI (Franklin et al., 2016; Rizvi et al., 2016). Generally, the app's focus was on defusion, mindfulness techniques, and positive self-talk that

could target common components of the integrated model of NSSI, as discussed earlier.

Regarding early maladaptive schemas, the findings showed that the use of the web app resulted in a general decrease in schemas. However, this reduction should be interpreted with caution because moderating the structure and contents of early maladaptive schemas is a complex process (Young et al., 2006). Since the designed protocol focused more on how to manage experiential avoidance and rumination, considered as maladaptive responses to schemas, we have to consider that defusion techniques applied to manage experiential avoidance and rumination could reduce schema-driven emotions and thoughts, explaining the changes in schema scores.

Distress tolerance was another component of the designed protocol in this study. The results showed that the use of the web app could lead to an increase in total distress tolerance. Since this construct was one of the most important factors in the literature of NSSI (Akbari et al., 2024), a separate session was considered to target that (holding ice cube).

Regarding experiential avoidance and rumination, the findings showed that using the web app resulted in decreased scores in both experiential avoidance and rumination. It seems that using the web app with more emphasis on defusion and then mindfulness techniques could help the adolescents manage experiential avoidance and rumination better. These findings are in line with previous findings of comparable studies using web apps with similar mindfulness techniques (Reyes, 2022; Webb et al., 2025).

Generally, the findings of our study showed that the use of the web app with especial focus on defusion and mindfulness techniques resulted in a reduction in all NSSI behaviors except burning, sticking, interfering/wound healing, and swallowing dangerous substances. One potential explanation is that these behaviors are considered to be impulsive (Dawood et al., 2018), and changing these behaviors is more difficult. The results also indicated that both—inter- and intrapersonal—functions of NSSI decreased after 2 weeks of using the web app. To explain these findings, we now take a look at NSSI functions in more detail: NSSI behaviors are committed with different functions among adolescents (Klonsky & Glenn, 2009). In other words, individuals choose these behaviors because of especial reasons that can be interpersonal (e.g., peer-bonding and intrapersonal influence) or intrapersonal (e.g., affect regulation and self-care). Now, offering other alternatives (e.g., techniques presented in the web app) leads to a decrease of these behaviors, as the findings of this study showed.

Limitations and Future Directions

This study has some limitations. First, since we did not actually test whether reductions in schemas, rumination, or improvements in distress tolerance resulted in subsequent improvements in NSSI behavior, improvements may not have arisen directly from improvements in these factors and instead could have arisen from factors not measured or controlled. So, there is a need for future studies to measure other potential factors in more controlled settings. Second, in this study, we do not have a

follow-up phase, so we could not monitor the development after using the web app. Thus, there is no data on whether the changes are persistent or not. Future studies can cover this limitation by using a follow-up phase. Third, since the adolescents needed to learn about how to use the app, some participants might have problems using the app and did not use it in an appropriate way. Future studies in this field could consider this limitation and should try to design even more attractive and user-friendly apps. Although Bonferroni corrections were applied to control for inflated Type I error due to multiple comparisons, these adjustments were conservative and may have reduced the sensitivity to detect some true effects. Moreover, given the exploratory nature of this study, other approaches to controlling false positives were not employed. Future studies with larger samples and pre-registered hypotheses could provide more robust estimates while minimizing the risk of Type I error.

Conclusion

The study examined the possibility of using a web-based protocol for NSSI in Iranian adolescents. Based on the results, it was demonstrated that the protocol could result in a reduction in NSSI behaviors in the experimental group. However, the results should be interpreted with caution. Despite the promising results about the effectiveness of web-based interventions in general, more studies are needed to identify the processes contributing to this effectiveness. In addition, the most effective procedures in which these apps can be used should be identified (Witt et al., 2017). In general, it seems that it is better to use these web-based interventions as an add-on intervention until further evidence is yielded in this field.

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Declarations

Ethics Statement The authors declare that the procedure of the study was in accordant with Ethical standards of ethics committee of Kharazmi University (IR. KHU. REC.1401.054) and with the Declaration of Helinski.

Consent The informed consent was obtained from all the participants.

Conflict of interest The authors declare that there is no conflict of interest.

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