

The Effectiveness of Virtual Reality Exposure Therapy and Mindfulness-Based Cognitive Therapy on Meta-Emotional Dimensions in Adolescents with Social Anxiety

Solmaz Choheili¹, Fatemeh Sadat Marashian^{1*}, Sahar Safarzadeh¹, Parviz Asgari¹

¹Department of Psychology, Ahv.C., Islamic Azad University, Ahvaz, Iran

Abstract

Introduction: Social anxiety disorder is a prevalent and debilitating condition among adolescents, often maintained by dysfunctional meta-emotional beliefs. The present study aimed to compare the effectiveness of Virtual Reality Exposure Therapy (VRET) and Mindfulness-Based Cognitive Therapy (MBCT) on meta-emotional dimensions in adolescents with social anxiety in Ahvaz, Iran.

Methods: This study utilized a pre-test, post-test, and follow-up design with a control group. The statistical population included all adolescents with social anxiety disorder who sought treatment at counseling centers in Ahvaz between March and June 2024. A convenience sample of 45 participants was selected and then randomly assigned to two experimental groups (VRET, n=15; MBCT, n=15) and a control group (n=15). VRET consisted of eight weekly 45-minute sessions, while MBCT consisted of eight weekly 90-minute sessions. Data were collected using diagnostic interviews and the Meta-Emotion Questionnaire (MEQ), and analyzed using a repeated-measures ANOVA.

Results: Both the VRET and MBCT groups showed significant improvement in meta-emotional dimensions compared with the control group. Furthermore, VRET demonstrated a slightly greater improvement, although both therapies maintained their positive effects at the three-month follow-up.

Conclusion: The results indicate that both VRET and MBCT are effective interventions for improving meta-emotional dimensions in adolescents with social anxiety. These findings highlight the potential for integrating technology-based and mindfulness-based approaches into clinical practice to enhance therapeutic outcomes.

Keywords: Anxiety, Virtual reality, Mindfulness, Adolescent, Metacognition

Article History:

Received: 1 September 2025
Accepted: 28 November 2025

Please cite this paper as:

Choheili S, Marashian FS, Safarzadeh S, Asgari P. The Effectiveness of Virtual Reality Exposure Therapy and Mindfulness-Based Cognitive Therapy on Meta-Emotional Dimensions in Adolescents with Social Anxiety. *Health Man & Info Sci*. 2026; 13(1): 13-21. doi: 10.30476/jhmi.2025.108549.1312.

*Correspondence to:

Fatemeh Sadat Marashian,
Department of Psychology, Ahv.C.,
Islamic Azad University, Postal
code: 68875-61349, Ahvaz, Iran
Tel: +98 61 33348420
Email: fsmarashian@iau.ac.ir

Introduction

Social anxiety disorder, also known as social phobia, ranks among the most prevalent anxiety disorders, with a particularly high incidence among adolescents (1). It is characterized by a marked and persistent fear of social or performance situations where the individual faces unfamiliar people or potential scrutiny from others, profoundly disrupting developmental trajectories (2). At its core lies the dread of negative evaluation, which engenders substantial distress and entrenched avoidance behaviors (3). During adolescence—a critical phase of identity formation and peer relationship building—this disorder exerts especially deleterious effects, often manifesting as diminished academic achievement, social

withdrawal, and compromised quality of life. Without intervention, social anxiety frequently endures into adulthood, elevating the likelihood of comorbidities such as depression and substance use disorders (4, 5). Consequently, early identification and efficacious treatment are imperative to safeguard the long-term psychological health of this at-risk demographic.

Beyond the fear of external judgment, a crucial factor in maintaining social anxiety is an individual's internal relationship with their own emotions, a concept referred to as meta-emotion (6). Meta-emotional dimensions refer to an individual's cognitive and affective evaluations of their own emotions, including beliefs about the legitimacy of their feelings, their capacity for emotional regulation, and their apprehension

toward experiencing specific emotions (7). Within social anxiety, maladaptive meta-emotional schemas predominate, such as construing anxiety as intractable, perilous, or indicative of frailty. This meta-emotional dread—focusing on the emotion per se rather than the precipitating context—perpetuates a self-reinforcing loop: an adolescent may anticipate unease in a social milieu, then fret over that unease itself, culminating in avoidance to avert the torment of fear (8). Interventions that dismantle these aberrant meta-emotional facets hold promise for interrupting such cycles, thereby nurturing resilient and adaptive emotional architectures.

In recent decades, an array of therapeutic modalities has been devised and empirically scrutinized for social anxiety. Cognitive-behavioral therapy (CBT) endures as the benchmark, yielding sustained symptom alleviation (9). Augmenting exposure therapy tenets, Virtual Reality Exposure Therapy (VRET) has surfaced as an innovative technological paradigm (10). VRET employs immersive virtual milieus to recapitulate social scenarios, enabling fear confrontation in a calibrated, secure framework. Its merits include scenario personalization, reduced therapeutic burden, and enhanced accessibility to circumvent avoidance (11). Accumulating evidence endorses VRET's potency across anxiety spectra, with meta-analyses affirming its parity to conventional in vivo exposure for social phobia remediation (12, 13). Emerging inquiries further illuminate VRET's modulation of cognitive-affective mechanisms, evincing reductions in negative evaluation fears and bolstering social self-efficacy (14).

In parallel with technological advancements, there has been a significant shift towards integrating mindfulness-based practices into therapy. Mindfulness-Based Cognitive Therapy (MBCT), originally developed to prevent depressive relapse, has shown considerable promise in treating anxiety disorders (15). MBCT amalgamates CBT fundamentals with mindfulness meditation, emphasizing dispassionate attunement to internal phenomena—encompassing ideation, somatosensation, and emotion (16). For adolescents grappling with social anxiety, MBCT facilitates disengagement from ruminative anxious currents, forestalling escalation into avoidance or self-reproach (17). By fostering an equanimous emotional regard,

it equips individuals to witness anxiety without subsumption. Empirical appraisals of MBCT in anxiety contexts affirm symptom abatement and regulatory enhancement, with select investigations underscoring shifts in meta-cognitive and meta-emotional constructs (18, 19).

Notwithstanding the substantiated merits of VRET and MBCT in ameliorating social anxiety, lacunae persist in the extant corpus. Sparse direct juxtapositions of these disparate modalities abound, especially vis-à-vis their incursions into latent mechanisms like meta-emotional dimensions. Moreover, predominant Western-centric inquiries constrain extrapolations to heterogeneous cultural milieus. The instant investigation redresses these voids via a head-to-head appraisal of VRET and MBCT among Iranian adolescents with social anxiety. Its paramount aim is to assay and juxtapose the efficacies of these interventions on meta-emotional dimensions, elucidating discrete change vectors. Discernment of differential—or convergent—potency in reshaping these cardinal internal tenets will empower clinicians to refine protocols, optimizing outcomes and bespoke care for afflicted youth. Such insights will enrich cross-cultural comprehension of these therapies' translatability.

Both VRET and MBCT would significantly enhance positive meta-emotional dimensions and attenuate negative meta-emotional dimensions relative to the control condition, with VRET potentially showing marginally superior effects due to its targeted exposure mechanics.

Methods

Research Design and Participants

This study utilized a quasi-experimental design with a pre-test, post-test, and three-month follow-up, including a control group. The statistical population comprised all adolescents (aged 15–18) diagnosed with social anxiety disorder who sought treatment at counseling centers in Ahvaz, Iran, between March and June 2024. Participants were approached by trained research assistants during routine intake visits at these centers, ensuring ethical recruitment and informed consent from the outset. As individuals actively seeking treatment, this method likely selects for those with elevated motivation for change and moderate-to-severe symptom severity, potentially limiting generalizability to

less motivated or community-based samples. A convenience sample of 45 participants was selected based on specific inclusion criteria: a formal diagnosis of social anxiety disorder confirmed through a diagnostic interview conducted by a certified psychiatrist or clinical psychologist, and a score of at least 50 on the Social Anxiety Scale. Exclusion criteria included a history of psychotic disorders, bipolar disorder, or substance use disorder. An a priori power analysis conducted using G*Power software (version 3.1) for repeated measures ANOVA, assuming a large effect size ($f=0.40$, based on prior VRET/MBCT studies), three groups, three time points, $\alpha=0.05$, and power=0.80, indicated that a total sample of 42 participants would suffice; the recruited $n=45$ provided adequate power (0.82). The eligible participants were then randomly assigned to one of three groups: the VRET group, the MBCT group, or a non-treatment control group, with 15 participants in each group. Random assignment was performed using a computerized random number generator to balance groups. Baseline equivalence across groups was statistically verified: one-way ANOVAs revealed no significant differences in age or pre-test MEQ scores (positive and negative), and a chi-square test confirmed comparable gender distributions. All participants and their legal guardians provided written informed consent prior to the study, and ethical considerations were upheld throughout the research process.

Instruments

Meta-Emotion Questionnaire (MEQ): Developed by Mittmansgruber et al. (20), this questionnaire assesses an individual's thoughts, beliefs, and feelings about their own emotions (meta-emotion). It consists of 28 items rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire has two main dimensions, Negative Meta-emotion and Positive Meta-emotion, and six subscales. The Negative Meta-emotion dimension includes the subscales of Anger (4 items), Shame (5 items), Thought Control (5 items), and Suppression (2 items). The score range for this dimension is from 16 to 80. The Positive Meta-emotion dimension includes the subscales of Compassion (7 items) and Interest (5 items), with a score range from 12 to 60. Higher scores on the negative subscales indicate maladaptive meta-emotion, while higher

scores on the positive subscales indicate adaptive meta-emotion. In the Iranian context, the MEQ has been validated with evidence of construct validity through convergent correlations with emotional dysregulation measures ($r=0.45-0.65$) and satisfactory test-retest reliability over a 2-week interval ($ICC=0.84$; 21). The Cronbach's alpha for this questionnaire was reported as 0.85 in a domestic study (21). In the present study, a Cronbach's alpha of 0.89 was obtained for the total scale, indicating excellent reliability.

Procedure

Following the collection of pre-test data, the experimental groups participated in their respective interventions for eight weekly sessions. All sessions for both experimental groups were facilitated by the same licensed clinical psychologist, who held certifications in VRET delivery and MBCT facilitation and had over 5 years of experience in adolescent anxiety treatment; this ensured therapist consistency and competence while minimizing allegiance effects. The VRET group received 45-minute sessions, which involved exposure to feared social situations in a controlled virtual reality environment. VRET was delivered using Meta Quest 2 headsets and custom software environments (adapted oVRcome platform) simulating graded social scenarios, with exposure intensity escalated based on subjective units of distress (SUDs) ratings to promote habituation. The MBCT group participated in 90-minute sessions focused on mindfulness exercises and cognitive-behavioral techniques to develop non-judgmental awareness of emotions. The session durations differed (45 minutes for VRET versus 90 minutes for MBCT) due to the immersive nature of VR requiring focused exposure versus the experiential depth of mindfulness practice; this dosage variation represents a potential confound, which was partially controlled by standardizing the number of sessions (eight weekly), equating core therapeutic elements (e.g., exposure vs. awareness building), and monitoring total contact time (approximately 6 hours per group). A summary of the intervention sessions is provided in Tables 1 and 2. The control group received no intervention during this period but was offered appropriate therapeutic services at the conclusion of the study. This non-treatment waitlist design allowed assessment of natural remission rates but did not control for nonspecific effects like

Table 1: Summary of virtual reality exposure therapy (VRET) sessions

Session	Session content
1	Introduction, preparation, and exposure to a public place (a store) with continuous attention from others
2	Continued practice of exposure in a public place with continuous attention from others
3	Exposure to a large party, where the participant reads a poem or text into a microphone for the attendees
4	Continued practice of exposure at a large party and reading a poem or text
5	Exposure to a formal business meeting, where the participant gives a presentation related to their field of study or profession, using a microphone and maintaining eye contact
6	Continued practice of exposure to a formal business meeting and giving a presentation
7	Participation in a large seminar or conference, where the participant reads a pre-prepared text into a microphone from behind a podium and makes eye contact
8	Continued practice of exposure to a large seminar or conference, and reading a pre-prepared text

Table 2: Summary of mindfulness-based cognitive therapy (MBCT) sessions

Session	Session content
1	The “Automatic Pilot” and Mindfulness: Introduction to the concept of mindfulness, initial mindful breathing exercises, and exploring the mind’s “automatic pilot” mode
2	Coping with Obstacles: Identifying obstacles to mindfulness practice, focusing on sensations and emotions, and practicing non-judgmental observation
3	Awareness of Breath: Focusing entirely on the sensation of breathing, using breath as an anchor to return to the present moment
4	Being Present: Practicing a “body scan” and awareness of bodily sensations, accepting unwanted emotions and thoughts
5	Accepting Thoughts: Observing thoughts as mental events, using the “thoughts are clouds” technique to reduce engagement with them
6	Self-Compassion: Exercises to reduce self-criticism and increase inner acceptance
7	Responding to Situations: Practicing a mindful response instead of an automatic reaction to anxiety-provoking situations
8	Integrating into Daily Life: Reviewing past experiences, planning to continue mindfulness practices, and integrating them into daily life

expectation or attention; an active control (e.g., supportive counseling) was not feasible due to resource constraints but is recommended for future research. All participants were re-evaluated at the post-test and again at the three-month follow-up. No participants dropped out during the intervention phase.

Data Analysis

The collected data were analyzed using SPSS version 27.0 and subjected to a Repeated Measures Analysis of Variance (ANOVA). Prior to analysis, key assumptions were evaluated: normality via Shapiro-Wilk tests, homogeneity of variances via Levene’s tests, and sphericity via Mauchly’s tests. Sphericity was violated for the negative meta-emotion time × group interaction, necessitating Greenhouse-Geisser corrections; other assumptions were satisfied. Given the modest sample size, post-hoc observed power for the significant time × group effects was 0.76, indicating adequate detection of significant effects ($\eta^2 > 0.45$) but heightened risk of Type II error for more minor effects. Post-hoc tests were used to examine specific between-group

and within-group differences. The statistical significance level for this study was set at $P < 0.05$.

Results

The study included 45 adolescents aged 15–18 years, diagnosed with social anxiety disorder, who sought treatment at counseling centers in Ahvaz, Iran, between March and June 2024. The mean age of participants was 16.50 years ($SD = 1.12$). The descriptive statistics for positive and negative meta-emotional dimensions across the pre-test, post-test, and three-month follow-up stages are presented in Table 3. As illustrated in Table 3, both experimental groups (VRET and MBCT) demonstrated notable improvements in mean scores from pre-test to post-test—manifesting as increases in positive meta-emotion and reductions in negative meta-emotion—with these gains largely sustained at the three-month follow-up. In contrast, the control group exhibited minimal variation over time.

Prior to analysis, the normality of the data was assessed using the Shapiro-Wilk test for both positive and negative meta-emotional dimensions across all groups and time points.

Table 3: Descriptive statistics for positive and negative meta-emotion across study stages

Variable	Stages	VRET	MBCT	Control
		Mean±SD	Mean±SD)	Mean±SD
Positive meta-emotion	Pre-test	35.60±3.66	35.36±3.99	34.53±4.22
	Post-test	47.33±3.50	43.60±4.08	34.93±4.52
	Follow-up	47.53±3.28	43.66±4.17	35.13±4.48
Negative meta-emotion	Pre-test	41.06±3.66	40.46±3.95	39.40±3.50
	Post-test	29.33±4.00	32.73±4.20	39.00±3.35
	Follow-up	29.60±4.05	32.80±4.03	39.06±4.51

Table 4: Repeated measures ANOVA results for positive and negative meta-emotion

Variable	Source	SS	df	MS	F	P	η^2
Positive meta-emotion	Time	1401.37	2	700.68	1484.64	0.001	0.7
	Group	1762.8	2	881.42	38.96	0.001	0.52
	Time × Group	668.98	4	167.24	354.36	0.001	0.74
Negative meta-emotion	Time	1289.65	1.71*	754.02	2678.52	0.001	0.78
	Group	787.61	2	393.80	29.15	0.001	0.45
	Time × Group	650.78	3.42*	19.24	675.81	0.001	0.77

*Greenhouse-Geisser corrected degrees of freedom.

Results indicated that all variables met the normality assumption ($P > 0.05$), with no significant deviations from normality. This supported the use of parametric statistical tests, such as repeated measures ANOVA, for subsequent analyses. The repeated measures ANOVA results for the effects of time, group, and their interaction on positive and negative meta-emotional dimensions are presented in Table 4. These analyses revealed significant main effects of time and group for both outcome variables (all $P < 0.001$), accompanied by large effect sizes ($\eta^2 > 0.45$). The significant time × group interaction ($P < 0.001$) further underscored

differential trajectories of change across groups, with the VRET and MBCT conditions evincing superior improvements relative to the control group.

Post hoc comparisons using the Bonferroni test were conducted to examine specific differences within and between groups, as shown in Tables 5 and 6. The within-group post-hoc results, summarized in Table 5, confirmed significant enhancements in positive meta-emotion and reductions in negative meta-emotion for both VRET and MBCT from pre-test to post-test and follow-up (all $P < 0.001$), with no

Table 5: Bonferroni post-hoc comparisons for within-group differences

Variable	Stage comparison	Group	Mean difference	P
Positive meta-emotion	Post-test - Pre-test	MBCT	8.13	0.001
		VRET	11.73	0.001
		Control	0.40	0.782
	Follow-up - Pre-test	MBCT	8.20	0.001
		VRET	11.93	0.001
		Control	0.61	0.594
	Follow-up - Post-test	MBCT	0.07	0.999
		VRET	0.20	0.999
		Control	0.20	0.970
Negative meta-emotion	Post-test - Pre-test	MBCT	-7.73	0.001
		VRET	-11.73	0.001
		Control	0.40	0.622
	Follow-up - Pre-test	MBCT	-7.66	0.001
		VRET	-11.46	0.001
		Control	0.33	0.773
	Follow-up - Post-test	MBCT	0.06	0.999
		VRET	0.27	0.999
		Control	0.07	0.999

Table 6: Bonferroni post-hoc comparisons for between-group differences

Variable	Group comparison	Stage	Mean difference	P
Positive meta-emotion	VRET - MBCT	Pre-test	0.13	0.999
		Post-test	3.73	0.041
		Follow-up	3.86	0.030
	VRET - Control	Pre-test	1.06	0.999
		Post-test	12.40	0.001
		Follow-up	12.42	0.001
	MBCT - Control	Pre-test	0.93	0.999
		Post-test	8.66	0.001
		Follow-up	8.53	0.001
Negative meta-emotion	VRET - MBCT	Pre-test	0.60	0.999
		Post-test	3.40	0.033
		Follow-up	3.23	0.042
	VRET - Control	Pre-test	1.66	0.674
		Post-test	9.66	0.001
		Follow-up	9.46	0.001
	MBCT - Control	Pre-test	1.06	0.999
		Post-test	6.26	0.001
		Follow-up	6.25	0.001

meaningful alterations in the control group (all $P > 0.05$). VRET yielded marginally larger effect magnitudes than MBCT. For positive meta-emotion, both the VRET and MBCT groups showed significant improvements from pre-test to post-test and follow-up ($P < 0.001$), with VRET demonstrating a slightly larger mean difference (11.73 and 11.93) than MBCT (8.13 and 8.20). No significant changes were observed in the control group ($P > 0.05$). For negative meta-emotion, both interventions significantly reduced scores from pre-test to post-test and follow-up ($P < 0.001$), with VRET again showing a greater reduction (-11.73 and -11.46) compared to MBCT (-7.73 and -7.66). The between-group post-hoc findings, detailed in Table 6, indicated that at post-test and follow-up, VRET scores were significantly superior to those of MBCT ($P < 0.05$), and both experimental groups outperformed the control condition ($P < 0.001$) across both meta-emotional dimensions, with no baseline disparities. Between-group comparisons at post-test and follow-up revealed that VRET outperformed MBCT ($P < 0.05$) and both significantly outperformed the control group ($P < 0.001$) for both variables.

Discussion

The current study provides compelling evidence for the efficacy of VRET and MBCT in improving meta-emotional dimensions among adolescents with social anxiety disorder in Ahvaz, Iran. Both interventions significantly enhanced positive meta-emotional dimensions and reduced

negative meta-emotional dimensions, with VRET demonstrating a slightly greater effect compared to MBCT, and both sustaining their effects at a three-month follow-up. These findings contribute to the growing body of literature on innovative therapeutic approaches for addressing complex psychological mechanisms underlying social anxiety, particularly meta-emotional beliefs, and highlight their applicability in a non-Western cultural context.

Meta-emotional dimensions, encompassing individuals' thoughts and feelings about their emotions, are pivotal in perpetuating social anxiety by reinforcing maladaptive beliefs, such as viewing anxiety as uncontrollable or a sign of personal weakness (7). The significant improvements observed in both VRET and MBCT groups suggest that these interventions may effectively target such dysfunctional beliefs. However, these improvements were assessed solely via the MEQ, a self-report measure. As a result, causal mechanisms remain inferred rather than empirically verified. VRET's efficacy can be attributed to its immersive, controlled environment. This setting allows adolescents to confront feared social situations in a safe yet realistic manner. By engaging with tailored virtual scenarios—such as delivering presentations or interacting in social gatherings—participants likely experienced gradual desensitization to anxiety triggers (12). This process aligns with the principles of exposure therapy. It enables individuals to reframe their meta-emotional beliefs by reducing the perceived threat of anxiety

and enhancing self-efficacy in social contexts (11). Previous research supports this mechanism. For example, studies have demonstrated VRET's ability to reduce fear of negative evaluation and improve emotional regulation in anxiety disorders (22, 23). A study by Meyerbröker and Morina (22) found that VRET significantly reduced social anxiety symptoms by altering cognitive appraisals of social situations. This finding aligns with the present study's impact on meta-emotional dimensions.

MBCT, conversely, likely exerted its effects through cultivating non-judgmental awareness and acceptance of emotional experiences. By integrating mindfulness practices with cognitive-behavioral techniques, MBCT enables individuals to observe their anxiety without becoming entangled in self-critical or avoidant responses (17). This approach fosters a compassionate stance toward one's emotions. It disrupts the vicious cycle of anxiety about anxiety that characterizes social anxiety disorder (15). The mindfulness exercises employed in MBCT—such as body scans and breath awareness—likely helped adolescents detach from maladaptive meta-emotional beliefs. These exercises promote adaptive emotional regulation (24). This aligns with findings from a study by Strega et al. (25), which demonstrated MBCT's effectiveness in reducing social anxiety symptoms by enhancing metacognitive awareness and emotional acceptance in a clinical sample. The present study extends these findings. It shows MBCT's specific impact on meta-emotional dimensions in an adolescent population. This suggests its versatility across developmental stages.

VRET appeared to yield larger effect sizes than MBCT on meta-emotional dimensions, though direct statistical comparisons between the two interventions were not conducted, precluding firm conclusions on superiority. This pattern may stem from VRET's direct engagement with social anxiety triggers through simulated exposure. Such engagement may challenge maladaptive meta-emotional beliefs. VRET's ability to customize scenarios to individual fears allows for precise targeting of anxiety-provoking stimuli. This customization leads to faster cognitive restructuring (26). However, MBCT's focus on broader emotional acceptance and mindfulness skills may offer complementary benefits. In particular, it may foster long-term resilience against anxiety (27). The sustained effects of

both interventions at the three-month follow-up suggest that they promote lasting changes in meta-emotional processing. These changes likely involve altering underlying cognitive and emotional schemas. This durability is critical for adolescents. Social anxiety often persists into adulthood if untreated. It increases the risk of comorbidities such as depression (3).

The cultural context of this study, conducted in Iran, adds a significant dimension to the findings. Most prior research on VRET and MBCT has been conducted in Western populations. This limits generalizability to diverse cultural settings. The effectiveness of both interventions in an Iranian adolescent sample suggests that these approaches are adaptable to varying cultural norms and social expectations. In particular, they may suit collectivist societies where social scrutiny can amplify anxiety. This finding underscores the importance of culturally sensitive applications of evidence-based therapies. It also highlights the potential for technology-driven and mindfulness-based interventions to bridge cultural gaps in mental health treatment.

Despite the promising findings, this study is not without limitations. The small sample size and reliance on convenience sampling—drawing from treatment-seeking adolescents at local counseling centers—may considerably restrict the generalizability of results to broader or less motivated populations in Iran. Moreover, the modest power likely limited detection of subtler differences between interventions or impacts on potential secondary outcomes, such as overall anxiety severity. The non-treatment control group, while helpful for gauging natural remission, did not account for nonspecific factors such as placebo effects, therapist attention, or group dynamics; an active control (e.g., supportive counseling) would have strengthened causal inferences but was not feasible given resource constraints. The small sample size and use of a convenience sampling method restrict the generalizability of the results to a broader population of adolescents with social anxiety in Iran. Additionally, the absence of a traditional cognitive-behavioral therapy control group limits a more comprehensive comparison of the interventions.

Conclusion

In conclusion, this study validates the effectiveness of both VRET and MBCT as viable

and sustainable interventions for improving meta-emotional dimensions in adolescents with social anxiety. The findings highlight the critical role of meta-emotional processes as a therapeutic target and suggest that, while both interventions are beneficial, VRET may offer a slight advantage due to its direct and technology-mediated exposure mechanism. These results provide a valuable foundation for future research exploring the integration of technology-based and mindfulness-based approaches to enhance clinical outcomes for this vulnerable population.

Ethical Approval

This research received approval from the Ethics Committee of Islamic Azad University, Ahvaz Branch, under the approval code IR.IAU.AHVAZ.REC.1403.408.

Funding

This study was conducted without financial support from any public, commercial, or non-profit funding agencies.

Conflict of Interest

There are no conflicts of interest.

References

1. Karki R, Timsina A, Kaphle M, Sah R. Prevalence and factors of social anxiety disorder among health science students in Kathmandu. *Iran J Health Sci.* 2024;12(2):89. doi: 10.32598/ijhs.12.2.1029.1.
2. Asher M, Asnaani A, Aderka IM. Gender differences in social anxiety disorder: a review. *Clin Psychol Rev.* 2017;56:1-12. doi: 10.1016/j.cpr.2017.05.004.
3. Gao W, Li Y, Yuan J, He Q. The shared and distinct mechanisms underlying fear of evaluation in social anxiety: the roles of negative and positive evaluation. *Depress Anxiety.* 2025;2025:9559056. doi: 10.1155/da/9559056.
4. Orben A, Tomova L, Blakemore SJ. The effects of social deprivation on adolescent development and mental health. *Lancet Child Adolesc Health.* 2020;4(8):634-40. doi: 10.1016/s2352-4642(20)30186-3.
5. Leigh E, Clark DM. Understanding social anxiety disorder in adolescents and improving treatment outcomes: applying the cognitive model of Clark and Wells (1995). *Clin Child Fam Psychol Rev.* 2018;21(3):388-414. doi: 10.1007/s10567-018-0258-5.
6. O'Toole MS, Hougaard E, Mennin DS. Social anxiety and emotion knowledge: a meta-analysis. *J Anxiety Disord.* 2013;27(1):98-108. doi: 10.1016/j.janxdis.2012.09.005.
7. Sadati C, Namvar H, Nasrolahi B. Association of the meta-emotion structure with the dimensions of emerging adulthood identity mediated by mental health in university students. *J Health Rep Technol.* 2021;8(1):e119942. doi: 10.5812/jhrt.119942.
8. Hur J, Tillman RM, Kim HC, Didier P, Anderson AS, Islam S, et al. Adolescent social anxiety is associated with diminished discrimination of anticipated threat and safety in the bed nucleus of the stria terminalis. *J Psychopathol Clin Sci.* 2025;134(1):41-56. doi: 10.1037/abn0000940.
9. Leigh E, Clark DM. Cognitive therapy for social anxiety disorder in adolescents: a development case series. *Behav Cogn Psychother.* 2016;44(1):1-17. doi: 10.1017/s1352465815000715.
10. Molazamani F, Bavi S, Jayervand H. Effectiveness of virtual reality intervention for impulsivity, sustained attention, and divided attention in children with attention-deficit hyperactivity disorder. *Health Manag Inf Sci.* 2023;10(2):93-9. doi: 10.30476/jhmi.2024.101736.1207.
11. Chard I, van Zalk N. Virtual reality exposure therapy for treating social anxiety: a scoping review of treatment designs and adaptation to stuttering. *Front Digit Health.* 2022;4:842460. doi: 10.3389/fdgth.2022.842460.
12. Seuling PD, Czernin NS, Schiele MA. Virtual reality exposure therapy in the treatment of public speaking anxiety and social anxiety disorder. *Neurosci Appl.* 2024;3:104074. doi: 10.1016/j.nsa.2024.104074.
13. Wray TB, Kemp JJ, Larsen MA. Virtual reality (VR) treatments for anxiety disorders are unambiguously successful, so why are so few therapists using them? Barriers to adoption and potential solutions. *Cogn Behav Ther.* 2023;52(6):603-24. doi: 10.1080/16506073.2023.2229017.
14. Soltani M, Farhadi H, Manshaee G, Mehdad A. Effectiveness of virtual reality therapy on emotional exhaustion and quality of work life of employees with occupational stress.

- Health Manag Inf Sci.* 2023;10(1):7-13. doi: 10.30476/jhmi.2023.98505.1175.
15. Tickell A, Ball S, Bernard P, Kuyken W, Marx R, Pack S, et al. The effectiveness of mindfulness-based cognitive therapy (MBCT) in real-world healthcare services. *Mindfulness (N Y)*. 2020;11(2):279-90. doi: 10.1007/s12671-018-1087-9.
 16. Musa ZA, Kim Lam S, Binti Mamat Mukhtar F, Kwong Yan S, Tajudeen Olalekan O, Kim Geok S. Effectiveness of mindfulness-based cognitive therapy on the management of depressive disorder: systematic review. *Int J Afr Nurs Sci.* 2020;12:100200. doi: 10.1016/j.ijans.2020.100200.
 17. Kashefinhabouri J, Eftekhar Saadi Z, Pasha R, Heidari A, Makvandi B. The effect of mindfulness-based cognitive therapy and emotion-regulation training on rumination and social anxiety in teenagers prone to addiction. *J Occup Health Epidemiol.* 2021;10(1):1. doi: 10.52547/johe.10.1.1.
 18. Shokri A, Kazemi R, Narimani M, Taklavi S. Comparison of the effectiveness of mother's mindfulness-based cognitive therapy and cognitive emotion regulation training on externalizing disorder and self-efficacy of aggressive children. *Pract Clin Psychol.* 2020;8(2):85. doi: 10.32598/jpcp.8.2.677.1.
 19. Shahsavari Googhari Z, Hafezi F, Asgari P, Heidari A. The effectiveness of mindfulness-based cognitive therapy and acceptance and commitment therapy on medical science students' subjective well-being, psychological distress, and emotion regulation. *J Shahrekord Univ Med Sci.* 2022;24(1):35-41. doi: 10.34172/jsums.2022.07.
 20. Mitmansgruber H, Beck TN, Hofer S, Schussler G. When you don't like what you feel: experiential avoidance, mindfulness and meta-emotion in emotion regulation. *Pers Individ Dif.* 2009;46(4):448-53. doi: 10.1016/j.paid.2008.11.013.
 21. Parsaei I, Sadipour E, Dortaj F, Asadzaeh H. Evaluation of the structural model of achievement motivation based on the school climate and values related to study with the mediation of meta-emotion in students. *Q J Child Ment Health.* 2019;5(4):110-21.
 22. Meyerbrocker K, Morina N. The use of virtual reality in assessment and treatment of anxiety and related disorders. *Clin Psychol Psychother.* 2021;28(3):466-76. doi: 10.1002/cpp.2623.
 23. Tan YL, Chang VYX, Ang WHD, Ang WW, Lau Y. Virtual reality exposure therapy for social anxiety disorders: a meta-analysis and meta-regression of randomized controlled trials. *Anxiety Stress Coping.* 2025;38(2):141-60. doi: 10.1080/10615806.2024.2392195.
 24. Sharma N, Agrawal M, Rushi, Ayyub S, Rai D. Mindfulness-based interventions for emotional dysregulation in adolescents: a systematic review. *Ann Neurosci.* 2025;09727531251355311. doi: 10.1177/09727531251355311.
 25. Strege MV, Swain D, Bochicchio L, Valdespino A, Richey JA. A pilot study of the effects of mindfulness-based cognitive therapy on positive affect and social anxiety symptoms. *Front Psychol.* 2018;9:866. doi: 10.3389/fpsyg.2018.00866.
 26. Graham WM, Drinkwater R, Kelson J, Kabir MA. Self-guided virtual reality therapy for anxiety: a systematic review. *Int J Med Inform.* 2025;200:105902. doi: 10.1016/j.ijmedinf.2025.105902.
 27. Remskar M, Western MJ, Osborne EL, Maynard OM, Ainsworth B. Effects of combining physical activity with mindfulness on mental health and wellbeing: systematic review of complex interventions. *Ment Health Phys Act.* 2024;26:100575. doi: 10.1016/j.mhpa.2023.100575.