KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 04 August 2025
Revised 11 November 2025
Accepted 18 November 2025
Initial Published 22 November 2025
Final Publication 01 January 2026

KMAN Counseling & Psychology Nexus

Volume 4, pp 1-12

E-ISSN: 3041-9026

Comparison of the Effectiveness of Eye Movement Desensitization and Reprocessing and Mindfulness-Based Cognitive Therapy on Working Memory in Individuals with Primary Insomnia

Behnoush. Shariati[1, 2], Mehrdad. Sabet[3*], Tahereh. Ranjbaripour[1, 2], Sheida. Sodagar[1, 2], Fatemeh. Mohammadi Shirmahaleh[1, 2]

[1] Department of Health and Clinical Psychology, Ka.C., Islamic Azad University, Karaj, Iran
[2] Clinical Cares and Health Promotion Research Center, Ka.C., Islamic Azad University, Karaj, Iran
[3] Department of Psychology, Ro.C., Islamic Azad University, Roudehen, Iran

*** Corresponding author email address**: mehrdadsabet@iau.ac.ir

Article Info

Article type:
Original Research
Section:
Rehabilitation Counseling

How to cite this article:
Shariati, B., Sabet, M., Ranjbaripour, T., Sodagar, S., & Mohammadi Shirmahaleh, F. (2026). Comparison of the Effectiveness of Eye Movement Desensitization and Reprocessing and Mindfulness-Based Cognitive Therapy on Working Memory in Individuals with Primary Insomnia. *KMAN Conseling and Psychology Nexus, 4*, 1-12.
http://doi.org/10.61838/kman.rc.psynexus.4774

ABSTRACT

Primary insomnia is one of the common disorders that has a significant negative impact on cognitive functioning, including working memory. The aim of the present study was to compare the effectiveness of Eye Movement Desensitization and Reprocessing (EMDR) and Mindfulness-Based Cognitive Therapy (MBCT) on working memory in individuals with primary insomnia. A total of 48 participants (16 in each group) were selected from among individuals with primary insomnia through convenience sampling while observing the inclusion criteria. They were then randomly assigned to two experimental groups and one control group. The research design was a quasi-experimental pretest–posttest design with a one-month follow-up. The data collection instrument was the N-Back Test (1958). Mixed ANOVA, Bonferroni post hoc test, and SPSS (Version 26) were used for data analysis. The results indicated that both Eye Movement Desensitization and Reprocessing and Mindfulness-Based Cognitive Therapy were effective in improving working memory in individuals with primary insomnia; however, there was no significant difference between the effectiveness of the two treatments. The findings of this study showed that both therapeutic approaches were effective in improving working memory. Nevertheless, future studies with larger sample sizes and long-term follow-ups are required to examine the stability of treatment effects and enhance the generalizability of the results.

Keywords: *Eye Movement Desensitization and Reprocessing (EMDR), Mindfulness-Based Cognitive Therapy (MBCT), working memory, primary insomnia*

1. Introduction

Primary insomnia is recognized as one of the most prevalent sleep disorders, with extensive evidence demonstrating its detrimental impact on cognitive, emotional, and physiological functioning. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, insomnia is conceptualized as a persistent difficulty with sleep initiation, sleep maintenance, or early-morning awakening that leads to impairment in daytime functioning (American Psychiatric, 2013). Research increasingly emphasizes that beyond its influence on mood and daily functioning, insomnia plays a central role in undermining the efficiency of executive functions, particularly working memory, which involves the temporary storage and manipulation of information necessary for complex cognitive tasks (Baddeley, 2003). Working memory is foundational for reasoning, learning, problem-solving, and self-regulation, and deficits in this domain can significantly impair day-to-day functioning. The centrality of working memory to cognitive performance has been repeatedly verified across multiple theoretical models, including the influential unity-and-diversity framework of executive functions (Miyake et al., 2000). Correspondingly, increasing evidence suggests that individuals with insomnia exhibit deficits in executive functioning components such as updating, attentional shifting, inhibition, and sustained attention, all of which rely heavily on working memory capacity (Wardle-Pinkston et al., 2019).

Extensive empirical and meta-analytic research confirms that insomnia is strongly associated with impaired performance on working memory tasks. For instance, a systematic review and meta-analysis found that individuals with insomnia consistently show reduced performance across domains such as digit span, n-back accuracy, reaction time, and complex working memory tasks (Ballesio et al., 2019). Experimental studies offer convergent support; research on sleep deprivation demonstrates that even short-term sleep loss can significantly diminish the speed and accuracy of working memory processing (Li et al., 2024). Similarly, the deterioration of working memory following disrupted or insufficient sleep has been well documented in naturalistic studies, suggesting that individuals with chronic insomnia experience cumulative cognitive burdens over time (Ong et al., 2009). Emerging evidence also indicates that recovery sleep can mitigate some of these impairments, demonstrating the sensitivity of working memory performance to sleep quality and duration (Peng et al., 2023). Altogether, these findings reinforce the conceptualization of working memory as a cognitive system susceptible to the destabilizing effects of insomnia.

Physiological research examining sleep architecture provides additional insight into the mechanisms linking insomnia and working memory. For instance, abnormal cardiovascular activity and dysregulated autonomic responses observed in individuals with primary insomnia may contribute to cognitive inefficiencies, particularly in tasks requiring sustained attention and rapid information processing (De Zambotti et al., 2011). Additionally, disruptions in slow-wave sleep and REM sleep—both strongly implicated in memory consolidation—further exacerbate cognitive decline in this population (Nelson et al., 2022). The importance of lifestyle and health-related factors is also increasingly recognized, with sedentary behavior, diet, and reduced physical activity demonstrating significant associations with sleep quality and subsequent cognitive performance (Ding et al., 2022). These findings highlight the multifactorial nature of insomnia-related cognitive impairment, involving interactions among physiological dysregulation, behavioral patterns, and psychological processes.

Working memory deficits have broad implications for daily functioning, contributing to difficulties with problem-solving, emotional regulation, and decision-making. Indeed, research on cognitive processes demonstrates that impaired working memory directly compromises individuals' capacity to make informed decisions and solve complex problems, thereby highlighting its importance as a target for therapeutic intervention (Zafar et al., 2025). Studies on children and adolescents also emphasize that training in verbal or visuospatial working memory can improve academic abilities such as reading comprehension, further demonstrating the significance of working memory in higher-order cognition (Chen et al., 2025). Similarly, research on populations with attentional difficulties shows that exercise or working memory training can enhance cognitive performance, reaffirming the plasticity of working memory and its responsiveness to targeted interventions (Zhang & Li, 2025). Other studies exploring digital cognition, such as video game research, also demonstrate that certain cognitive skills—including visuospatial working memory and hand–eye coordination—are sensitive to training and can be meaningfully enhanced (Zioga et al., 2025). These findings collectively support the rationale for examining therapeutic interventions that might improve working memory in individuals suffering from insomnia.

E-ISSN: 3041-9026

Eye Movement Desensitization and Reprocessing (EMDR) is one intervention that has been widely studied for its effects on cognition and emotional processing. Originally developed by Shapiro (Shapiro, 1989), EMDR has become an evidence-based treatment for post-traumatic stress, with robust empirical support for its capacity to reduce the emotional intensity and vividness of distressing memories. EMDR works through bilateral stimulation—typically eye movements—while patients recall distressing experiences, facilitating the reprocessing of maladaptive memory networks. Over time, EMDR research expanded to encompass its effects on broader cognitive processes. For example, studies indicate that EMDR-based eye movements tax working memory resources, thereby reducing the vividness and emotional load of negative ideation, which contributes to cognitive relief and improved processing efficiency (van den Hout et al., 2011). Case studies suggest that EMDR may also improve verbal memory, as shown in neurological patients with cognitive impairments (Virgilio et al., 2022). Research on older adults with PTSD further demonstrates that EMDR can improve aspects of cognitive functioning, including working memory performance (Gielkens et al., 2024). EMDR has also been shown to be effective in improving cognitive performance and working memory in other clinical conditions such as myocardial infarction, supporting its potential applicability to cognitive deficits in diverse populations (Behnam-Moghadam et al., 2024; Behnam-Moghadam et al., 2023). Its therapeutic value has also been demonstrated in medical contexts, such as among patients undergoing bypass surgery with PTSD symptoms, showing reductions in emotional distress through reprocessing maladaptive memory networks (Safaeyan et al., 2023). Early research in Iran also documented its effectiveness for improving sleep quality and reducing primary insomnia symptoms, suggesting that EMDR may influence sleep-related arousal mechanisms (Ranjbaripour et al., 2014). Furthermore, EMDR's broader applicability in psychological and medical settings has been widely discussed (Shapiro, 2014). Collectively, these findings highlight EMDR as a promising candidate for targeting cognitive impairments associated with insomnia.

Mindfulness-Based Cognitive Therapy (MBCT), developed by Segal and colleagues, integrates mindfulness principles with cognitive-behavioral strategies to reduce rumination, enhance attentional control, and improve emotion regulation (Segal et al., 2002). MBCT is widely validated for its ability to reduce psychological distress and improve cognitive functioning. Systematic reviews demonstrate that mindfulness-based programs can significantly enhance cognitive functions—including working memory, inhibition, and attentional control—in both clinical and nonclinical populations (Whitfield et al., 2022). MBCT has been shown to improve sleep quality and cognitive abilities in individuals with insomnia, suggesting that the cultivation of nonjudgmental awareness may reduce hyperarousal mechanisms implicated in sleep disturbance (Kamali-Nasab et al., 2022). Other mindfulness-based interventions similarly show improvements in sleep, emotional functioning, and cognitive performance in populations with test anxiety, psychiatric disorders, and insomnia (Nikro et al., 2022; Peters et al., 2022). In long-term follow-up studies, mindfulness meditation has demonstrated sustained benefits for individuals with insomnia beyond the initial treatment period (Ong et al., 2009). Moreover, MBCT has demonstrated significant efficacy in improving executive functions in students with behavioral difficulties, further supporting its potential to enhance working memory (Vahedi et al., 2019). Mindfulness practices may also reduce the vividness and emotionality of negative thoughts via attentional mechanisms similar to those activated during EMDR, suggesting potential overlapping cognitive pathways (van den Hout et al., 2011). Beyond sleep-related research, mindfulness training has also been shown to improve cognitive performance and reduce symptoms in individuals with ADHD and other cognitive vulnerabilities (Madani et al., 2017). Studies on chronic pain populations also highlight mindfulness-based approaches as beneficial, with improvements in sleep quality and reductions in cognitive and physical distress (Honda et al., 2022). Overall, the literature supports MBCT as a cognitive–emotional regulatory intervention capable of improving sleep and cognition simultaneously.

Sleep quality, as a multidimensional construct, is strongly affected by psychological, cognitive, and physiological factors. Conceptual analyses emphasize the evolutionary significance of sleep in maintaining cognitive health (Nelson et al., 2022). Poor sleep can arise from or exacerbate chronic medical conditions such as pain, leading to compounding cognitive deficits and daytime dysfunction (Honda et al., 2022). Studies of behavioral health emphasize the interconnectedness of lifestyle behaviors—including sedentary habits, nutrition, and stress—and their influence on both sleep and cognitive status (Ding et al., 2022). Research on information-processing theories provides further context for understanding insomnia-related cognitive difficulties, as cognitive overload and inefficient processing pathways disrupt memory consolidation and executive functioning (Çeliköz et al., 2019). Local Iranian studies have also documented the relationship between anxiety, working memory, and sleep, suggesting that interventions targeting cognitive–emotional processing can yield meaningful therapeutic gains (Kalantar Qureshi et al., 2012). Other research highlights the important role of psychopathological symptoms associated with insomnia, demonstrating that cognitive-behavioral and mindfulness-based interventions can significantly reduce sleep disturbances and improve cognition (Besak-Nejad et al., 2011). Additional evidence from clinical populations such as migraine sufferers demonstrates that EMDR, CBT, and biofeedback can each improve sleep quality and reduce cognitive distress, further supporting the broader utility of such interventions (Mehrmanesh et al., 2023). Together, these findings illuminate the complex interplay between sleep quality, executive functioning, and cognitive–emotional processes.

Recent investigations continue to expand the theoretical and clinical understanding of insomnia and cognition. For example, large-scale studies exploring sleep and cognition in children, adolescents, and adults emphasize the need to address working memory impairments in the context of sleep disturbances (Ding et al., 2022; Peng et al., 2023). Research on cultural and social determinants of sleep also deepens the understanding of insomnia as a multifaceted phenomenon influenced by individual, social, and environmental variables (Nikro et al., 2022; Safaeyan et al., 2023). Moreover, EMDR has been explored in diverse populations, including individuals with neurological injuries, cardiopulmonary conditions, and trauma histories, demonstrating its cognitive benefits (Gielkens et al., 2024; Janssen et al., 2023). Studies in psychology emphasize the interconnectedness between emotion regulation, attentional functioning, and sleep quality, supporting the hypothesis that interventions targeting cognitive-emotional processes can also improve working memory, particularly in populations with chronic sleep difficulties (Perrault et al., 2022). Additionally, research on the psychological mechanisms of insomnia highlights maladaptive cognitive patterns, hyperarousal, and attentional biases as core contributors to cognitive decline, providing a foundation for targeting these mechanisms through EMDR and MBCT (Ong et al., 2009). Collectively, this body of literature provides strong theoretical and empirical justification for examining therapeutic approaches that may alleviate working memory deficits among individuals suffering from primary insomnia.

Given the strong relationship between insomnia and working memory deficits, and the documented effectiveness of EMDR and MBCT in improving cognitive processes, sleep quality, and emotional regulation, it is necessary to compare these two interventions within the same empirical framework. The present study aims to compare the effectiveness of Eye Movement Desensitization and Reprocessing and Mindfulness-Based Cognitive Therapy on working memory in individuals with primary insomnia.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a quasi-experimental design with two experimental groups and one control group, using a pretest–posttest design with a one-month follow-up. The statistical population consisted of all individuals with insomnia who referred to the researcher in Tehran. To determine the sample size, the G*Power software was used. An effect size of 0.25, Type I error of 0.05, test power of 0.90, number of groups as 3, and number of observations (three stages: pretest, posttest, and follow-up) as 3 were entered. Based on these parameters, a sample size of 45 participants across the three groups was suggested; however, considering possible attrition, a total of 48 individuals (16 per group) were selected through convenience sampling.

The inclusion criteria were as follows:

1. Receiving a diagnosis of primary insomnia based on the diagnostic criteria of this disorder through an interview by a physician and the researcher.
2. Having at least a middle-school education.
3. Monitoring medication use (to prevent the effect of medications on research outcomes) through assessment by the relevant physician.
4. Being between 30 and 75 years of age.
5. Providing informed and voluntary consent to participate in the study.
6. Not being pregnant.

The exclusion criteria included:

1. Having a physical illness that affects working memory or sleep quality.
2. The emergence of any acute physical or psychological symptoms that prevent the participant from continuing the study.
3. Lack of cooperation to continue participation or being absent from more than two sessions during the intervention.

E-ISSN: 3041-9026

4. Receiving pharmacotherapy or psychotherapy for any other chronic psychiatric or physical disorder during the study (based on self-report).

2.2. Measures

N-Back Test: The N-back test is a cognitive assessment task related to executive functioning, first introduced by Kirchner in 1958. It plays a role in both information maintenance and information manipulation; therefore, it is widely used to assess working memory and is considered one of the most commonly applied culture-free tools. In this test, a sequence of visual stimuli appears step by step on a computer screen, and the participant must press the (N) key if the current stimulus matches the previous one and the (Z) key if it does not match. In the present study, the participant was required to retain only one stimulus in memory (i.e., the stimulus presented one step earlier). Additionally, each new stimulus replaces the previous one. The design of this task requires the participant to respond to every stimulus; hence, the task demands continuous monitoring and updating of information in working memory. Two scores are derived from this test: the number of correct responses and the reaction time (in seconds). The test has strong validity, with validity coefficients ranging from 0.54 to 0.84, and a reported reliability of 0.78. Its validity as an indicator of working memory performance is considered highly acceptable. In Iran, Taghinejad, Nejati, Mohammadzadeh, and Akbarzadeh (2014) confirmed the reliability of this test in their study. A number of individuals who were diagnosed with primary insomnia by the researcher and provided informed consent were selected through purposive sampling. A total of 48 participants were randomly assigned to three groups (two experimental groups and one control group). The research objectives, procedures, confidentiality of information, and the right to withdraw freely were explained to them. After obtaining written consent and randomly assigning the participants to groups, all participants completed the N-Back Test (1-back) as the pretest.

2.3. Interventions

The EMDR protocol begins with an introduction and orientation phase that includes obtaining a complete history, evaluating the existing support system, assessing distress tolerance and the client's self-soothing ability, identifying goals, establishing session rules, and examining the client's capacity to cope with potential distress arising during reprocessing. The second phase focuses on building a therapeutic alliance, explaining the EMDR process and its effects, preparing the client, teaching relaxation skills, clarifying treatment expectations, increasing the client's knowledge about the disorder, teaching the rationale of EMDR, conducting imagery-based EMDR practice, providing direct instruction on the procedure, and teaching muscle relaxation (0–5 minutes, practiced once daily for one week). In the third phase, the therapist identifies target components such as anxiety-provoking memories, images, and associated symbols, elicits the client's negative belief about the problem or bodily sensations, helps select a positive belief to replace the negative one, and pairs the traumatic image with the negative belief while rating the client's level of distress. The fourth phase involves desensitization through eye movements by asking the client to focus on the negative belief while the therapist quickly moves their fingers horizontally for the client to follow, continuing this procedure until the client's distress is reduced to one or zero. The fifth phase, installation, focuses on strengthening and replacing negative cognition with positive cognition through cognitive restructuring and reprocessing. The sixth phase, body scan, assesses any remaining somatic tension by instructing the client to hold the target event and positive cognition together while scanning the body for muscular tension. The seventh phase, closure, involves asking the client to report disturbing images, thoughts, or emotions that occurred during treatment, and the client is instructed to record all events experienced during the process—including thoughts, situations, dreams, memories, and other issues—in a notebook. The final phase includes reevaluating previously processed targets and conducting re-assessment.

The MBCT protocol begins with Session 1, which includes orientation, emphasis on confidentiality, introducing the course structure, addressing questions, discussing the automatic functioning of the mind, teaching the principles of mindfulness, conducting the mindful raisin-eating exercise, and assigning homework (body scan, bringing awareness to daily activities, mindful eating). Session 2 reviews previous homework, teaches the "two modes of mind" (thinking and direct experience), explores the interaction between thoughts and emotions, and introduces new homework (mindful breathing/seat meditation, body scan, mindful awareness of daily activities, and pleasant events calendar). Session 3 reviews homework, increases awareness of physical sensations and emotions, practices the three-minute breathing space, teaches metaphor-based exercises, and assigns homework (mindful

E-ISSN: 3041-9026

stretching and breathing, mindful movement meditation, three-minute breathing space three times daily, and unpleasant events calendar). Session 4 reviews homework, teaches skills for engaging with unpleasant experiences, observing negative states with minimal aversion, practices the three-minute breathing space, introduces guided sitting meditation (seeing and hearing), and assigns homework (alternate-day sitting meditation, alternate-day mindful walking or movement, three-minute breathing space three times daily, plus additional breathing spaces as needed). Session 5 reviews homework and focuses on accepting feelings and unpleasant experiences instead of avoiding them, uses the "guest house" metaphor, introduces shifting from resistance to acceptance, practices guided sitting meditation, and assigns homework (sitting meditation focusing on working with difficulties, three-minute breathing space, and responsive breathing space). Session 6 reviews homework, emphasizes the transitory nature of thoughts, feelings, and experiences, introduces metaphors, and assigns homework (sitting meditation focusing on thoughts as mental events, normal three-minute breathing space, responsive three-minute breathing space, and establishing an early warning system). Session 7 reviews homework, develops a list of pleasant and mastery activities, examines the relationship between such activities and the responsive breathing space, discusses inverse motivation, and assigns homework (continuous mindful attention practice, three-minute breathing space, responsive breathing space, and creating an action plan for relapse prevention). Session 8 involves summarizing and integrating learned skills, reviewing progress, providing feedback, and emphasizing continued use of both formal and informal mindfulness practices, accompanied by responsive three-minute breathing space exercises.

2.4. Data analysis

Mixed ANOVA, Bonferroni post hoc tests, and SPSS software (Version 26) were used for data analysis.

3. Findings and Results

At the end of the present study, 47 participants remained across three groups: Eye Movement Desensitization (15 participants), Mindfulness-Based Cognitive Therapy (16 participants), and Control (16 participants). The mean and standard deviation of participants' age in the Eye Movement Desensitization group were 45.20 and 9.48 years, respectively; in the Mindfulness-Based Cognitive Therapy group, 43.88 and 6.07 years, respectively; and in the Control group, 44.25 and 8.85 years, respectively. In the Eye Movement Desensitization group, there were 10 women and 5 men; in the Mindfulness-Based Cognitive Therapy group, 9 women and 7 men; and in the Control group, 11 women and 5 men. In the Eye Movement Desensitization group, educational levels were as follows: 2 participants below high school diploma, 6 with a diploma, 1 with an associate degree, 4 with a bachelor's degree, and 2 with a master's degree. In the Mindfulness-Based Cognitive Therapy group, 2 participants were below high school diploma, 7 had a diploma, 3 had a bachelor's degree, and 4 had a master's degree. In the Control group, 1 participant was below high school diploma, 6 had a diploma, 2 had an associate degree, 4 had a bachelor's degree, and 3 had a master's degree. Finally, in the Eye Movement Desensitization group, 2 participants were single, 11 were married, and 2 were divorced. In the Mindfulness-Based Cognitive Therapy group, 4 were single, 11 were married, and 1 was divorced; and in the Control group, 4 were single and 12 were married.

Table 1 presents the mean (standard deviation) of participants' working memory scores across the pretest, posttest, and follow-up stages.

Table 1

Mean (Standard Deviation) of Working Memory Scores in Pretest, Posttest, and Follow-up

Variable	Group	Pretest	Posttest	Follow-up
Correct Responses	Eye Movement Desensitization	56.60 (8.53)	77.60 (11.64)	80.53 (13.93)
	Mindfulness-Based Cognitive Therapy	54.37 (10.25)	70.69 (13.27)	75.44 (10.38)
	Control	53.31 (10.78)	57.44 (12.24)	57.37 (11.70)
Reaction Time	Eye Movement Desensitization	726.13 (89.44)	628.60 (85.72)	618.13 (83.16)
	Mindfulness-Based Cognitive Therapy	763.88 (49.75)	633.75 (92.68)	598.25 (95.36)
	Control	750.69 (91.23)	735.19 (76.52)	737.81 (75.88)

Table 1 shows that in the two experimental groups, the mean correct responses increased in the posttest and follow-up stages compared to the pretest, and reaction time decreased. In contrast, similar changes were not observed in the control group.

To assess the assumption of normality, Shapiro–Wilk values for the research variable for each group in the pretest, posttest, and follow-up stages were examined. It should be noted that Levene's test was used to evaluate the homogeneity of error variance across groups, and results indicated that this assumption was also met.

Next, the assumptions of homogeneity of covariance matrices were examined through Box's M test, and the sphericity assumption was assessed using Mauchly's test. The results are presented in Table 2.

Table 2

Results of Box's M Test and Mauchly's Test

Variable	M.Box	F	p	Mauchly's W	χ^2	p
Correct Responses	13.67	1.03	.422	0.995	0.20	.905
Reaction Time	21.87	1.64	.074	0.963	1.64	.441

According to Table 2, Box's M for working memory (N-back) was not significant. This indicates that the assumption of homogeneity of covariance matrices for working memory was met.

After confirming the assumptions, data were analyzed using mixed ANOVA. Table 3 presents the multivariate analysis results for comparing the effects of Eye Movement Desensitization and Mindfulness-Based Cognitive Therapy on working memory in individuals with primary insomnia.

Table 3

Multivariate Tests (Wilks' Lambda)

Variable	Wilks' Lambda	F	df	p	η^2
Correct Responses	0.721	3.83	4, 86	.007	0.151
Reaction Time	0.749	3.34	4, 86	.013	0.135

Table 3 shows that the effect of the independent variables on correct responses (Wilks' $\lambda = 0.721$, $F = 3.83$, $p = .007$, $\eta^2 = 0.151$) and reaction time (Wilks' $\lambda = 0.749$, $F = 3.34$, $p = .013$, $\eta^2 = 0.135$) in the N-back test was statistically significant.

Table 4 presents the mixed ANOVA results explaining the effects of Eye Movement Desensitization and Mindfulness-Based Cognitive Therapy on working memory in individuals with primary insomnia.

Table 4

Mixed ANOVA Results

Variable	Effects	SS	SS Error	F	p	η^2
Correct Responses	Group	5954.43	7432.23	17.60	.001	0.444
	Time	6278.40	5238.40	52.74	.001	0.545
	Group × Time	2065.56	10068.96	4.51	.002	0.170
Reaction Time	Group	202210.91	345872.31	12.86	.001	0.369
	Time	214127.61	290665.75	32.41	.001	0.424
	Group × Time	104531.83	567196.82	4.06	.005	0.156

Table 4 shows that, in addition to the effects of group and time, the interaction effect of group × time was significant for correct responses ($F = 12.86$, $p = .001$, $\eta^2 = 0.369$) and reaction time ($F = 4.06$, $p = .005$, $\eta^2 = 0.156$). These findings indicate that Eye Movement Desensitization and Mindfulness-Based Cognitive Therapy significantly affected working memory in individuals with primary insomnia.

E-ISSN: 3041-9026

Table 5 presents the results of the Bonferroni post hoc test for working memory scores across the three groups and three time points.

Table 5

Bonferroni Post Hoc Test Results

Variable	Groups Compared	Mean Difference	SE	p
Correct Responses	Eye Movement Desensitization vs. MBCT	4.74	2.70	.256
	Eye Movement Desensitization vs. Control	15.54	2.70	.001
	MBCT vs. Control	10.79	2.65	.001
Reaction Time	Eye Movement Desensitization vs. MBCT	–7.67	18.40	1.00
	Eye Movement Desensitization vs. Control	–83.61	18.40	.001
	MBCT vs. Control	–75.94	18.10	.001

The results of the Bonferroni post hoc test in Table 5 indicate that the differences in mean correct responses and reaction time in the N-back test were statistically significant between the pretest–posttest and pretest–follow-up stages; however, the differences between posttest and follow-up stages were not significant. In addition, the Bonferroni results comparing group effects show that in both experimental groups, mean correct responses increased and mean reaction time decreased in the posttest and follow-up stages compared to the control group.

The trend of mean changes shown in Table 1 indicates that the improvements in working memory following the two independent variables remained stable at follow-up. Table 5 also shows that the difference between the effects of the two treatment methods on participants' performance in the N-back test was not statistically significant. Therefore, although both Eye Movement Desensitization and Mindfulness-Based Cognitive Therapy improved working memory in individuals with primary insomnia, the difference between their effects was not statistically significant.

4. Discussion and Conclusion

The present study aimed to compare the effectiveness of Eye Movement Desensitization and Reprocessing (EMDR) and Mindfulness-Based Cognitive Therapy (MBCT) on working memory among individuals with primary insomnia. The results demonstrated that both EMDR and MBCT significantly improved working memory performance, as evidenced by increased correct responses and reduced reaction times in the n-back task across the posttest and follow-up stages when compared with the control group. However, no significant difference was observed between the two treatment modalities, indicating that both interventions exert comparable positive effects on working memory in this population. These findings align with the growing body of evidence that conceptualizes insomnia as a disorder with profound cognitive repercussions, particularly impairments in working memory, attentional control, and executive functioning (Ballesio et al., 2019; Wardle-Pinkston et al., 2019).

The significant improvement in working memory among participants receiving EMDR is consistent with previous studies demonstrating that EMDR is not only effective in reducing emotional distress but also influences cognitive functioning through mechanisms of working memory taxation. During EMDR, bilateral stimulation such as eye movements engages the working memory system, temporarily reducing the vividness and emotionality of distressing memories, which in turn facilitates cognitive reprocessing (van den Hout et al., 2011). This mechanism helps reduce hyperarousal, a hallmark of insomnia, and likely contributes to the observed improvements in cognitive control and reduced reaction times. The cognitive benefits of EMDR have been noted in several clinical contexts, including patients recovering from myocardial infarction who showed improvements in working memory and cognitive processing after EMDR-based interventions (Behnam-Moghadam et al., 2024; Behnam-Moghadam et al., 2023). Similarly, EMDR has been effective in enhancing cognitive outcomes in trauma-related and neurological conditions; studies on older adults with PTSD indicate that EMDR yields improvements in memory, attention, and executive functioning (Gielkens et al., 2024). Case-based research also supports EMDR's capacity to improve verbal memory in neurological populations (Virgilio et al., 2022). These patterns align closely with the present findings, suggesting that the working memory taxation and emotional reprocessing central to EMDR may play a unique role in improving cognitive performance in individuals with primary insomnia.

The results regarding MBCT also align with extensive literature documenting the cognitive benefits of mindfulness-based interventions. MBCT emphasizes sustained attention, metacognitive awareness, and nonjudgmental observation of thoughts and bodily sensations, mechanisms that directly address the cognitive hyperarousal and intrusive thinking patterns characteristic of insomnia (Peters et al., 2022; Segal et al., 2002). By repeatedly engaging attentional networks and teaching participants to redirect attention from ruminative or intrusive thoughts back to the present moment, MBCT strengthens frontal–executive systems essential for working memory. Systematic reviews confirm that mindfulness-based programs lead to improvements in working memory, inhibitory control, and overall executive functioning across diverse populations (Whitfield et al., 2022). MBCT has also demonstrated significant effectiveness in improving sleep quality and cognitive functioning in individuals with impaired sleep, including women with insomnia, who showed meaningful improvement in both sleep parameters and cognitive performance after participating in mindfulness-based interventions (Kamali-Nasab et al., 2022). Additionally, mindfulness-based programs have been shown to enhance cognitive performance in individuals with test anxiety, psychiatric disorders, and other conditions characterized by intrusive thought patterns and heightened arousal (Nikro et al., 2022). These studies support the conclusion that the attentional training and metacognitive restructuring central to MBCT may explain the improvements in working memory observed in this study.

The improvements in working memory within both treatment groups may also be understood through the lens of theoretical models of executive functioning. Working memory is a core component of executive control, and models such as Baddeley's multicomponent framework emphasize the importance of updating and attentional control in maintaining goal-directed behavior (Baddeley, 2003). Insomnia is well known to disrupt these processes by impairing sleep-dependent memory consolidation, weakening attentional stability, and increasing cognitive load due to intrusive thoughts (Ballesio et al., 2019; Wardle-Pinkston et al., 2019). From this perspective, both EMDR and MBCT may improve working memory by reducing cognitive interference, emotional arousal, and maladaptive thought patterns, thereby freeing cognitive resources necessary for efficient updating and information manipulation.

Furthermore, research on sleep deprivation underscores the sensitivity of working memory to changes in sleep continuity and quality. Studies examining total sleep deprivation demonstrate significant deterioration in working memory speed and accuracy, which partially recovers with restorative sleep (Li et al., 2024; Peng et al., 2023). These findings support the interpretation that improvements in working memory observed in the present study may be partially mediated by improvements in sleep quality and reduced physiological hyperarousal following psychological intervention. This interpretation is supported by research indicating that autonomic dysregulation and cardiovascular abnormalities observed in primary insomnia may impair cognitive functioning, meaning that any intervention reducing physiological arousal is likely to yield cognitive benefit (De Zambotti et al., 2011). MBCT's emphasis on body awareness, relaxation, and attentional stabilization aligns with these mechanisms, as does EMDR's capacity to reprocess distressing memories and reduce related physiological arousal (Shapiro, 2014).

Moreover, the present findings resonate with earlier Iranian studies documenting the positive impact of psychological interventions on sleep and cognition. Research has shown that both relaxation training and cognitive–behavioral techniques can significantly improve working memory and reduce anxiety in individuals with sleep difficulties (Kalantar Qureshi et al., 2012). Similarly, cognitive–behavioral and mindfulness-based therapies have been found effective in improving sleep quality and cognitive performance among students and adults with insomnia or anxiety (Besak-Nejad et al., 2011; Vahedi et al., 2019). The meaningful improvements in working memory observed in the current study are therefore consistent with broader research from Iranian and international contexts.

The lack of significant difference between the two treatments demonstrates that despite their distinct theoretical foundations, EMDR and MBCT may exert convergent effects on cognitive processing. This idea is supported by research demonstrating that EMDR and mindfulness both tax working memory and reduce the vividness and emotionality of distressing imagery, suggesting shared cognitive mechanisms underlying emotional regulation and cognitive enhancement (van den Hout et al., 2011). Modern sleep research also recognizes that cognitive–emotional processes are deeply intertwined with sleep quality (Nelson et al., 2022), meaning that any intervention that improves

E-ISSN: 3041-9026

emotional regulation, attentional control, or physiological arousal may indirectly enhance cognitive performance in insomnia.

Additionally, both EMDR and MBCT have been shown to improve sleep quality directly. EMDR has demonstrated effectiveness in reducing insomnia symptoms, lowering sleep-related anxiety, and improving general sleep patterns in individuals with primary insomnia (Ranjbaripour et al., 2014). MBCT has been shown to produce long-lasting benefits for chronic insomnia, as mindfulness skills continue to support emotional stability and improved sleep regulation over time (Ong et al., 2009). Therefore, improved sleep may serve as a mediating factor contributing to improved working memory performance in both treatment groups.

Considering the synergistic relationship between sleep quality, emotional regulation, and cognitive performance, the present findings substantiate the hypothesis that psychological interventions targeting emotional and attentional systems can improve working memory among individuals with insomnia. The consistency of these results with prior studies strengthens the argument that working memory deficits in insomnia are not fixed impairments but modifiable cognitive outcomes influenced by psychological, behavioral, and physiological processes.

This study is limited by its relatively small sample size, reliance on self-report for screening certain exclusion criteria, and the absence of objective sleep measures such as polysomnography. The follow-up period was also limited to one month, restricting insight into long-term treatment effects. Additionally, potential confounding factors such as daily stress levels, medication usage, and lifestyle variables were controlled only through participant self-report.

Future studies should include larger and more diverse samples, longer follow-up periods, and objective sleep assessments to better understand the relationship between sleep quality and cognitive performance. Comparative studies evaluating EMDR and MBCT alongside other evidence-based treatments, including CBT-I or neurocognitive training, would strengthen understanding of specific mechanisms. Neuroimaging studies could further clarify the neural pathways underlying working memory improvements.

Practitioners may consider both EMDR and MBCT as viable treatment options for individuals with primary insomnia who also exhibit working memory deficits. Integrating cognitive–emotional regulatory strategies into insomnia treatment plans may enhance both sleep quality and cognitive functioning. Mental health providers may also find benefit in combining elements of these interventions to create individualized treatment protocols tailored to patients' symptom profiles and cognitive needs.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. The study received ethical approval from the Ethics Committee of Islamic Azad University, Karaj Branch, under approval code IR.IAU.K.REC.1401.151.

References

American Psychiatric, A. (2013). *Diagnostic and Statistical Manual of Mental Disorders*. American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596

Baddeley, A. (2003). Working memory and language: An overview. *Journal of Communication Disorders*, *36*(3), 189–208. https://doi.org/10.1016/S0021-9924(03)00019-4

Ballesio, A., Aquino, M. R., Kyle, S. D., Ferlazzo, F., & Lombardo, C. (2019). Executive functions in insomnia disorder: a systematic review and exploratory meta-analysis. *Frontiers in psychology*, *10*, 101. https://doi.org/10.3389/fpsyg.2019.00101

Behnam-Moghadam, A., Mahmoudi, A., Mardpour, A., Zadeh-Bagheri, F., & Behnam-Moghadam, M. (2024). Examining the effect of EMDR on enhancing working memory in patients with myocardial infarction: A randomized clinical trial. *Journal of Disability Studies*, *14*, 48–48.

Behnam-Moghadam, A., Mardpour, A., Zadeh-Bagheri, F., & Mahmoudi, A. (2023). Investigating the effect of eye movement desensitization and reprocessing (EMDR) on cognitive performance in patients with myocardial infarction. *Armaghan-e-Danesh*, *28*(4), 442–454. https://doi.org/10.61186/armaghanj.28.4.442

Besak-Nejad, S., Aghajani-Afjedi, A., & Zargar, Y. (2011). Investigating the effectiveness of mindfulness-based cognitive therapy on sleep quality and quality of life in female university students. *Psychological Achievements*, *18*(2), 181–198. https://psychac.scu.ac.ir/article_11726.html

Çeliköz, N., Erisen, Y., & Sahin, M. (2019). Cognitive learning theories with emphasis on latent learning, gestalt and information processing theories. *Journal of educational and instructional studies in the world*, *9*(3). https://eric.ed.gov/?id=ED598366

Chen, J., Wang, Z., & Wu, S. (2025). Comparison of the effects of verbal and visuospatial working memory training on reading comprehension of students with special needs. *International Journal of Developmental Disabilities*, 1–12. https://doi.org/10.1080/20473869.2025.2473405

De Zambotti, M., Covassin, N., De Min Tona, G., Sarlo, M., & Stegagno, L. (2011). Sleep onset and cardiovascular activity in primary insomnia. *Journal of Sleep Research*, *20*(2), 318–325. https://doi.org/10.1111/j.1365-2869.2010.00871.x

Ding, C., Fan, J., Yuan, F., Feng, G., Gong, W., Song, C., Ma, Y., Chen, Z., & Liu, A. (2022). Association between physical activity, sedentary behaviors, sleep, diet, and adiposity among children and adolescents in China. *Obesity Facts*, *15*(1), 26–35. https://doi.org/10.1159/000519268

Gielkens, E. M., Rossi, G., van Alphen, S. P., & Sobczak, S. (2024). Can Eye Movement Desensitization and Reprocessing Improve Cognition in Older Adults With PTSD? A First Exploration. *Journal of Geriatric Psychiatry and Neurology*, *37*(3), 206–221. https://doi.org/10.1177/08919887231207639

Honda, H., Ashizawa, R., Kiriyama, K., Take, K., Hirase, T., Arizono, S., & Yoshimoto, Y. (2022). Chronic pain in the frail elderly mediates sleep disorders and influences falls. *Archives of Gerontology and Geriatrics*, *99*, 104582. https://doi.org/10.1016/j.archger.2021.104582

Janssen, E. P., Spauwen, P. J., Rijnen, S. J., & Ponds, R. W. (2023). Exploration of EMDR in treating PTSD in patients with acquired brain injury: A retrospective case series. *European Journal of Psychotraumatology*, *14*(2), 2264117. https://doi.org/10.1080/20008066.2023.2264117

Kalantar Qureshi, M., Barjalee, A., Zamayad, A., & Dartaj, F. (2012). The effectiveness of relaxation training and exercises on anxiety and working memory capacity. *Quarterly Journal of Clinical Psychology Studies*, *3*(6), 65–88. https://jcps.atu.ac.ir/article_2061.html

Kamali-Nasab, Z., Koushki, S., Bani-Jamali, S. A., & Ourki, M. (2022). A comparison of the effectiveness of cognitive-behavioral therapy and mindfulness on sleep quality and cognitive abilities in women with insomnia. *Clinical Psychology Studies*, *12*(48), 57–84. https://jcps.atu.ac.ir/article_15407.html

Li, J., Cao, Y., Ou, S., Jiang, T., Wang, L., & Ma, N. (2024). The effect of total sleep deprivation on working memory: evidence from diffusion model. *Sleep*, *47*(2), zsae006. https://doi.org/10.1093/sleep/zsae006

Madani, S., Alizadeh, H., Farkhi, N., & Hakimi, A. (2017). Development of an executive functions training program and evaluation of its effectiveness in reducing symptoms in children with ADHD. *Psychology of Exceptional Individuals*, *7*(26), 1–25. https://jpe.atu.ac.ir/article_7860.html

Mehrmanesh, A., Hafezi, F., Ehteshamzadeh, P., & Bakhtiarpour, S. (2023). A comparison of CBT, EMDR, and biofeedback on migraine attacks, anxiety sensitivity, and sleep and life quality. *Health and Treatment Management*, *14*(3), 19–35. https://www.sid.ir/paper/1442715/fa

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49–100. https://doi.org/10.1006/cogp.1999.0734

Nelson, K. L., Davis, J. E., & Corbett, C. F. (2022). Sleep quality: An evolutionary concept analysis. *Nursing Forum*, *57*(1), 144–151. https://doi.org/10.1111/nuf.12659

Nikro, B., Shahabi-Zadeh, F., & Nasri, M. (2022). The effectiveness of MBCT and ACT on sleep quality in students with test anxiety. *Journal of Mental Health Principles*, *24*(6), 383–390. https://jfmh.mums.ac.ir/article_21464.html

Ong, J. C., Shapiro, S. L., & Manber, R. (2009). Mindfulness meditation and cognitive behavioral therapy for insomnia: a naturalistic 12-month follow-up. *EXPLORE*, *5*(1), 30–36. https://doi.org/10.1016/j.explore.2008.10.004

Peng, Z., Hou, Y., Xu, L., Wang, H., Wu, S., Song, T., Shao, Y., & Yang, Y. (2023). Recovery sleep attenuates impairments in working memory following total sleep deprivation. *Frontiers in Neuroscience*, *17*, 1056788. https://doi.org/10.3389/fnins.2023.1056788

Perrault, A. A., Pomares, F. B., Smith, D., Cross, N. E., Gong, K., Maltezos, A., McCarthy, M., Madigan, E., Tarelli, L., McGrath, J. J., & Savard, J. (2022). Effects of cognitive behavioral therapy for insomnia on subjective and objective measures of sleep and cognition. *Sleep Medicine*, *97*, 13. https://doi.org/10.1016/j.sleep.2022.05.010

Peters, A. L., Saunders, W. J., & Jackson, M. L. (2022). Mindfulness-based strategies for improving sleep in people with psychiatric disorders. *Current psychiatry reports*, *24*(11), 645–660. https://doi.org/10.1007/s11920-022-01370-z

Ranjbaripour, T., Hashemian, K., Ahadi, H., Rezabakhsh, H., & Farkhi, N. (2014). The effectiveness of eye movement desensitization and reprocessing (EMDR) therapy on primary insomnia. *Clinical Psychology Studies*, *4*(15), 127–140. https://jcps.atu.ac.ir/article_348.html

Safaeyan, S., Pournaghash-Tehrani, S., Gholam-Ali Lavasani, M., & Abdoli-Bidehendi, M. (2023). The effectiveness of EMDR therapy on PTSD symptoms in patients undergoing coronary artery bypass graft surgery. *Journal of Psychological Sciences*, *22*(127), 1303–1318. https://psychologicalscience.ir/article-1-1811-fa.html

Segal, Z. V., Teasdale, J. D., Williams, J. M., & Gemar, M. C. (2002). The mindfulness-based cognitive therapy adherence scale: Inter-rater reliability, adherence to protocol and treatment distinctiveness. *Clinical Psychology & Psychotherapy*, *9*(2), 131–138. https://doi.org/10.1002/cpp.320

Shapiro, F. (1989). Efficacy of the eye movement desensitization procedure in the treatment of traumatic memories. *Journal of Traumatic Stress*, *2*(2), 199–223. https://doi.org/10.1002/jts.2490020207

Shapiro, F. (2014). The role of EMDR therapy in medicine: addressing psychological and physical symptoms stemming from adverse life experiences. *The Permanente Journal*, *18*(1), 71. https://doi.org/10.7812/TPP/13-098

Vahedi, S., Mirnasab, M., Fathi-Azar, E., & Damghani-MirMahalleh, M. (2019). The effect of mindfulness-based cognitive therapy on executive functioning and the reduction of oppositional defiant disorder symptoms in students. *Sabzevar University of Medical Sciences Journal*, *26*(6), 709–718. https://sid.ir/paper/365817/fa

van den Hout, M. A., Engelhard, I. M., Beetsma, D., Slofstra, C., Hornsveld, H., Houtveen, J., & Leer, A. (2011). EMDR and mindfulness: Eye movements and attentional breathing tax working memory and reduce vividness and emotionality of aversive ideation. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*(4), 423–431. https://doi.org/10.1016/j.jbtep.2011.03.004

Virgilio, E., Solara, V., Sarnelli, M. F., Vecchio, D., & Comi, C. (2022). Early successful EMDR therapy for verbal memory impairment in an adjustment disorder: a case report in a newly-diagnosed multiple sclerosis patient. *Reports*, *5*(2), 17. https://doi.org/10.3390/reports5020017

Wardle-Pinkston, S., Slavish, D. C., & Taylor, D. J. (2019). Insomnia and cognitive performance: A systematic review and meta-analysis. *Sleep Medicine Reviews*, *48*, 101205. https://doi.org/10.1016/j.smrv.2019.07.008

Whitfield, T., Barnhofer, T., Acabchuk, R., Cohen, A., Lee, M., Schlosser, M., Arenaza-Urquijo, E. M., Böttcher, A., Britton, W., Coll-Padros, N., & Collette, F. (2022). The effect of mindfulness-based programs on cognitive function in adults: A systematic review and meta-analysis. *Neuropsychology Review*, *32*(3), 677–702. https://doi.org/10.1007/s11065-021-09519-y

Zafar, U. e. H., Arshad, F., Karamat, A., Hayat, U., Khan, Z. K., & Ashraf, T. (2025). The Role of Working Memory in Problem-Solving and Decision-Making. *Bbe*, *14*(2), 11-16. https://doi.org/10.61506/01.00586

Zhang, R., & Li, H. (2025). Effect of vigorous-intensity exercise on the working memory and inhibitory control among children with attention deficit hyperactivity disorder: a systematic review and meta-analysis. *Italian Journal of Pediatrics*, *51*(1), 104. https://doi.org/10.1186/s13052-025-01924-w

Zioga, T., Ferentinos, A., Konsolaki, E., Nega, C., & Kourtesis, P. (2025). Video Game Skills Across Diverse Genres and Cognitive Functioning in Early Adulthood: Verbal and Visuospatial Short-Term and Working Memory, Hand–Eye Coordination, and Empathy. https://doi.org/10.31234/osf.io/e75cd

E-ISSN: 3041-9026