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Effectiveness of Eye Movement Desensitization and Reprocessing Therapy and Computer-Based Cognitive Rehabilitation on the Cognitive Bias of Veterans with Post-traumatic Stress Disorder

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Abstract

Background: People with post-traumatic stress disorder (PTSD) from war have more severe symptoms when combined with other chronic disorders, worsening their condition.

Objectives: The present study aimed to investigate the effects of eye movement desensitization and reprocessing (EMDR) therapy and computer-based cognitive rehabilitation on the cognitive bias of veterans with PTSD.

Methods: This was a quasi-experimental study with pretest, posttest, follow-up, and a control group. The statistical population included all the veterans under the Foundation of Martyrs and Veterans Affairs coverage of Ahvaz, Iran, in 2021. After the necessary examinations, 45 eligible participants were randomly assigned to two experimental groups and one control group (15 participants per group) after the necessary coordination. The experimental groups separately received EMDR therapy and computer-based cognitive rehabilitation, whereas the control group received no intervention. Repeated measures ANOVA in SPSS-24 was used for data analysis.

Results: The results showed that compared to the control group, EMDR and computer-based cognitive rehabilitation interventions significantly influenced the cognitive bias of veterans with PTSD ($P < 0.001$). Moreover, cognitive bias scores from the posttest and follow-up significantly differed from those from the pretest ($P < 0.001$).

Conclusions: Since EMDR and computer-based cognitive rehabilitation improved cognitive bias in veterans with PTSD, these methods are recommended for improving their psychological characteristics.

Keywords: Eye Movement Desensitization and Reprocessing, Cognitive, Rehabilitation, Stress, Veterans

1. Background

Post-traumatic stress disorder (PTSD) is a major concern in public and mental health caused by encountering at least one traumatic event and can have long-term emotional, social, and financial consequences (1). As the fourth most commonly diagnosed psychiatric disorder, PTSD affects 10% of men and 18% of women. PTSD follows a shocking disaster that exposes a person to physiological harm or the threat of harm (2). The harm may affect the person or a loved one, or the person could have witnessed the terrible event experienced by a person of interest or strangers (3). PTSD has symptoms such as avoiding others, sleep disorders, inability to recollect parts of the trauma, reliving experiences, and concentration problems (4, 5). People with PTSD from war have more severe symptoms when combined with other chronic disorders, worsening their condition (6, 7).

War veterans have suffered much physical harm and sometimes severe mental disorders that significantly affect their families (8). It is of the utmost importance to design and organize effective therapeutic measures and interventions to address PTSD symptoms and improve veterans' quality of life (9). Veterans suffer from various disorders, including cognitive biases (10). Veterans with cognitive biases cannot adaptively manage their emotional reactions to stressful events during or at the beginning of cognitive biases (11, 12). All cognitive theories believe that bias in information processing has an important role in creating and sustaining emotional disorders (13). Cognitions change and become susceptible to error when people cannot control their emotions.

Cognitive bias is an often-predictable mental error (14).

In terms of persistence, even after awareness of the subject's nature, cognitive biases are like visual errors (15). Awareness of biases alone does not lead to correct perception, making it difficult to overcome cognitive biases (16). Many psychologists' experiments aimed at discovering the rules most people use when encountering incomplete or ambiguous data and discovered the rules that lead to incorrect decisions and judgments (17). Some veterans have seen their organization, working memory, retention and conversion, motor control, inner language, and problem-solving abilities impaired (18). Vulnerable to mental disorders, these people choose and store emotional information about their disorder in their minds and keep recollecting it. Increasing negative moods can intensify the bias toward emotional information. These people recollect the most threatening events, which sustain and intensify anxiety (19).

Eye movement desensitization and reprocessing (EMDR) is among the cognitive therapies employed in recent years to effectively reduce PTSD symptoms. It is a hybrid therapy with methods and a structural protocol (20). In other words, exposure therapy for clients who have suffered traumatic stress overlaps with trauma-focused cognitive-behavioral therapy (21). Trauma-focused treatments are known as the first line of psychotherapy (22). In this method, the therapist asks the patient to mentally visualize and retain the distressing and intrusive memory while focusing on the external stimulus, usually the therapist's finger, and tracking it with their eyes (23, 24). The literature suggests that EMDR is very effective for soldiers wounded in war and victims of violent assaults (25-27).

Computer-based cognitive rehabilitation therapy mainly aims to improve the patient's cognitive function (28, 29). Cognitive rehabilitation therapy is based on the brain's neuroplasticity principles, including targeted exercises for enhancing various aspects of cognition, such as attention, memory, language, and executive functions (30). This computer-based instructional method corrects intrusive memory evaluations and encourages people to adopt a more positive (or negative) information processing style (29). This method deals with cognitive bias, which includes new ways of information processing for changing processing biases such as selective attention and interpretive biases.

2. Objectives

Based on the issues outlined in the background, the present study aimed to investigate the effectiveness of EMDR and computer-based cognitive rehabilitation on the cognitive bias of veterans with PTSD.

3. Methods

This was a quasi-experimental pre-test-post-test-follow-up study with a control group. The statistical population included veterans covered by the Foundation of Martyrs and Veterans Affairs of the City of Ahvaz in 2021. Purposive sampling was employed to select 45 veterans visiting the psychological centers affiliated with the Foundation of Martyrs and Veterans Affairs of the City of Ahvaz. After the necessary coordination, they were randomly assigned to three groups (15 per group). After allocating participants into three groups (EMDR, computer-based cognitive rehabilitation therapy, and control), the experimental groups separately received EMDR and computer-based cognitive rehabilitation therapy at the Martyrs and Veterans Affairs counseling center in Bustan Hospital. However, the control group received no intervention. The participants responded to the research scale in three stages: pretest, posttest, and follow-up (45 days after the last session of intervention programs). The inclusion criteria were: War wounded referred to psychological centers affiliated with the Foundation of Martyrs and Veterans Affairs, having a score above the mean on the Mississippi Scale for Combat-Related PTSD, high school education or above, 40 - 65 years of age, written informed consent, no stressful events such as divorce and death of relatives in the last three months, and no other simultaneous treatments. The exclusion criteria were the simultaneous use of psychiatric drugs, participants refusing to complete questionnaires, and absence from two or more sessions.

3.1. Instrument

Davos Assessment of Cognitive Biases Scale: This self-report instrument was developed by van der Gaag et al. (31) and consists of 42 items, each scored on a 7-point Likert scale from one (completely disagree) to seven (completely agree). The range of the total score of cognitive biases can be between 24 and 294. The higher the score, the greater the participant's cognitive biases. Heidari et al. (32) reported that the test-retest reliability coefficient of the Davos Assessment of Cognitive Biases Scale was 0.90.

3.2. Intervention Programs

Regular Eye Movements Desensitization and Reprocessing Therapy Protocol: Based on Shapiro's (33) EMDR intervention program, ten 60-minute EMDR

Table 1. Content and Structure of EMDR Protocol Sessions

Sessions	Target	Content of Each Stage
1	Collecting information	Collecting the necessary information from clients, evaluating personal beliefs, finding clients' safe spaces, and determining the goals of the intervention
2	Preparation	Creating a suitable therapeutic environment, explaining the eye movement desensitization and reprocessing method
3	Evaluation	Plotting the stress experienced from the incident until counseling, the clients selecting the target image, and recognizing physical emotions
4	Desensitization	Determining the substitute positive belief and the positive belief the client prefers
5	Desensitization	Advancing toward adaptive solutions, focusing on physical emotions and images, reducing the client's irritation by the target
6	Desensitization	Strengthening positive beliefs, reducing irritation, focusing on physical feelings, emotions, and images
7	Desensitization	Stabilizing, evaluating, and strengthening the positive belief that the client prefers, reducing the client's irritation from the target
8	Brokerage	Body scan and focusing on unpleasant physical emotions or pain and trying to cleanse them
9	End of session	Returning to relaxation, simultaneously checking the client's thoughts, emotions, and physical characteristics
10	Re-evaluation	Presenting a summary of therapy and changes, re-evaluating the positive and negative beliefs, teaching coping skills

treatment sessions (two sessions every week) were held for the participants individually, as summarized in Table 1.

Computer-Based Cognitive Rehabilitation Package (Captain's Log): This study held this program individually in sixteen 60-minute sessions (two weekly sessions). The software for this package was first developed by BrainTrain in 2000. With around 2000 exercises, this software is used in various fields for improving the cognitive abilities of people 6 years of age and above (34). This software is developed based on the pattern information processing system (PIPS) necessary for learning general, social, and educational information processing. PIPS reflects personal ability and talent for identifying, distinguishing, and processing information in routine life and the environment. Each training exercise has a starting stage, with the stages ranked by difficulty and training time. This program enables people to design training programs based on their condition and can consider personalized training programs with different exercises and configurations. In this program, all exercises at any level have 15 stages that become increasingly difficult with each passing stage.

3.3. Data Analysis

Descriptive statistics such as mean and standard deviation and inferential statistics such as repeated measures ANOVA and Bonferroni's post hoc and presuppositions tests were used for data analysis. SPSS 24 was used for data analysis based on a significance level of $\alpha = 0.05$.

4. Results

As shown in Table 2, the mean and standard deviation of cognitive bias in the EMDR and control groups are presented.

This study employed Levene's test to examine the homogeneity of variances. The results indicated the homogeneity of variance, meaning that the experimental and control groups were homogeneous before the treatment (pretest). The results shown in Table 3 suggest a significant difference in the cognitive bias variable of the EMDR, computer-based cognitive rehabilitation, and the control groups $P < 0.001$).

This study used Bonferroni's post-hoc test to compare the mean cognitive bias of different groups. The results indicate a significant difference in the mean of the EMDR and control groups ($P < 0.001$). This finding showed a significant difference in cognitive bias between the EMDR and the control groups in favor of the former. There was also a significant difference in cognitive bias between the mean of the computer-based cognitive rehabilitation and control groups ($P < 0.001$). In other words, there was a significant difference in cognitive bias between the computer-based cognitive rehabilitation group and the control group in favor of the former. Table 4 shows a significant difference in cognitive bias between the EMDR and computer-based cognitive rehabilitation groups ($P < 0.001$). This finding showed a significant difference in cognitive bias between the EMDR and computer-based cognitive rehabilitation groups in favor of the latter. These results were consistent up to the follow-up stage.

Table 2. Mean ± SD of the Cognitive Bias in Experimental and Control Groups in the Pretest, Posttest, and Follow-up

Variable and Phases	EMDR Group	Computer-Based Cognitive Rehabilitation Group	Control Group
Cognitive bias			
Pretest	176.07 ± 9.49	174.60 ± 8.33	174.73 ± 8.40
Posttest	165.33 ± 10.42	157.60 ± 8.48	173.47 ± 8.39
Follow-up	166.20 ± 10.12	157.53 ± 8.29	173.07 ± 8.17

[a] Values are expressed as mean ± SD.

Table 3. Repeated Measurement Results for the Effects of Interventions on Cognitive Bias

Variables	Source	SS	df	MS	F	P-Value	η^2
Cognitive bias	Time	2044.90	1	2044.90	330.33	0.001	0.81
	Group	720.30	1	720.30	314.99	0.001	0.79
	Group × time	890.60	2	445.30	71.93	0.001	0.72

Table 4. Results of Pairwise Comparison of the Cognitive Bias in the Post-test and Follow-up Phases

Variables	Phases	Groups	Mean Difference	SE	P-Value
Cognitive bias	Posttest	EMDR - Control	9.60	1.39	0.001
		Computer-based cognitive rehabilitation-control	15.73	1.30	0.001
		EMDR-computer-based cognitive rehabilitation	6.10	1.29	0.001
	Follow-up	EMDR - Control	6.87	0.60	0.001
		Computer-based cognitive rehabilitation-control	15.69	0.64	0.001
		EMDR-computer-based cognitive rehabilitation	7.27	1.35	0.001

5. Discussion

The present study aimed to investigate the effectiveness of EMDR and computer-based cognitive rehabilitation on the cognitive bias of veterans with PTSD. The findings showed a significant difference between the EMDR and the computer-based cognitive rehabilitation groups in the cognitive bias of veterans suffering from PTSD. Moreover, the computer-based cognitive rehabilitation method was more effective than the EMDR method. In line with the findings of this study, Ranjbaripour et al. (35) reported that EMDR was effective in treating primary insomnia in patients with primary insomnia. Moreover, Jung et al. (28) reported that computer-assisted cognitive rehabilitation improved cognitive functions in patients with traumatic brain injury and stroke. Computer-based cognitive rehabilitation is a training program where the person develops and strengthens their basic cognitive skills that are the basis for many routine activities, such as learning with repeated cognitive exercises. The computer presents these exercises quickly and accurately, whereby consecutive successes in these challenges enhance cognitive skills (22). In computer-based cognitive rehabilitation, cognitive tests, clinical observations, routine functions, and more are used to identify cognitive skills needing development and plan their development (28). Thus, computers can be used to better identify and treat cognitive biases.

There are several noteworthy points in explaining EMDR. This method is based on Shapiro's (33) accelerated data processing model. The innate physiological system of humans is configured to process information about mental health. This information processing system is designed for mental health recovery as the rest of the body heals physiologically after injury. Traumatic life events create pathological patterns of emotions, behaviors, cognitions, feelings, and related structures (27). Pathological structures occur due to the lack of information processing; traumatic information accumulates stagnant, unresolved, and fixed as it occurs. Irritating old experiences are stored in the nervous system in a special state, causing the trauma to get "stuck" or "blocked" in the nervous physiology (33). Psychological trauma continues after the fact due to routine stimuli, emotions, and negative thoughts, recalling such traumatic memories and coordinating the patient's actions with the trauma. In other words, the lack of processing or a proper solution leads the patient to emotionally and behaviorally

react to the trauma. When a person is stuck in an irritating and stimulating state, current events continuously set the trauma in motion and lead to the expression of trauma in the form of nightmares, flashbacks, intrusive thoughts, and avoidance (35). Thus, unblocking this system and transforming memories will change personality traits. To unblock the information process system, the EMDR method is used more commonly than eye saccades. Therefore, this therapy can unlock the nervous system, like rapid eye movements during dreams.

This study had certain methodological limitations, the most important of which were the process of selecting participants, the small sample size, and the inability to directly supervise exercises. Furthermore, since the statistical population covered all veterans suffering from PTSD in Ahvaz, the results must be cautiously generalized.

5.1. Conclusions

It is suggested that therapists employ EMDR and computer-based cognitive rehabilitation as new and multi-dimensional therapeutic techniques alongside other treatments for the psychological disorders of veterans and prioritize this therapeutic approach in treating psychological disorders.

Footnotes

Authors' Contribution: TB and RH developed the study concept and design. TB acquired the data. RH and AH analyzed and interpreted the data and wrote the first draft of the manuscript. All authors contributed to the intellectual content manuscript editing and read and approved the final manuscript. RH and AH provided administrative support.

Conflict of Interests: There was no conflict of interest to be declared.

Ethical Approval: The Ethics Committee of Islamic Azad University, Ahvaz branch approved the study under the ethical code of IR.IAU.AHVAZ.REC.1400.164.

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Informed Consent: Questionnaires were filled with the participants' satisfaction and written informed consent was obtained from the participants in this study.

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