Effectiveness of Cognitive Rehabilitation on Academic Achievement with the Moderating Role of Emotion Regulation in Earthquake-stricken Adolescents with Post-traumatic Stress Disorder in Kermanshah

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Abstract

INTRODUCTION: Post-traumatic stress disorder (PTSD) is one of the adverse events occurring in people exposed to severe traumatic experiences, such as earthquakes. The devastating effects of such events and their associated losses are significantly higher in children and adolescents. The present study aimed to determine the effectiveness of cognitive rehabilitation on academic achievement with the moderating role of emotion regulation in earthquake-stricken adolescents with PTSD in Kermanshah.

METHODS: This cross-sectional study was conducted based on a pre- and post-test design with control and experimental groups. Among the students who were diagnosed with PTSD in Kermanshah earthquake, 48 cases were selected and assigned to the control and experimental groups. Data collection instruments were Captain's Log cognitive rehabilitation software, and motion Regulation Scale developed by Gratz and Roemer. Students' academic achievement was judged based on the scores obtained from end-of-semester transcripts and teachers' evaluations. Data were analyzed in SPSS software (version 26).

FINDINGS: Based on the results, cognitive rehabilitation is effective in the academic achievement of students with PTSD ($P<0.01$). Moreover, emotion regulation can moderate the effect of this method on academic achievement ($P<0.05$).

CONCLUSION: As evidenced by the obtained results, cognitive rehabilitation can effectively strengthen cognitive abilities and components related to executive functions. In so doing, it enhances the educational performance of students with PTSD and brings them academic achievement

Keywords: Academic Achievement; Cognitive Rehabilitation; Earthquake; Emotion Regulation; Post Traumatic Stress Disorder (PTSD).

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Introduction

Many earthquake survivors demonstrate specific clinical responses after experiencing a stressful event, such as loss of loved ones, disruption of social structure, and loss of social support (1). In fact, traumatic events exert profound devastating effects on people's mental health. Post-traumatic stress disorder (PTSD) is one of the consequences of severe traumatic events. It is usually the first response of survivors to the traumatic experience which predicts long-term outcomes on their

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mental and physical health (2).

The symptoms of this complex and chronic disorder include three dimensions of high arousal, avoidance and apathy, and re-experiencing the traumatic event through intrusive flashbacks (3). The emergence of PTSD symptoms in children and adolescents can cause major problems due to the loss of social and family support, such as the loss of parents (4). Children and adolescents with PTSD experience functional deficits and suffering which can be manifested in the form of academic dysfunction and other functional areas (5).

Traumatic events exert more profound effects on children and adolescents, compared to adults (6). They experience the psychological symptoms of PTSD more severely than adults (7). Studies have evidenced that one of the main causes of academic failure and weakness in academic variables of students with PTSD is the poor performance of these people in executive functions (8). Moreover, executive functions also play a role in emotion regulation (9). Position selection, position modification, attention expansion, cognitive change, and behavioral adjustment are regarded as emotion regulation strategies.

In fact, emotion regulation can be considered a variable with a moderating role in the effect of cognitive rehabilitation method on academic achievement. Accordingly, the present study aimed to assess the effectiveness of cognitive rehabilitation on academic achievement with the moderating role of emotion regulation in adolescents with post-traumatic stress disorder (PTSD). Mental health is of paramount importance, especially during adolescence, and plays a prominent role in socio-psychological development and academic achievement in adolescents (10). Nonetheless, exposure to unpleasant events, such as earthquakes, can severely affect the lives of adolescents, cause numerous mental/physical disorders (11), and disrupt their academic life (12).

One of the frequently observed disorders reported in injured or traumatized people, such as earthquake-stricken victims, is Post Traumatic Stress Disorder (PTSD). The results of studies conducted on people with PTSD suggested that they suffer from executive function deficiencies, including deficits in working memory and attention. It is acknowledged that these functions are among the main effective factors on learning and academic achievement, and defects in these functions can impair learning, cognitive functions, and academic achievement (13).

In view of the above considerations, it is imperative to use educational strategies that can positively affect the executive functions of students with PTSD and ultimately lead to their improved academic performance and achievement. Cognitive rehabilitation is one of the most recently used methods to strengthen cognitive skills. It is utilized to improve and restore lost cognitive functioning through repetitive exercises and the provision of stimuli.

In light of the aforementioned issues, the present study was conducted to determine the effectiveness of cognitive rehabilitation in academic achievement with the moderating role of emotion regulation in earthquake-stricken adolescents with post-traumatic stress disorder (PTSD) in Kermanshah in 2019.

Methods

This cross-sectional study was conducted based on a pre- and post-test design with control and experimental groups. In the present study, cognitive rehabilitation and academic achievement were regarded as independent and dependent variables, respectively. Moreover, emotion regulation (high and low) was considered the moderating variable. The statistical population of the present study included 576 first and second-year high school students diagnosed with PTSD in Sarpol-e Zahab, Kermanshah, in the 2018-2019 academic year. A total of 48 students were selected from the target population using purposive sampling and randomly assigned to the control and experimental groups.

Data collection tools

Emotion Regulation Scale: This 36-item scale was designed by Gratz and Roemer (2004). The reliability and validity of this scale were evaluated by the same researchers in a study conducted on 479 undergraduate students. This scale showed good internal consistency with Cronbach's alpha coefficients of 0.93 and >0.8 in the total score and all subscales, respectively. Moreover, its test-retest reliability over a 4-8 week period was reported to be 0.88 for the total score and 0.57 for the score of subscales at the level of $P<0.01$.

Captain's Log cognitive rehabilitation software: It is one of the most frequently used programs to

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rehabilitate and improve the cognitive functions and mental abilities of individuals. It is based on the basic information processing system and provides feedback on individual capabilities, competencies, and self-efficacy. This program which takes advantage of the working memory and central processing speed was used as a cognitive rehabilitation training tool.

The training sessions were moderated by a skilled examiner in medical centers, and meanwhile, the control group did not receive any training despite attending the medical center; nonetheless, the conditions were considered the same for both groups. Students' academic and semester transcripts, as well as teachers' opinions before and after rehabilitation training, were used to assess their academic achievement. The components studied in academic achievement were mathematics and literature courses as two different functional areas in individuals that can be affected by PTSD. It is worth noting that the teachers were blind to the test.

The collected data were analyzed in SPSS software (version 26) using descriptive analysis (mean and standard deviation) and inferential analysis (multivariate analysis of covariance). After selecting the research sample, the subjects and their parents were asked to participate in the research, and they were provided with a clear explanation of the conditions and methods of the training. The next measures were implemented in case of their willingness to cooperate in the study.

Findings

The descriptive results presented in Table 1 show that in the pre-test stage, the mean score in the experimental and control groups did not much differ according to the level of emotion regulation (good-low). In the post-test phase, however, the mean score of mathematics increased in the experimental group, compared to the control group. Moreover, the experimental group who had a good level of emotion regulation displayed a more pronounced increase in mathematics mean score, in comparison to those with a low level of emotion regulation.

In the pre-test stage, the mean score of Persian literature in the experimental and control groups did not much differ according to the level of emotion regulation (good-low). In a similar vein, in the post-test stage, the mean score of Persian literature increased in the experimental group, as compared to the control group. Moreover, the experimental group who had a good level of emotion regulation showed a more remarkable increase in Persian literature mean score, in comparison to those with a low emotion regulation level.

As illustrated in Table 2, cognitive rehabilitation training had a significant effect on the academic achievement scores of students with PTSD ($P<0.01$). In other words, the results showed that the scores of the experimental and

Table 1. Measures of central tendency and dispersion

Group	Test	Pre-test				Post-test			
	Variable / Indicator	Mathematics		Persian literature		Mathematics		Persian literature	
	Emotion regulation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Experimental	Good	14.76	0.43	15.02	1.58	16.89	0.55	17.38	1.04
	Low	14.09	0.53	14.18	1.40	15.18	0.61	15.27	1.48
Control	Good	14.21	0.51	15.30	0.94	15.38	0.87	15.01	0.58
	Low	14.40	0.71	13.18	1.67	15.01	1.08	13.63	0.81

Table 2. Multivariate analysis of covariance to investigate the effect of cognitive rehabilitation training on academic achievement in mathematics and Persian courses

Effect	Test	Value	F	DF (hypothesis)	DF (error)	Significance level	Eta squared
Group	Pillai's Trace	0.474	18.93	2	42	0.001	0.47
	Wilk's Lambda	0.518	18.93	2	42	0.001	0.47
	Hoteling's Trace	0.989	18.93	2	42	0.001	0.47
	Roy's Largest Root	0.989	18.93	2	42	0.001	0.47

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control groups were significantly different in at least one of the courses of Persian literature and mathematics (P<0.01). According to ETA squared of Wilks' lambda (0.47%), it can be concluded that the independent variable (cognitive rehabilitation) determines 0.47% of the total variance, that is to say, 0.47% of inter-group is due to the effect of cognitive rehabilitation training.

Cognitive rehabilitation was also effective in the mathematical achievement of adolescents with PTSD. Table 3 displays the effect of cognitive rehabilitation on the mathematical achievement of students with PTSD. Based on these results, there was a significant difference between the experimental and control groups in terms of the post-test mathematics scores after controlling the initial pre-test differences (P<0.05; F = 6.592). In other words, cognitive rehabilitation had a significant effect on the mathematical achievement of students with PTSD.

In addition, the other findings point to the significant effect of grouping on mathematical achievement (p <0.01; F = 11.836). In other words, these results indicated that cognitive rehabilitation increased the mathematics scores in the experimental group, compared to the scores obtained in the control group. The ETA squared in Table 3 demonstrates the effect size of cognitive rehabilitation on the mathematical achievement of students with PTSD. As depicted in this table, this value was obtained at 21% at the significance level of P <0.01; accordingly, 21% of mathematical achievement variance can be attributed to cognitive rehabilitation. These results pointed to the statistically significant effect size of cognitive rehabilitation (0.21) on the academic achievement of students with PTSD (P <0.01)

As presented in Table 4, there is a significant difference between the experimental and control groups in terms of the post-test Persian literature scores after controlling the initial pre-test differences (P <0.01; F = 25.908). In other words, cognitive rehabilitation had a significant effect on the academic achievement of students with PTSD in Persian literature. In addition, the other findings pointed to the significant effect of grouping on students' achievement in Persian literature (P<0.01; F=11.836). In other words, these results showed that cognitive rehabilitation increased literature scores in the experimental group, compared to the control group.

The ETA squared in Table 4 demonstrates the effect size of cognitive rehabilitation on the achievement of students with PTSD in Persian literature. As depicted in this table, this value was obtained at 46% at the significance level of P <0.01; accordingly, 46% of variances of literature achievement can be attributed to cognitive rehabilitation. These results indicate that the effect size of cognitive rehabilitation (0.46%) on academic achievement of students with PTSD was statistically significant (P <0.01)

The research findings on the moderating role of emotion regulation in the academic achievement of students with PTSD in mathematics and Persian courses are illustrated in Table 5. Based on the results of the Wilks' Lambda test in this table, the effect of cognitive rehabilitation on the academic achievement of students with PTSD in mathematics and Persian literature courses is significantly moderated by emotion regulation (F= 4.98; P<0.05).

Table 3. Results of one-way analysis of covariance on MANCOVA text to evaluate the effectiveness of cognitive rehabilitation on the variable of mathematical achievement

Dependent variable	Source of effect	Total squares	Degree of freedom	Mean squares	F	Significance level	ETA squared
Mathematics	Pre-test	6.332	1	6.332	6.592	0.014	0.13
	Group	11.371	1	11.371	11.836	0.001	0.21
	Error	14.308	43	0.961			

Table 4. Results of one-way analysis of covariance on MANCOVA text to evaluate the effectiveness of cognitive rehabilitation on the variable of academic achievement in Persian literature

Dependent variable	Source of effect	Total squares	Degree of freedom	Mean squares	F	Significance level	ETA squared
Persian literature	Pre-test	25.769	1	25.769	25.908	0.001	0.37
	Group	36.941	1	36.941	37.140	0.001	0.46
	Error	42.770	43	0.995			

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Table 5. Multivariate analysis of covariance to investigate the effect of cognitive rehabilitation training on academic achievement in mathematics and Persian courses by the moderating role of emotion regulation

Source of effect	Test	Value	F	DF (hypothesis)	DF(error)	Significance	Eta squared
Emotion regulation group	Pillai's Trace	0.195	4.98	2	41	0.012	0.19
	Wilk's Lambda	0.805	4.98	2	41	0.012	0.19
	Hoteling's Trace	0.989	4.98	2	41	0.012	0.19
	Roy's Largest Root	0.989	4.98	2	41	0.012	0.19

Discussion and Conclusion

Although no study directly assessed the effectiveness of computer-based cognitive rehabilitation on the academic achievement of students with PTSD in mathematics, the findings of the present research can be considered consistent with the results of some studies. In line with the results of the current study, Oraki et al. showed that computer-based cognitive rehabilitation can effectively improve the academic achievement of students with mathematics disabilities (14).

Along the same lines, in their study, Hajizadeh et al. indicated that computer-based education can have a positive effect on Bloom's cognitive levels in learning and memorizing mathematical concepts (15). The findings of the two mentioned studies confirm the result of the present study. In a similar vein, a study performed by Ebtehaj showed that computer-based cognitive rehabilitation is effective in the improvement of problem-solving, reasoning, and academic performance of students (16).

Since academic achievement in mathematics is one of the dimensions of academic performance, the findings of the present study can be considered consistent with these results. Narimani et al. also pointed out that cognitive rehabilitation is effective in the academic achievement of children with mathematics disabilities (17). This finding also supports the result obtained in the present study. It can be argued that students with PTSD have major deficits in cognitive and executive functions, and numerous studies conducted on these students have demonstrated this finding.

In this regard, in their study, Valencia et al. examined the cognitive profile of children with PTSD using neurological tests. They reported that these children are weak in cognitive and executive functions. Moreover, they are presented with serious problems in their working memory and attention span (18). In addition, De Jongh et al. and Sahragard et al. have pointed to the existence of cognitive and executive deficits in people with PTSD (19). Nevertheless, the improvement of academic performance, especially mathematical achievement, mainly depends on cognitive abilities and executive functions, and many experts have highlighted the role of these abilities in learning mathematics (20).

Moreover, the results of the previously conducted studies acknowledge the importance of executive functions and cognitive abilities in academic performance and learning mathematical concepts (21). Therefore, it can be argued that cognitive rehabilitation can enhance the academic performance of students with PTSD and their ability to learn mathematical concepts by increasing cognitive ability and improving executive functions. In general, it can be stated that cognitive rehabilitation can effectively strengthens cognitive abilities and components related to executive functions. In so doing, it enhances educational performance of students with PTSD and brings them academic achievement.

The results of the current study pointed out that cognitive rehabilitation had a positive effect on the academic achievement of students with PTSD in literature. This implies that the participation of the experimental group in cognitive rehabilitation sessions improved their literature scores, while no academic achievement was observed in the control group who had not received any training. In their study, Hossein Khanzad et al. showed that computer-based cognitive rehabilitation improved the reading performance of dyslexic students. This finding can be regarded as consistent with the result of the present study since reading is one of the basic skills required for a literature course.

In the same context, Azimi et al. pointed to the effect of educational computer games on academic achievement and attitude towards a science course. Since learning the concepts of science and literature courses requires similar cognitive abilities, this finding can be considered in line with the results reported in the current

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study (22). Moreover, the findings of the present study are consistent with the results of some other published studies. For instance, Sánchez-Pérez et al. demonstrated that computer-based cognitive education can increase students' academic achievement (23).

Wexler et al. indicated that education designed to strengthen cognitive functions can exert positive effects on academic achievement and (24). In another study, Bloomberg et al. pointed out the effectiveness of digital games in the improvement of students' motivation and learning (25). The results of all the above-mentioned studies support the findings of the present research. In fact, they demonstrate the effectiveness of cognitive rehabilitation in improving student's academic school skills.

It can be concluded that cognitive rehabilitation can lead to better performance in learning concepts and doing assignments by reducing the cognitive deficits in adolescents with PTSD. Moreover, since cognitive functions play a vital role in the process of adapting to stressful situations, the improvement of these functions by cognitive rehabilitation can enhance the academic achievement of students with PTSD. In fact, apart from its detrimental effects on cognitive ability, PTSD also brings about some serious symptoms, such as fear, anxiety, and feelings of guilt and shame, which in turn, negatively affect students' academic performance.

Based on the results, the effect of cognitive rehabilitation on the mathematical achievement of students with PTSD is significantly moderated by emotion regulation. This finding is consistent with the results of some studies, such as the research conducted by Kohkha et al. They found that the use of emotional skills, recognition of feelings and emotions, as well as regulation and correct expression of emotions can positively affect academic activities. In a similar vein, the findings of the current study showed that an appropriate level of emotion regulation is effective in the enhancement of academic achievement (26).

In another study, Azar et al. stated that emotion regulation strategies have a significant relationship with academic achievement. This finding is also in agreement with the results of the present study (27). Furthermore, some other studies support the findings of the present study. For example, Al-badareen found that emotion regulation strategies affect students' academic achievement (28). In another study, Hafiz et al. showed that emotion regulation and related strategies play a positive role in increasing students' academic performance (29).

In general, in support of the findings of the present research, the results of these studies indicate that emotion regulation plays a vital role in students' life and exerts a dramatic effect on their academic performance and success. It can be argued that the proper use of emotion regulation strategies can contribute greatly to students' academic achievement. Regulation and improvement of emotions result in increased resilience. In this regard, Andamikhoshk et al. denoted that emotion regulation strategies are a determining factor in predicting resilience (30).

Therefore, it can be inferred that students with PTSD will be more resilient and perform better in mathematics if they use emotion regulation strategies properly. Other results of the study suggested that the effect of cognitive rehabilitation on the academic achievement of students with PTSD in the Persian literature course is significantly moderated by emotion regulation. The results of a study conducted by Shahmohammadi and Mokhtari illustrated that non-adaptive emotion regulation strategies perform a mediation role in the relationship between perceived social support and adolescents' academic achievement (31).

In support of the findings of the current research, the results of the referred study denoted that non-adaptive emotion regulation strategies can contribute to the reduction of academic achievement. In another study, Mohebbi and Badri examined the predictions and consequences of emotion regulation and found that academic achievement can be one of the consequences of emotion regulation (32). Along the same lines, Rahmati and Ghaffari revealed that emotional regulation is one of the factors that can predict students' academic achievement (33). The findings of these two aforementioned studies are consistent with the results of the present study.

Among other published studies, we can refer to some results which are in line with the findings of the present study. For instance, McCann et al. evidenced that emotion understanding and management can increase students' achievement (34). Richard and Sumathi also conducted a study to examine emotion regulation and academic achievement in adolescent students. The results of

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this study found a relationship between emotion regulation and academic achievement (35). Cognitive rehabilitation can lead to better performance learning concepts and doing assignments by tackling the cognitive deficits of children with PTSD.

Furthermore, since cognitive functions play a key role in the process of adapting to stressful situations, the improvement of these functions by cognitive rehabilitation can enhance the academic achievement of students with PTSD. In fact, strengthening and improving cognitive functions and executive abilities is a major contributing factor in the reduction of problems and academic failure of students. Therefore, cognitive rehabilitation can strengthen the cognitive components required for academic education by strengthening the cognitive abilities of children with PTSD.

Moreover, it can reduce the psychological signs and symptoms of PTSD and increase students' mental health, which in turn, leads to their active cooperation in school activities. In light of the aforementioned considerations, it can be concluded that cognitive rehabilitation is an efficient method to improve the academic performance of students with PTSD by strengthening the cognitive functions required for academic performance. Therefore, it can be used as an effective method for the rehabilitation of students and peoples from all walks of life who face destructive and severe crises.

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Conflict of Interests

The authors declare that they have no conflicts of interest regarding the publication of the current study.

Footnotes

Authors Contribution: Mohammadreza Amirian was responsible for the study conception and design. Majid Zargham Hajebi supervised the whole thesis. Mohammadreza Amirian prepared the first draft of the manuscript. Mohammadreza Amirian prepared the first draft of the manuscript conducted the data analysis, made a critical revision to the paper for important intellectual content, and supervised the study conducted the data analysis, made a critical revision to the paper for important intellectual content, and supervised the study. All authors read and approved the final manuscript.

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