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Investigating the Effects of Cognitive Rehabilitation on Executive Functions and Social Cognition of Adolescents with Epilepsy

Abstract

Epilepsy is a chronic and prevalent neurological disease, which is caused by the excessively and simultaneously abnormal electrical discharge of the brain. Studies have suggested that this disease could lead to a wide range of neurological and psychological disorders in people and leave adverse impacts on their lives. For this, the present research aims to investigate the effects of cognitive rehabilitation on executive functioning and social cognitions of adolescents with epilepsy. The present quasi-experimental study was performed on 9 adolescents with epilepsy. The subjects received 12 treatment sessions involving cognitive rehabilitation of executive functions and social cognition through attentive rehabilitation of attention and memory, and emotion recognition and mind reading-based cognitive rehabilitation. Data related to the components of executive functions were collected through Stroop's neuropsychological tests, Wisconsin Test, Continuous Performance Test, and N-Beck Test, while data related to components of social cognition were collected through emotion recognition and mind reading test in five stages of pretest, posttest, and one-week, one-month and three-month follow-up stages, as the data were analyzed using descriptive statistical (mean and SD) and inferential (repeated measures ANOVA) tests. Results indicated that in the post-test stage, the scores about the components of social cognition and executive functions, excluding those of selective attention and sustained attention, were significantly higher than components of the pretest stage, with the score differences being significant (0.05 and 0.1). One-week, one-month, and three-month follow-ups also revealed that the improvement achieved in the posttest was sustainable. A cognitive rehabilitation program is a novel approach to removing the neurological problems of people with epilepsy. Thus, the findings of this research suggested that health experts can use this intervention, along with other interventions, to improve the lives and social relations of these people.

Keywords: *Cognitive rehabilitation, Executive functions, Social cognition, Epilepsy, Adolescents*

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Introduction

One of the oldest and most prevalent chronic diseases is epilepsy, which involves all age and racial groups and may endanger the public health of society (Kanner et al. 2018). By definition, epilepsy refers to the outburst of brain activity due to the intense, sudden, and usually brief electrical discharge of the brain cells whose symptoms vary from shortened attention span and muscular shaking (tremor) to severe and long-period seizures with intervals of apparent health and loss of consciousness. The cause of these seizures is not yet clear, as the interval between the seizures should be 24 hours.

Prevalence and incidence of epilepsy, as suggested by different studies, vary by age, gender, race, and social-economic class. Over 50 million people around the world have epilepsy (World Health Organization, 2019). In Iran, its prevalence comes at 1.200.000 people (Mohammadi et al. 2006). Also, the prevalence of this disease in developing nations is greater than that in developed nations (Ngugi et al. 2011). It is estimated that 2.4 million new cases occur each year across the world with half of this rate occurring in childhood and adolescence (World Health Organization, 2017).

When a child or adolescent is diagnosed with epilepsy, the goal is not to just treat the disease. Although the children with epilepsy are to some extent treated (which mainly leads to the satisfactory control of the seizures), little progress has been made in the understanding of the short- and long-term causes of the disease or the relevant extensive disability of these patients (Yuen et al. 2017). The nature of this disability is mainly cognitive or behavioral (Kavanaugh et al. 2014), which significantly affects the development and quality of the life of people with epilepsy, thus causing numerous problems for them (Schraegle & Titus, 2017). Therefore, one of the consequences of epilepsy pertains to executive functioning problems, which can include behavioral and social problems as well as academic failures (Smith, 2016). Executive functions can be defined as a set of high-level cognitive processes that help mental control and self-regulation (Juric et al. 2013). Executive functions are good predictors of life quality and academic achievements (Diamond, 2013).

Psychologists often regard "executive functions" to refer to an umbrella, which involves wide-ranging skills that are mainly controlled by the frontal lobe of the brain. These skills include attention, reasoning, judgment, problem-solving, working memory, and awareness of one's and others' performance (Scott & Schoenberg, 2011). Some researchers maintain that executive functions involve regions beyond the frontal lobes; executive functions, such as fast or high-order functions, seem to relate to the integrity of structural connectivity in the brain. When performing complicated cognitive tasks, executive functions continuously review and regulate cognitive processes (Locozi, 2016). Consistent with the neuro-psychological perspective, executive functions can be used as a tool to diagnose diseases or injuries related to the frontal lobe. Many of the executive function-related deficits will continue or deteriorate over time for adolescents with epilepsy (Mazure-Mosiwics, et al. 2013).

In a study, aimed at investigating the executive profile of the adults with juvenile myoclonic epilepsy, and its association with seizure proximity, history of familial epilepsy, and one-dimensional and multi-dimensional therapies using antiepileptic medications, the number of 110 healthy people and 31 patients with juvenile myoclonic epilepsy were included in the study using the Frontal Assessment Battery (FAB) to assess the frontal lobe functioning as a clinical screaming tool. Patients with epilepsy were found to suffer from executive function deficits of various dimensions. Compared to healthy people, patients with juvenile myoclonic epilepsy gained lower scores in conceptualization, cognitive flexibility, planning, sensitivity to interference, and the entire assessment test. In sum, patients with juvenile myoclonic epilepsy were suffering from executive function deficits in various aspects (Sanjari Moghaddam et al. 2020).

In a study aimed at investigating the executive actions in patients with unknown epilepsy, the number of 40 adult patients with consecutive unknown epilepsy (focal or generalized) with the age range of 18-45 years, IQ higher than 85, under the treatment of monotherapy or polytherapy were matched with 40 healthy adult volunteers in terms of age, gender and level of education. The patients with epilepsy revealed executive functioning deficits in all items of the test; however, those with focal and generalized epilepsy revealed no difference except for the meantime of correct response in the sequential performance test. Also, a positive and significant correlation was noted between frequency of seizure, mean total time and mean the number of extra films in the Tower of London Test, verbal working memory (word span-numbers), and omission errors in the Sequential Performance Test. At the same time, there was a significantly negative correlation between the level of accuracy and frequency of seizures in the Sequential Performance Test and the visuospatial part of the working memory (The Corsi block-tapping test). The adults with the unknown epilepsy were found to have executive function disorders compared to the control group; however, no difference was observed in the people with generalized and focal epilepsy except for the meantime of correct response to the Sequential Performance Test. Moreover, the increased frequency of seizures was associated with planning, attentional and working memory (verbal or visuospatial) (Borai et al. 2013).

A large spectrum of neurobehavioral disorders, including cognitive disorders, mental harm, and social adjustment problems may affect the patient with epilepsy; these problems usually persist before the beginning of the seizure and mostly after the seizure is controlled. Accordingly, one of the most salient cognitive phenotypes relating to epilepsy is social cognition (Matthews & Tye, 2019). In 2013, the Diagnostic and Statistical Manual of Mental Disorders, published by the American Psychiatric Association, defined social cognition to be one of the six main components of the neuro-cognitive functions of each individual (American Psychiatric Association, 2013). Social cognition involves several discrete, but reciprocal mental processes. This concept serves as a kind of information processing that includes an accurate understanding and interpretation of behaviors, thoughts, and feelings of others and as a guide for an appropriate response to social situations. A large spectrum of secondary processes involves social cognition, including the theory of mind, facial emotion recognition, empathy, prosody perception and body language interpretation (Brothers, 1991), appreciation of interpersonal relations, and moral judgments (Adolphs, 2001). Unfortunately, vulnerabilities of social cognition could persist until adulthood, which would lead to unemployment, unsuccess marriages, the tendency to crime, and social instability.

In another study, aimed at assessing the facial emotions recognition and theory of mind in children and adolescents with focal epilepsy and its relationship with intelligence and executive functions of 62 children and adolescents aged 7-16 suffering from focal epilepsy, 32 ones, matched in terms of gender and age, were selected as the control group. The mean emotion recognition score of the epilepsy group was significantly lower than that of the control group in the t-test. Compared to the control group, the epilepsy group experienced disorders with happiness, grief, anger, and fear recognition. The mean theory of mind score in the epilepsy group was significantly lower than that of the control group (Operto, 2020).

In another study assessing the social cognition of self-Limited childhood epilepsy with centrotemporal spikes, and its relationship with traditional executive function tests and clinical variables of epilepsy, 23 patients with childhood epilepsy (65% male and a mean age of 10.64 years) and 20 healthy children (75% male and a mean age of 10.15 years) were assessed. Patients with self-Limited childhood epilepsy were suffering from slip error deficits, compared to healthy counterparts (p<0.001).

Impairment of some executive functions was associated with the worsening social cognition of these patients. It was found that except for the anticonvulsants, the factors related to epilepsy did not impair the performance with slip error tests (p<0.001). The result is that social cognition in children and adolescents with self-limited epilepsy is impaired with centrotemporal spikes. Persisting seizures and recurring epileptic activities were found to have no association with social cognition. Thus, on its own, epilepsy was associated with social cognition (Lima et al. 2020).

The cognitive neuroscience field has made considerable progress over recent decades. In this connection, cognitive rehabilitation therapy can be mentioned. Cognitive rehabilitation is a modern therapeutic method that is mainly aimed at improving cognitive deficits and dysfunctions, including concentration, attention, memory, executive functioning, and social cognition. Cognitive rehabilitation refers to a kind of experience of learning which focuses on restoring brain dysfunctions to improve peoples' performance in real life (Abbariki et al. 2017). Since this kind of therapy is mainly directed at the individual's cognitive abilities, it can be regarded as a specifically unique therapy. This kind of therapy uses various methods and techniques to train the "skill of thinking"; thus, the term cognitive remediation can be used instead of cognitive rehabilitation

In a quasi-experimental study conducted by Tabatabaei et al. (2018), which was aimed at assessing and rehabilitating working memory and selective attention, thirty 13-16-year-old students with temporal lobe epilepsy were randomly placed in one control and two experimental groups. This research used a non-computer cognitive rehabilitation program for the first experimental group and a computer rehabilitation program for the second experimental group. Each of the intervention groups was treated by the said rehabilitation packages for 4 weeks (15 sessions of one hour each). The control group, meanwhile, did not receive any of the training packages. However, the control group, like the experimental groups, participated in the pretest, posttest, and three-month follow-up after the intervention. Findings from this study revealed significant differences in the mean dependent variable scores in the first and second experimental groups compared to the control group, and differences in the first experimental group compared to the second experimental group. This research provided two types of results: first, cognitive rehabilitation programs (computer and non-computer) affected the improvement of executive functions of people with temporal lobe epilepsy, and second, non-computer packages of working memory and selective attention were found to be more effective on executive functions than the computer Capitan's Log package.

In a study by Chelbianlou et al. (2020), forty people with brain injuries were selected by purposive sampling method using inclusion and exclusion criteria, and then randomly divided into an experimental and a control group after being matched. The people of the experimental group underwent treatment through Rahakam software-based cognitive rehabilitation and continuous performance test for 8 weeks (three 30-minute sessions per week). Statistical analysis results using multivariate analysis of covariance suggested that Rahakam software-based cognitive rehabilitation training could significantly improve sustained and divided attention in the experimental group.

carried out a rehabilitation program for attention deficits on two groups of patients (experimental=52, and control=57) who had undergone surgery for the removal of the temporal lobe. Both groups were assessed for memory, before and three months after the surgery of the temporal lobe. Findings revealed that sustained attention performance could improve from cognitive training.

investigated the efficacy of cognitive rehabilitation based on emotion recognition and theory of mind (mind-reading) in children with autism disorder. This quasi-experimental study which included a pretest and post-test design with a control group examined 298 students (65 girls and 232 boys) with autism disorder in the city of Shiraz in 2019-2020; meanwhile, the students were randomly divided into an experimental and a control group. The experimental group received therapy for 12 sessions. Research tools were the Autism Spectrum Disorder Questionnaire (ASSQ), Theory of Mind Test (Tom Test), and Emotion Recognition-based Cognitive Rehabilitation Program. Results indicated that the emotion recognition-based cognitive rehabilitation training had a significant effect on the first and second levels as well as on the total score of the Theory of Mind; however, the training did not have a significant effect on the third level of the theory of mind. It is thus concluded that training in cognitive rehabilitation based on appropriate emotional recognition can improve levels of theory of mind (mind-reading). In general, researchers have suggested the effectiveness of social cognitive rehabilitation on behavioral and cognitive problems of hyperactive children; the effectiveness of cognitive rehabilitation of mind-reading on behavioral symptoms of children with autism (Yaghouti et al. 2019), and effectiveness of cognitive rehabilitation based on systematic computer games on the development of mirror neurons and their effects on the theory of mind of children with autism and epilepsy (Koyama, 2009).

Procedure

The present research was a quasi-experimental study with a pretest-posttest and a one-week, one-month, and three-month follow-up design without a control group. The statistical population of this research consisted of all 15-25-year-old-adolescents with epilepsy who presented to the Imam Khomeini Hospital of Tehran in 2021. Following coordination with and acquiring codes of ethics from competent authorities of the Imam Khomeini Therapeutic Center, and filling out of parental consent form, the number 24 volunteers with a history of epilepsy were selected based on inclusion and exclusion criteria via convenience method. In the end, due to the fewer number of volunteers and loss of samples, only data from 9 subjects were gathered. Inclusion criteria were having minimum and maximum age of 15 and 20 years, respectively, having diagnosed with epilepsy and lapse of at least 6 months from the process of treatment, no history of diagnosis with other chronic physical diseases at the time of the intervention, lack of psychiatric diseases that would affect cognitive functions, ability to read and write, weakness with at least one standard deviation of executive functioning, filling of the consent form, etc., while the exclusion criteria were presence of any chronic physical or psychiatric diseases that would affect the executive functioning, presence of weakness with two standards of deviation in intelligence tests, history of treatment on the head, presence of brain tumors and history of brain trauma or harms, non- filling in of the consent form in the research, no-participation in the sessions for at least two sessions, history of epilepsy in the first-degree relatives and non-satisfaction with taking part in the study.

Measurement tools used in the research include the following:

Tools to measure executive functions:

Stroop Test: This test was first developed by Ridley Stroop to assess cognitive functions, including selective attention and cognitive flexibility. There are various forms of this test for research objectives. This research uses the Computer Stroop Test, designed based on the Delphi programming language. This test is also made of three stages: (W=reading the word); (C=naming the color) and (CW=naming the color without regard for the word) .The reliability of this test in the first, second, and third stages were 0.88, 0.88, and 0.80, respectively (Basharpour, 2004). The interval between the stimuli is 800 milliseconds and the time at which each stimulus is provided is 2000 milliseconds. In the end, the number of correct responses is obtained from the difference in the score between the number of congruent correct responses and the number of incongruent correct responses.

Wisconsin Cards Sorting Test: This test dates back to the mid-20th century when Berg began a study under the supervision of Grant at the University of Wisconsin (Grant & Berg, 1948; quoted by Strauss et al. 2006). Miller (1963; quoted by Eling et al. 2008) did a study entitled "Different effects of brain lesions" where he used this test to introduce it as a neurocognitive test. This test measures higher brain functions, including abstract thinking and problem-solving (Mohib, 2012). Four main cards (triangle, star, cross, and circle) are displayed on top of the computer screen fixedly until the test ends. Sixty other cards are placed in fully random order on the bottom of the screen and close to the left corner. When a card is shown, the subject has to decide under which the main card this card is placed. The interval between the subject's response and presentation of the feedback is 100 milliseconds, the length of the feedback is 200 milliseconds and the interval between the end of the feedback and the presentation of the next card is 700 milliseconds. The present research used a standard computer Wisconsin Test. The test's validity of cognitive deficits following brain injuries was 0.86, while its reliability was 0.85 using the test-retest method.

N-back Test: It is one of the cognitive neuroscience tests that is not dependent on culture; this test was first developed in 1958 by Kirchner. This test is computer software for the assessment of working memory and was first used in a study in 2008. The letter N in N-back suggests that the subject has to name several previous stages to decide about and respond to the similarity of the stimuli. In this test, several visual stimuli are presented in succession on the screen at a speed of 300 milliseconds. The interval between each presentation with the previous one is 2 seconds (Ajilchi et al. 2013). If dissimilar, the subject has to press button "2", and if similar similarity, button "1". According to this assignment, the subject has to maintain the information of only one stimulus in his/her memory (i.e., the stimuli of one or two previous stages). This assignment is designed in a way that people have to respond to all the stimuli in all the stages; for this, this assignment requires continuous control and updating of the information in the working memory. This test uses hundred-linear image sets. This test enjoys a strong validity and is currently used in clinical and empirical studies. Its validity is also shown along with several other tests which measure working memory (Quoted by Khorasani et al. 2019). In Iran, this test is also used as a credible and reliable test and its validity ranges from 0.54 to 0.84, which is great (Khorasani et al. 2018).

Continuous Performance Test (CPT): The continuous performance test was developed by) to investigate attention errors in patients with minor epilepsy. This test measures the ability to be attentive sustained attention and consistent focus in different age groups. The procedure of the software is in a way that a number is selected as a target; then, the intended number is represented irregularly among other numbers. The subject has to provide his/her response by pressing a button when the target stimulus is presented. The interval between the presentation of the numbers is 0.05 seconds; also, the time duration and the type of the numbers can be changed. This test scores two types of errors: omission errors (Ostojic, 2018), and commission errors (Christoff, 2016). Omission errors occur when the subject does not respond to the target stimulus, which indicates s/he has faced a problem in perceiving the stimulus. This type of error is interpreted as a problem with sustained attention, suggesting inattention to the stimuli. Commission errors occur when the subject responds to the non-target stimulus. This type of response indicates weakness in impulsivity inhibition and is interpreted as a problem with controlling impulses or impulsivity. In this test, these two types of errors are counted through the computer program. In addition, the number of subjects' correct responses and time of reaction to the stimulus is also calculated. The Persian form of this test has been standardized and its reliability using the retest method ranges from 0.59 to 0.93 (Hadianfar et al. 2001).

Social cognition measurement tools

Nim Stim Emotion Recognition Test: This test has been changed by Nejati (2013) and includes a 42-image short form. Facial images of various emotions are presented on the computer screen in colorful forms and on a white background. Each image is presented for 200 milliseconds (Russo, 2015). In every attempt, an image is presented with emotions of happiness, grief, anger, hatred, surprise, and fear. The subject has to recognize the emotional state of the images (Tottenham, 2009). Ghasempour et al. (2012) obtained the Cronbach's alpha of this test to be 0.71.

Ekman's Facial Expression Recognition Test: This test was developed by Ekman and Frizen in 1976, and is made of 36 black and white images of a man and a woman. This test reveals six main emotions of anger, hatred, fear, happiness, grief, and surprise, as the subject has to recognize and respond to the intended emotion by looking at the images. The above test is carried out in computer forms and is rated in the form of zero and one. Here, the subject's performance is measured by the number of correct responses. The reliability of the above test in the present research was shown to be 0.71 via Cronbach's alpha.

Reading the Mind in the Eyes Test: This test is a neuropsychological test, developed by Baron and Cohen (2001), and involves images of famous foreign actors, with part of their eyes removed. Each of these images reveals 36 various mental states like comfortable, disappointed, terrified, etc. For each image, mental states of similar emotional capacity are provided. The respondent has to use the visual information available for each image to select only a choice from among the four choices that would best describe the mental state of the person in the image. The maximum score to select the correct words in this test is 36, while the least score is 0. In most studies, this test has been used to investigate the ability of mind-reading of healthy and patient people. Baron and Cohen's test scoring method is based on the subject's correct responses to the items, as the total, correct responses of the items constitute the individual's score. The maximum time required for the administration of this test is 15 minutes. In a study, the Cronbach's alpha coefficient for the English version was 0.77, and for the French version was 0.53. also, the intra-group correlation coefficient of the French version of this scale was 0.70; the version also enjoyed good internal reliability and retest (Pervost, 2013).

Iranian Version of Reading the Mind in the Eyes Test: This test is like its foreign counterpart, being different in that it uses the images of the Iranian artists' eyes. Nejati et al. (2012) reported the Cronbach's alpha to be 0.72, and the reliability coefficient of its retest to be 0.61 in a sample consisting of 30 students within two weeks. Three linguists were consulted to translate the English words into Persian.

Rehabilitation Tools:

Attentive Rehabilitation of Attention and Memory: This program is software to investigate various dimensions of attention and memory, developed by Nejati (2013). The effectiveness of this test on attention and memory has been demonstrated in much research. This intervention is administered in 10 individual sessions (two 60-minute sessions per week for five weeks). Th basic principles of this program include the following (Najjarzadegan et al. 2015): 1) assignments are organized in a hierarchical form, with the exercises getting difficult gradually; 2) the proper doing of the assignment will be followed by immediate rewards, with the rewards gradually being provided at longer delays; 3) the assignments have been designed based on various functions of the working memory, including updating, transfer, and inhibition; 4) the assignments are exciting and are provided with emotion stimuli so that the subject's motivation for the administration is strengthened; 5) the assignments should be repeated to get the subject to reach a desirable level, and 6) progress in the program is dependent on the subject's effectiveness, and the presence of the therapist for the improvement of the levels of the assignment is critical. The attention rehabilitation of attention and memory was developed from the model of attention by Solberg and Matir and the active model of memory by Alan Bedley. The said program assignments include colorful houses, faces, similar windows, cropped images, last colors, animal detection, repeated images, and delayed pairing of the colors. The difficulty levels of all assignments range from one to ten which are based on the number, speed of presentation, and complexity of the stimuli. When designing cognitive rehabilitation exercises. Major learning principles such as diversity, overload, feedback, and rating are used (Nejati, 2017).

Cognitive rehabilitation program based on emotion recognition and mind reading: This program is local software developed by Nejati (2017) and Behavioral Neuroscience Research Center. The effectiveness of this program was revealed in a study that investigated the social cognition of children with autism (Nejati et al. 2017). Results from the said study suggested that this program affected the social cognition skills (mind-reading) of children with autism. According to this program, the emotional abilities and mental states of children with autism are strengthened in a classified form. The nominal form of this program was confirmed by several researchers. The validity of the said program was also examined by experts and clinical psychologists from a content perspective (Ghorbani et al. 2019).

The methods used to describe the data in this research include mean, standard deviation, minimum and maximum scores, and graphs; since the current research design is pseudo-experimental with pre-test, post-test, and follow-up design without a control group, the analysis of variance test method with repeated measurements was used to analyze the data.

Findings:

Table 1 gives descriptive indicators of executive function variables such as mean, standard deviation, minimum and maximum score, as executive function variables include five test subjects (selective attention, cognitive flexibility, sustained attention, working memory with consecutive images, and working memory with one in between images). As noted, there was a difference in all five investigated variables between the pre-test and the post-test scores and the one-week, one-month, and three-month follow-up scores.

Statistical analysis of data

Table 5: Descriptive indicators of Executive functions variables

Variable	Measurement stage	Mean	SD	Lowest Score	Highest score
Selective attention	Pretest	87.55	17.37	49	99
	Posttest	98	1.87	95	100
	One-week	98.88	1.53	95	100
	One-month	99.11	1.05	97	100
	Three-month	98.22	1.56	95	100
Cognitive flexibility	Pretest	72	12.92	48	89
	Posttest	92	4.31	-1.10	1.21
	One-week	94	2.06	91	97
	One-month	93.55	1.23	91	95
	Three-month	93.88	1.53	91	96
Sustained attention	Pretest	15	-	15	15
	Posttest	15	-	15	15
	One-week	15	-	15	15
	One-month	15	-	15	15
	Three-month	15	-	15	15
Working memory Consecutive images	Pretest	67	27.32	14	98
	Posttest	96.11	1.90	93	98
	One -week	97.55	0.52	97	98
	One-month	96.77	1.39	94	98
	Three-month	95.77	1.78	93	98
Working memory alternating images	Pretest	59.66	19.44	23	81
	Posttest	94.11	3.01	87	97
	One-week	95.66	1.58	93	98
	One-month	95.77	1.71	93	98
	Three-month	94.55	3.16	90	98

Table 2 pertains to the kurtosis and skewness indicators. As for the research data about executive function variables, the assumption of the data normality was met. As shown, the skewness and kurtosis values of all variables were at -2 and +2.

Table 2: Skewness and kurtosis indicators for the normality of the executive function variables

Variable	Measurement stage	Skewness	Kurtosis

Selective attention	Pretest	-1.77	0.52
	Posttest	-0.29	-1.33
	One-week	-0.42	0.63
	One-month	-1.09	0.61
	Three-month	-0.97	1.27
Cognitive flexibility	Pretest	-0.77	0.91
	Posttest	-1.10	1.21
	One-week	0	-1.22
	One-month	-1.43	1.52
	Three-month	-0.82	0.48
Sustained attention	Pretest	-	-
	Posttest	-	-
	On- week	-	-
	One-month	-	-
	Three-month	-	-
Working memory Consecutive images	Pretest	-0.76	0.29
	Posttest	-0.48	-1.36
	One-week	-0.27	-0.57
	One-month	-0.92	0.35
	Three -month	-0.08	-1.31
Working memory Alternating images	Pretest	-0.70	-0.22
	Posttest	-1.85	0.03
	One-week	-0.27	-0.51
	One-month	-0.13	-0.82
	Three-month	-0.17	-1.42

Multivariate test results in Table 3 showed that the Wilks' lambda of the variables of cognitive flexibility, working memory of consecutive images, and working memory of alternating images (F=6.20, p<0.05, F=10.14, p<0.05, and F=8.61, p. <0.05, respectively), were significant, indicating that the cognitive rehabilitation intervention had affected these components in different stages of the test. However, Wilks' lambda results of the variable of selective attention (F=3.72, p<0.05) were not significant, suggesting that the cognitive rehabilitation intervention had not affected this component in different stages of the test. Because the subjects did not reveal any changes in the scores, this variable was not analyzed.

Table 3: Multivariate test results on the sores from executive function variables

Dependent variables	Indicator	Valu e	F value	Freedom degree hypothesis	Error of freedom degree	Sig.
Selective attention	Wilks' lambda	0.24	3.72	4	5	0.082
Cognitive flexibility	Wilks' lambda	0.16	6.20	4	5	0.035
Sustained attention	Wilks' lambda	-	-	-	-	-
Working memory/consecutive images	Wilks' lambda	0.11	10.14	4	55	0.013
Working memory/ alternating images	Wilks' lambda	0.13	8.61	4	5	0.018

Table 4 uses Mauchly's Test of Sphericity for the review of the assumption. If the size of Mauchly's test is not made significant statistically, the results will be reported based on the Test of Sphericity, and if made significant, the results will be reported based on the Greenhouse-Geisser statistic. Since the Mauchly's Test was made significant in all variables, the results were reported based on the Greenhouse-Geisser statistic.

Table 4: Mauchly's test results of executive functions

Variables	Intra-subject effect	Mauchly (W)	Chi-Square	Freedom degree	Sig.
Cognitive flexibility	Time	0.007	43.67	9	0.001
Working memory/consecutive images	Time	0.000	82.45	9	0.001
Working memory/in-between images	Time	0.001	53.61	9	0.001

As noted in Table 5, the effect of the time agent on the variables of cognitive flexibility (F=19.79, P <0.01, and effect size = 0.71); working memory of consecutive images (F=10.34, p<0.05, and effect size = 0.56), and working memory of alternating images (F=28.57, p<0.05, and effect size=0.78) was significant; i.e., the mean estimated cognitive flexibility, working memory of consecutive images and working memory of alternating images saw a significant difference in all pretest, posttest and follow-up stages (p<0.01).

Table 5: Analysis of variance with repeated measures results for executive functions

Sources of changes	Agent of time	Sum of squares	Freedom degree	Mean squares	F	Sig.	Eta squared
Cognitive flexibility	Agent (measurement stages)	276.008	1.20	229.963	19.79	0.001	0.71
Working memory/consecutive images	Agent (measurement stages)	630.086	1.01	618.048	10.34	0.012	0.56
Working memory/ alternating images	Agent (measurement stages)	898.115	1.11	802.328	28.57	0.001	0.78

Table 6 shows that for the mean cognitive flexibility of the subjects, there is a statistically significant difference between the pretest and the post-test, one-week, one-month, and three-month follow-ups (p<0.01), with the mean posttest and later follow-ups being statistically higher than the mean pretest. Also, there was no statistically significant difference between the mean post-test scores and one-week, one-month, and three-month follow-up scores (p>0.05), indicating the stability of the results as affected by the cognitive rehabilitation intervention on working memory of consecutive images. There was only a significant difference in the mean working memory of consecutive images (p<.05) between one week, three-month, and follow-up. Table 6 shows that there is a significant difference in the mean working memory of alternating images (p<0.01) between the pretest and post-test, one-week, one-month, and three-month follow-ups, with the mean posttest and later follow-ups being statistically higher than the mean pretest. Also, there was no statistically significant difference between post-test scores and one-week-, one-month, and three-month follow-ups (p>0.05), suggesting the stability of the results was affected by the cognitive rehabilitation intervention on the working memory of the alternating images.

Table 6: Pairwise comparison of mean scores of executive functions in five-time stages

Variables	Time (a)	Time (b)	Mean diff	SD	Sig.
cognitive flexibility	Pretest	Posttest	-18.88*	3.72	0.001
		One-week	-20.00*	4.16	0.001
		One-month	-19.55*	4.45	0.001
		Three-month	-19.88*	4.38	0.001
	Posttest	One-week	-1.11	1.43	0.462
		One-month	-0.66	1.46	0.661
		Three-month	-1.00	1.23	0.457
	One-week	One-month	0.44	0.94	0.650
		Three-month	0.11	0.63	0.865
	One -month	Three-months	-0.33	0.52	0.545

	Pretest	Posttest	-29.11*	9.28	0.014
		One -week	-30.55*	9.09	0.010
		One-month	-29.77*	9.19	0.012
		Three-month	-28.77*	9.08	0.013
Working memory/consecutive images	Posttest	One -week	-1.12	0.58	0.063
		One-month	-0.66	0.78	0.419
		Three-month	0.33	0.86	0.710
	One-week	One -week	0.77	0.49	0.154
		One-month	-1.77*	0.46	0.005
One-month		Three-month	1.00	0.70	0.195
	Pretest	Posttest	-34.11*	6.68	0.001
		One -week	-36.00*	6.50	0.001
		One-month	-36.11*	6.27	0.001
		Three-month	-34.88*	6.34	0.001
Working memory/ alternating images	Posttest	One -week	-1.88	1.27	0.176
		One-month	-2.00	1.34	0.174
		Three-month	-0.77	1.65	0.652
	One-week	One-month	-0.11	0.48	0.824
		Three-month	1.11	1.03	0.314
	one-month	Three-month	1.22	0.79	0.163

Table 7 gives descriptive indicators of mean, standard deviation, minimum and maximum score of social cognition variables. Differences were noted between the pre-test and post-test scores and one-week, one-month, and three-month follow-up scores in all four variables under study.

Table 7: Descriptive indicators of social cognition variables

Variable	**Measurement stage**	**Mean**	**SD**	**Lowest Score**	**Highest score**
Nim Stim Emotion recognition	Pretest	28.33	4.06	23	36
	Posttest	33.88	1.96	29	36
	One-week	33	1.93	30	37
	One-month	32.66	1.87	30	37
	Three-month	32.44	1.50	30	35
Ekman emotion recognition	Pretest	5.22	1.92	2	7
	Posttest	7.33	1.32	5	9
	One-week	7.66	0.50	7	8
	One-month	7.66	0.50	7	8
	Three-month	8.22	0.66	7	9
Mind-reading through the eyes	Pretest	14.88	3.14	9	19
	Posttest	22.11	2.14	19	25
	One-week	23.66	1.93	20	26
	One-month	23.44	2.24	20	26
	Three-month	25.22	1.39	23	27
The Iranian version of mind-reading through the eyes	Pretest	8.22	2.33	1	8
	Posttest	9.55	0.72	8	10
	One-week	9.55	0.52	9	10
	One-month	9.55	0.52	9	10
	Three-month	9.44	0.72	8	10

Table 8 pertains to the kurtosis and skewness indicators for the review of social cognition normality of data. As shown, the skewness and kurtosis values of all variables were at -2 and +2.

Table 8: Skewness and kurtosis indicators for the normality of social cognition variables

Variable	Measurement stage	Kurtosis	Skewness
Nim stim emotion recognition	Pretest	0.58	0.11
	Posttest	-0.56	1.33
	one-week	0.66	0.17
	One-month	1.50	0.26
	Three-month	0.13	0.01
Ekman emotion recognition	Pretest	-0.5	-1.14
	Posttest	-0.37	-0.31
	one-week	-0.85	-1.71
	One-month	-0.85	-1.71
	Three-month	-0.25	-0.04
Mind reading through the eyes	Pretest	-0.46	0.11
	Posttest	-0.37	-0.98
	one-week	-0.59	0.21
	One-month	-0.80	-0.90
	Three-month	-0.14	-1.96
Iranian version of mind reading through the eyes	Pretest	-0.49	-0.28
	Posttest	-1.50	1.45
	one-week	-0.27	-0.57
	One-month	-0.27	-0.57
	Three-month	-1.01	0.18

Multivariate test results in Table 9 showed that the Wilks' lambda of the variables of Ekman emotion recognition, mind reading through the eyes, and Iranian version of mind reading through the eyes ($F=6.55$, $p<0.05$, $F=15.70$, $p<0.01$, and $F=5.52$, p. <0.05, respectively), were significant; thus, the cognitive rehabilitation intervention affected the components in different stages of the test. However, Wilks' lambda results of the variable of Nim Stim emotion recognition ($F=3.65$, $p<0.05$) were not significant, suggesting that the cognitive rehabilitation intervention had not affected this component in different stages of the test.

Table 9: Multivariate test results of social cognition variable scores

Dependent variables	Indicator	Value	Value F	Freedom degree of hypothesis	Error of freedom degree	Sig.
Nim stim emotion recognition	Wilks' lambda	0.25	3.65	4	5	0.094
Ekman emotion recognition	Wilks' lambda	0.16	6.55	4	5	0.032
Min dreading through the eyes	Wilks' lambda	0.07	15.70	4	5	0.005
Iranian version of mind reading through the eyes	Wilks' lambda	0.18	5.52	4	5	0.044

Table 10 uses Mauchly's Test of Sphericity for the review of the assumption. If the size of Mauchly's test is not made significant statistically, the results will be reported based on the Test of Sphericity, and if made significant, the results will be reported based on the Greenhouse-Geisser statistic. Since the Mauchly's Test was made significant in all variables, the results were reported based on the Greenhouse-Geisser statistic.

Table 10: Mauchly's test results of social cognition

Variable	Intra-subject effect	Mauchly (W)	Chi-square	Freedom degree	Sig.
Ekman emotion recognition	Time	0.048	19.45	9	0.026
Mind reading through the eyes	Time	0.243	9.07	9	0.446
Iranian version of mind reading through the eyes	Time	0.041	20.53	9	0.018

As noted in Table 11, the effect of time agent on the variables of Ekman emotion recognition (F=9.32, P <0.01, and effect size = 0.53); mind reading through the eyes (F=27.33, p<0.01 and effect size = 0.77), an Iranian version of mind reading through the eyes (F=22.80, p<0.05, and effect size=0.74) was significant; i.e., the mean estimated for the Ekman cognitive flexibility, mind reading through the eyes and Iranian version of mind reading through the eyes saw a significant difference in all pretest, posttest and follow-up stages (p<0.01).

Table 11: analysis of variance for repeated measures on social cognition

Sources of changes	Agent of time	Sum of squares	Freedom degree	Mean squares	F	Sig.	Eta squared
Ekman emotion recognition	Agent (measurement stages)	48.66	1.71	28.45	9.32	0.004	0.53
Mind reading through the eyes	Agent (measurement stages)	591.64	4	147.91	27.33	0.001	0.77
Iranian version of mind reading through the eyes	Agent (measurement stages)	133.55	1.55	85.95	22.80	0.001	0.74

To compare the results in the test stages (pretest, posttest, one-week, one-month, and three-month follow-ups) of social cognition, pairwise comparison was used, the results of which are given in Table 12. Consistent with the reported findings, there is a significant difference in the mean Ekman's emotion recognition (p<0.05) between the pretest and post-test and one-week, one-month, and three-month follow-ups, with the mean posttest and later follow-ups being statistically higher than the mean pretest. Also, there was a statistically significant difference between the mean post-test scores and one-week, one-month, and three-month follow-up scores (p>0.05), suggesting the stability of the results was affected by the intervention of the cognitive rehabilitation on Ekman's emotion recognition. Also, as given in Table 12, there was a significant difference in the mean test of mind reading (p<0.01) between the pretest and post-test and one-week, one-month, and three-month follow-ups, with the mean posttest and later follow-ups being statistically higher than the mean pretest. Also, there was a statistically significant difference between the mean post-test scores and one-week, one-month, and three-month follow-up scores (p>0.05), suggesting the stability of the results was affected by the cognitive rehabilitation intervention on the mind reading through the eyes. There was only a significant difference between the posttests and three-month follow-up in the mind reading test (p<0.05). Finally, as given in Table 12, there was a statistically significant difference in the mean of the Iranian version of the mind reading test from the eyes between the pre-test and the post-test, one week, one month, and three months follow-up (p<0.01), with the mean posttest and later follow-ups being statistically higher than the mean pre-test. Also, there was no statistically significant difference between the mean post-test scores and the one-week, one-month, and three-month follow-ups (P>0.05), indicating the stability of the results as affected by the cognitive rehabilitation intervention on the Iranian version of the mind reading test.

Table 12: Pairwise comparison of mean social cognition scores in five-time stages

Variables	Time (a)	Time (b)	Mean diff.	SD	Sig.
Ekman emotion recognition	Pretest	Posttest	-2.11*	0.87	0.042
		One-week	-2.44*	0.72	0.010
		One-month	-2.43*	0.66	0.006
		Three-month	-3.00*	0.57	0.001
	Posttest	One-week	-0.33	0.32	0.347
		One-month	-0.32	0.47	0.500
		Three-month	-0.88	0.51	0.121
	One-week	One-month	0.00	0.23	1.00
		Three-month	-0.55	0.29	0.095
	One-month	Three-month	-0.54	0.30	0.096
Mind-reading through the eyes	Pretest	Posttest	-7.22*	1.34	0.001
		One-week	-8.77*	1.57	0.001
		One-month	-8.55*	1.50	0.001
		Three-month	-10.33*	1.15	0.001
	Posttest	One-week	-1.55	0.70	0.060
		One-month	-1.33	0.81	0.141
		Three-month	-3.11*	0.75	0.003
	One-week	One-month	0.22	0.79	0.787
		Three-month	-1.55*	0.86	0.111
	One-month	Three-month	-1.77	1.01	0.117
Iranian version of mind reading through the eyes	Pretest	Posttest	-4.33*	0.86	0.001
		One-week	-4.33*	0.85	0.001
		One-month	-4.33*	0.79	0.001
		Three-month	-4.21*	0.72	0.001
	Posttest	One-week	0.00	0.23	1.00
		One-month	0.00	0.34	1.00
		Three-month	0.11	0.42	0.799
	One-week	One-month	0.00	0.23	1.00
		Three-month	0.12	0.35	0.760
	One-month	Three-month	0.11	0.30	0.729

Discussion

The goal of this study was to investigate the effects of cognitive rehabilitation on executive functions and social cognition. Data analysis suggested that cognitive rehabilitation therapy in the post-test stage could significantly improve such components as cognitive flexibility, working memory, and total score of executive functions among adolescents with epilepsy, as these changes remained unchanged within one-week, one-month, and three-month intervals. This program was not, however, effective on components of selective attention and sustained attention. Results from this research were consistent with findings from Sarika Oğul (2019), Rich et al. (2018), Gerald et al. (2017), Mazur et al. (2016), and Mashio et al. (2015), and Farina et al. (2015). The results also indicated significant changes to the total social cognition scores, components of emotion recognition, and mind-reading (theory of mind) in the post-test and follow-up stages. The results from this research were also in line with those of Zupan et l. (2009) and Bumohofen et al. (2008).

The first finding of the research suggested that the cognitive rehabilitation program of executive functions did not improve selective attention (behavior inhibition). The findings of this research in this part were consistent with those of Rigs et al. (2017), Wulkapert and Noyel (20160, Doys et al. (2015), and Fisher (2011), while, on the other hand, in conflict with those of Belakei et al. (2015), Rey et al. (2015), Ingi et al. (2014), Pugin et al. (2014), Vandermolin et al. (2010), Turrel et al. (2009), and Najjarzadegan et al. (2015). Results inconsistent with the research indicated that the cognitive rehabilitation program did not improve the component of selective attention not just in the adult population, but also in normal children, mentally retarded children (Vendi Mullen et al. 2010), and those with autism spectrum. Part of this inconsistency can be attributed to the methodological domain, including individual differences of the subjects (age, gender, level of education, health, and type of disease), type, and the number of intervention sessions. Also, the use of different measurement tools was found to explain the difference between the empirical evidence and findings from the research. The present research used the computer Stroop test to measure selective attention abilities (behavior inhibition). Another issue was the time constraints the subjects were facing because the stimuli provided were time constraints. Another factor that could explain the component of selective attention was the complexity of the nature of this component. Since in the present research, the assignments provided in the cognitive rehabilitation program were focused on the component of cognitive inhibition, it didn't have enough power to create a significant change to the selective attention abilities. Hughes maintained that all components of executive functions could not equally respond to the intervention, as the inefficacy of the training of executive functions on inhibition components was found to be caused by cognitive processes involved in the intervention which distinguished it from other components (Hughes, et al. 2010).

The second finding of the research suggested that no changes were made to the component of sustained attention in the pretest and posttest stages. The above finding was consistent with those of Helmsteider et al. (2008), inconsistent with Engleberts et al. (2002), Gupta and Naurem (2003), Chelbilano et al. (2020), Pantartizou et al. (2017), and Fernandez et al. (2018). To explain the ineffectiveness of the cognitive rehabilitation program on the component of sustained attention in people with epilepsy, few researches on the effects of computer cognitive rehabilitation programs, lack of access to enough information sources on comparing the Cortex software (the program used in this research) with other interventional programs, as well as the significance of the effects of cultural issues on cognitive interventions can be cited. It is also assumed that the ability of sustained attention in the studied group was not so affected by the effects of epilepsy and anticonvulsants, because all the people had a good sequential performance in the pretest stage, indicating a lack of deficit in this skill; however, due to the low number of people of the intervention group and lack of control group, the research finding cannot be generalized to a larger group, and a review of the problems in the area of sustained attention in people with epilepsy warrants further investigations.

The third finding indicated a significant change in the cognitive flexibility skill, meaning the effectiveness of cognitive rehabilitation of executive functions on this skill among adolescents with epilepsy. The results from this research can be regarded as consistent with those of Sanjari Moghadam et al. (2020), Burai et al. (2020), and Gastona et al. (2018).

To explain the above cases, two reasons can be mentioned:

Executive functions-based exercises (cognitive flexibility) were found to strengthen neural networks and cognitive performance. Thus, repetition and practice could improve cognitive flexibility skills (Blair, 2016). The plasticity of the nervous system is another issue that can be used to explain the usefulness of cognitive interventions. Strengthening executive functions was found to increase brain activity in the inferior and middle anterior gyrus and the gray area of the brain (area related to cognitive flexibility) (Klingberg, 2012). Because the frontal lobe and executive functions in adolescents with epilepsy suffer from deficits, and recurrent excitation of a damaged area could strengthen neurons and thus improve the dysfunction, cognitive rehabilitation is said to stimulate this area, related to cognitive flexibility, to improve this component in people with epilepsy (Loughan et al., 2019).

The fourth finding of the research suggested that the cognitive rehabilitation program of executive functions could improve the working memory of adolescents with epilepsy. This finding is consistent with those of Zuplin et al. (2018), Fuents et al. (2016), Fisher (2015), and Kanner et al. (2015). To explain the above finding, it is suggested that rehabilitation assignments of the working memory could improve the working memory performance through increasing memory capacity (short-term storage) and information processing speed (central executive functioning). The cognitive rehabilitation program of working memory helps improve the central executive component of the working memory and fluid intelligence, thus increasing the capacity of solving abstract issues and cognitive control processes. Cognitive rehabilitation therapy can change the synaptic network and structure and thus create new synapses and eliminate older ones (Kolb & Gibb, 2014).

Cognitive rehabilitation provides various exercises through making changes to the structure of neurons and modifying neurons responsible for the working memory, recurrent and appropriate stimulation of less active areas in the brain, to strengthen basic mental processes involved in high-level learning in adolescents with epilepsy. Also, as regards the stability of the changes made in the one-month evaluation, it is suggested that cognitive rehabilitation based on the principle of brain plasticity can result in stable functional or structural changes in the brain (Ayouzi et al., 2018).

The fifth finding of this research revealed that the cognitive rehabilitation program of social cognition was found to increase the emotion recognition of adolescents with epilepsy.

The results of this finding were consistent with those of Lucas (2013) and Saks et al. (2012). To explain the effectiveness of social cognition rehabilitation, one can refer to the plasticity of the brain that has a cognitive synaptic base. Synaptic plasticity refers to the capacity of the central nervous system to reorganize itself, and its adaptability to respond to environmental changes or harms. The compensation of brain lesions through plasticity processes follows a hierarchical model, as the injured structures are first internally reorganized, and then, when the damaged hemispheres are active, internal and external reorganization occurs (Desmurget et al. 2007). Since cognitive rehabilitation in people with a disability involves learning skills, learning theories (practical and classic conditioning, behavior formation and alternating strengthening, etc.), as well as mechanism memory, could justify the rehabilitation. When engaging in cognitive rehabilitation tasks, the principle of no-error learning (i.e., preventing people from making mistakes as much as possible when learning a new skill or acquiring new information) was found to be very effective in rehabilitating the memory (Kessels et al., 2003). The cognitive rehabilitation program uses computer images with a high-frequency filter to stimulate and activate the amygdala, thereby reducing behavioral problems by developing emotional recognition when involved in interaction and expression of desires (Barzegar & Nejati, 2013). Because of the total social cognition score and Ekman's emotion recognition test score, it can be concluded that cognitive rehabilitation intervention can affect the emotion recognition ability of people with epilepsy. However, the Nim Stim emotion recognition test score was not significant, which can be due to the following:

the application of different measurement tools in different studies, the lower sensitivity of this test compared to the ability of emotion recognition, fatigue of or pressure mounting on the subjects in terms of time and complexity of the nature of this component.

The sixth finding of the research suggests that the cognitive rehabilitation program of social cognition can improve the mind-reading of adolescents with epilepsy. The results of this study are consistent with those of Yaghini et al. (2020).

To explain the above finding (Hebb's model, 1949; and Murre & Robertson's model, 1999), connectionist models of learning can be referred to which deal with learning mechanisms of new information and specific cognitive assignments in social cognition rehabilitation. These models describe mental and behavioral phenomena as interconnected networks of simple units. The most common connectionist models are nervous network models in which neurons are regarded as a nervous unit, while connections between them as synapses in the network. Every time, a network can change by activating a nervous unit (or a group of nervous units) in the network and expanding activation to all other units. Therefore, two neurons or a group of neurons, cut off as a result of injuries, may connect if simultaneously activated. If the two neurons are connected to the unit circuit separately, and the neurons are connected from a functional perspective, neurons will be simultaneously activated. As this process iterates several times, damaged nervous circuits could be connected, and get the cerebral cortex to be recovered. The reason for the improved one-month follow-up can be attributed to the structural and functional changes of the neurons responsible for this action, which arises as a result of cerebral plasticity and self-remedy. Thus, by introducing cognitive interventions, mental state recognition through the eyes, and theory of mind, the ability of adolescents with epilepsy can strengthen their social interaction and the quality of their mental states.

This research also suffered from some limitations which are: 1) failure to provide an educational setting by the hospital to conduct the intervention due to observance of health protocols of Covid-19; 2) time constraints; 3) low number of subjects in the experimental group; 4) lack of a control group due to chronic Covid-19 conditions and lack of access to a sample, and 5) presence of different epilepsy syndromes. Thus, to generalize the effectiveness of this type of intervention, the following are proposed: 1) using cognitive rehabilitation interventions in the low number of sessions along with complementary treatments; 2) using variables of social cognition interventions to investigate its effects on coping strategies of the treated; 3) using the control group to compare the experimental groups to generalize the findings to a larger group, and 4) using more people to be included in the experimental group.

Conclusion

Although normal imaging does not reveal any clear structural abnormalities in the brain of people with epilepsy, more advanced imaging methods reveal abnormalities in the cerebral structural and functional connections (Kim et al., 2014). Cognitive findings often demonstrate that despite having average general intelligence, people with epilepsy demonstrate deficits and disorders in specific cognitive areas such as executive functions, as compared to healthy people. In people with epilepsy who take anticonvulsants, the drug may affect the development of the theory of mind and leave negative social consequences (Scheffer et al., 2017). Retarded mind, anemia, reduced verbal control, disorders with executive function, and disorders with the theory of mind, attention, and memory are often noted in patients with epilepsy (Giovagnoli et al., 2014). Cognitive rehabilitation is a program that is aimed to cooperate with health experts and people with cognitive impairment and their families to reduce their functional disorders and increase their social activity and participation within the framework of personal goals and appropriate approaches. One of the most important goals of cognitive rehabilitation is to recover individual independence (Oğul et al., 2018). By providing cognitive tasks and targeted stimuli, cognitive rehabilitation seeks to reduce cognitive and performance problems of people with epilepsy. Research findings show that this type of intervention reduces the executive function disorders of the treated people. This research demonstrates that one of the most effective factors in the daily life of people with epilepsy is cognitive function deficits, which, if removed, the quality of life and social relations of these people can be improved and strengthened. One of the main goals of therapies for chronic diseases such as epilepsy is to improve the quality of life and mental health; thus, it is concluded that this type of intervention is a useful therapy due to its low price and availability. Because cognitive neuroscience helps gain an internal insight into cerebral function, it is recommended to educational researchers to take measures to improve the neurological functioning of people with epilepsy and to investigate its effect on the quality of life and social relationships of those people.

Ethical considerations

For ethical approval, the present project was approved by the ethics committee responsible for the research implementation process of Imam Khomeini Hospital and Tehran University of Medical Sciences (IR.TUMS.MEDICINE.REC.1400.228). Also, written informed consent forms were taken from all the participants, who were informed about the confidentiality of the information and their voluntary participation in the study.

Contribution of authors

The first author participated in study design, data collection, analysis, and writing. The second author contributed to writing and editing the article. The third and fourth authors participated in the study design, preparation of the clinical environment, and data analysis. All authors read and approved the final manuscript.

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Conflict of interest

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