Epilepsy & Behavior 164 (2025) 110277

Contents lists available at ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

A computer-assisted rehabilitation program improves self-management, cognition, and quality of life in epilepsy: A randomized controlled trial

Ulku Saygili Duzova [a,*], Zuhal Seflek [b], Fettah Eren [c], Serefnur Ozturk [c], Murat Faruk Tutar [c]

[a] Selcuk University, Nursing Faculty, Department of Internal Medicine Nursing, Konya, Turkey
[b] Selçuk University, Vocational School of Health Services, Department of Medical Services and Techniques, Konya, Turkey
[c] Selçuk University, Medical Faculty, Department of Neurology, Konya, Turkey

ARTICLE INFO

Keywords:
Cognitive function
Computer Assisted Rehabilitation
Epilepsy
Self-management
Quality of life

ABSTRACT

Objective: This study aimed to evaluate the impact of a computer-assisted rehabilitation program on self-management, cognitive function, and quality of life in people with epilepsy (PwE).
Methods: A randomized controlled trial was conducted with 44 PwE (22 intervention, 22 control) at a university hospital's neurology clinic. The intervention group received 12 sessions of the RehaCom program (45 min/session, twice a week for six weeks). Data were collected using the "Quality of Life in Epilepsy Inventory (QOLIE)", "Epilepsy Self-Management Scale (ESMS)", and "Moxo test" before and after the intervention.
Results: The intervention group showed significant improvements in attention and timing dimensions of the MOXO test and reductions in hyperactivity symptoms compared to the control group ($p < 0.05$). ESMS scores, including overall self-management, information management, lifestyle management, and safety management sub-dimensions, significantly increased. Similarly, QOLIE scores, particularly in cognitive functioning, emotional well-being, and energy/fatigue, improved, while seizure worry scores decreased ($p < 0.001$).
Significance: The computer-assisted rehabilitation program enhanced self-management, quality of life, attention, and responsiveness while reducing impulsivity and hyperactivity symptoms in PwE.

1. Introduction

Epilepsy is a central nervous system disorder characterized by recurrent seizures caused by abnormal electrical activity in the brain. These seizures can lead to various symptoms such as temporary changes in consciousness, convulsions, and sensory or behavioral disturbances [1]. While epilepsy's core pathology is well understood, its cognitive and behavioral comorbidities are often underappreciated despite their significant impact on the quality of life (QoL) and self-management of people with epilepsy (PwE) [2,3]. Cognitive impairments, affecting approximately 70–80 % of PwE, include deficits in memory, planning, problem-solving, attention, and concentration [3,4]. These impairments are influenced by factors such as interictal EEG abnormalities, frequent seizures, long disease duration, low education level, and polytherapy with antiepileptic drugs. It is observed clinically as well as in scientific studies that cognitive and behavioral comorbidities accompany epilepsy [6–8].

Cognitive impairment and recurrent seizures profoundly impact the quality of life (QoL) and self-management abilities of people with epilepsy (PwE) [5,9,10]. Self-management is defined as an individual's capacity to collaborate with family, community, and healthcare professionals to mitigate the disease's adverse effects, adhere to treatment, and implement necessary lifestyle changes to maintain health [11]. However, unlike other chronic diseases, systematic self-management support for PwE is severely lacking. The unpredictability of seizures, the burden of social stigma, and overprotective familial attitudes often exacerbate feelings of anger and hopelessness, further impairing self-management abilities [12]. Conversely, strong self-management skills have been shown to foster a more positive attitude toward the illness and significantly enhance QoL [11–13].

Recent studies have highlighted the therapeutic potential of computer-assisted cognitive rehabilitation for neurological conditions, including epilepsy [14–18]. Research on cognitive rehabilitation programs for people with epilepsy (PwE) underscores the importance of

* Corresponding author.
E-mail addresses: ulkusaygili@selcuk.edu.tr (U.S. Duzova), seflek.zuhal@gmail.com (Z. Seflek), dreren42@hotmail.com (F. Eren), serefnur@yahoo.com (S. Ozturk), m.faruktutar.58@gmail.com (M.F. Tutar).

https://doi.org/10.1016/j.yebeh.2025.110277
Received 5 November 2024; Received in revised form 16 December 2024; Accepted 14 January 2025
Available online 23 January 2025

tailoring interventions to the cognitive profiles and specific needs of individual patients. Among PwE, memory and attention impairments are particularly prevalent and have been the primary focus of these rehabilitation efforts [17]. RehaCom, a software program specifically developed for cognitive rehabilitation, offers a modular and interactive approach designed to enhance cognitive functions. It employs compensatory strategies, controlled stimuli, and real-time feedback to improve attention, memory, visuospatial processing, and executive functions. The system has demonstrated utility in addressing cognitive impairments that impact critical areas such as attention, concentration, memory, perception, and activities of daily living [14]. Despite the well-documented negative impact of cognitive impairments on the quality of life and daily functioning of PwE, this area remains under-researched [14,16].

RehaCom stands out from other rehabilitation methods due to its modular design and interactive features, which enable personalized interventions. The program's use of controlled stimuli and real-time feedback enhances cognitive domains such as attention, memory, visuospatial skills, and executive functions. However, existing studies on cognitive rehabilitation in PwE have primarily focused on cognitive impairments, often neglecting other crucial aspects like self-management skills and quality of life, which are integral to patients' overall well-being. To address these gaps, this study aims to evaluate the effectiveness of computer-assisted cognitive rehabilitation not only in improving cognitive functions but also in enhancing self-management skills and quality of life. By establishing links between cognitive dysfunction and poor self-management, this research explores the innovative potential of RehaCom to provide a comprehensive solution for improving the quality of life in PwE.

1.1. Study's hypotheses

H1: RehaCom is effective in improving the self-management total score averages of PwE.

H2: RehaCom is effective in improving the quality of life score averages of PwE.

H3: RehaCom is effective in improving the cognitive function score averages of PwE.

2. Materials and methods

2.1. Study design

This study is in a single-blind, prospective, randomized controlled experimental design.

2.2. Sample size and randomization

The study was conducted with people with epilepsy (PwE) followed up in the neurology outpatient clinic of a university hospital between March 2023 and July 2024. From a population of 205 PwE registered in the outpatient clinic, the sample size was calculated using "G. Power-3.1.9.4″ software at a 95 % confidence level, based on self-management scores reported in a prior study by Yeni et al. (2020) [12]. To account for potential losses, the minimum sample size was set at 48 individuals, with 24 participants assigned to each group. Randomization was carried out by a statistician using the simple randomization method and the "Research Randomizer" software (https://www.randomizer.org/) (Fig. 2).

2.3. Inclusion criteria from the study

The inclusion criteria for the study were as follows: (1) having been diagnosed with epilepsy at least 6 months prior to the study and having medical records available, (2) possessing the ability to communicate, (3) being aware of their condition and voluntarily agreeing to participate in the study, (4) having the necessary physical and mental capacity to participate in the study, (5) being between the ages of 18 and 60, (6) not having any cognitive impairment or other mental or physical illnesses, as verified by treating physicians and medical records, (7) being able to read and write, (8) not having previously participated in any psychotherapy or cognitive programs, (9) having no obstacles to using a computer and mouse, (10) not being pregnant, and (11) not having experienced seizures or major stress in the past month.

2.4. Exclusion criteria from the study

The exclusion criteria were defined as follows: (1) refusal to participate in the study, (2) inability to attend more than one intervention session for any reason, (3) a Standardized Mini-Mental Test score below 24, and (4) sustaining a physical or psychological injury that prevents continued participation in the study.

2.5. Data collection

Study data were collected using the Participant Information Form, the Quality of Life in Epilepsy Inventory, the Epilepsy Self-Management Scale, the MOXO Test, the Mini-Mental State Examination, and the RehaCom screening module. These forms and tests were administered to participants who met the inclusion criteria through face-to-face interviews conducted by the researchers in the outpatient clinic. Prior to data collection, patients were informed about the purpose of the study and the interview process. Written consent was obtained from those who agreed to participate. Both pre-test and post-test assessments were conducted, with each session taking approximately 45 min to complete.

2.5.1. Participant information form

This form, developed by the researchers based on a review of the literature, was organized into two main sections: sociodemographic characteristics and information about the disease process. The sociodemographic section included questions about age, gender, marital status, educational background, occupation, employment status, and income level. The disease-related section addressed topics such as the type and duration of the disease, medications used, comorbidities, and functional status [10,12,19].

2.5.2. Quality of life in epilepsy Inventory (QOLIE)

The Quality of Life in Epilepsy Inventory (QOLIE-31) scale, revised by Cramer et al., consists of 10 items and is a shortened version of the longer QOLIE-89 scale [18]. Mollaoğlu et al. (2015) adapted the QOLIE-31 for use in the Turkish population, and the validity and reliability studies of this version are ongoing [19]. The scale comprises 31 items across seven sub-dimensions: seizure worry, emotional well-being, energy/fatigue, social functioning, cognitive functioning, medication effects, and overall quality of life. Additionally, an item assessing overall health status is included. Total scores range from 0 to 100, with higher scores indicating better quality of life. The Cronbach's alpha value for the original scale was reported as 0.91 [10], while in this study, it was found to be 0.96.

2.5.3. Epilepsy Self-Management scale (ESMS)

The Epilepsy Self-Management Scale (ESMS) was developed by DiIorio et al. (2004) [20] to assess self-management behaviors in people with epilepsy. The validity and reliability of the scale for Turkish use were established by Yeni et al. (2020) [12]. The scale comprises 38 items across five sub-dimensions: medication management, information management, safety management, seizure management, and lifestyle management. Scores on the scale range from a minimum of 38 to a maximum of 190, with higher scores indicating better self-management. The original Cronbach's Alpha coefficient of the scale was reported as 0.74 [12], while in this study, it was calculated as 0.95, demonstrating excellent internal consistency.

2.5.4. Objective cognitive assessment: MOXO test

The MOXO test, developed in 2013, is a computerized continuous performance test designed to assess attention and executive function under distracting conditions. It evaluates performance across four key domains: MOXOA (Attention), MOXOT (Timing), MOXOI (Impulsivity), and MOXOH (Hyperactivity). A unique feature of the MOXO test is its ability to measure how distractions affect a participant's performance, providing valuable insights into cognitive functioning. The test is suitable for individuals aged 13 to 60 years, lasts approximately 18.2 min, and is fully administered and scored via computer software. During the test, participants are instructed to press the space key as quickly as possible when the target stimulus appears on the screen. Once the stimulus disappears, a designated free time equivalent to the duration the target remained on the screen—is provided. This feature allows for an accurate evaluation of participants who may not be easily distracted but demonstrate difficulties in timing [21,22]. A review of the literature on the Turkish validation and use of the MOXO test in chronic diseases indicates that it has been employed to assess cognitive performance across various chronic conditions, consistently yielding reliable results [23,24].

2.5.5. Mini Mental status Examination

The Mini-Mental State Examination (MMSE), developed by Folstein et al. (1975), is a widely used tool for assessing various cognitive domains, including orientation, memory, attention, calculation, recall, language, motor function, and perception. The test is scored on a 30-point scale [25]. Its Turkish validity and reliability were established by Ertan et al. (1999). The MMSE evaluates orientation, memory and attention, visual and motor skills, and language use. Scores on the MMSE are interpreted as follows: 0–9 indicates severe cognitive impairment, 10–19 indicates moderate cognitive impairment, 20–23 indicates mild cognitive impairment, and 24–30 falls within normal limits [26]. In this study, the MMSE was utilized as an exclusion criterion during sample selection.

2.5.6. Computer-assisted rehabilitation program – RehaCom scanning module

Computer-assisted cognitive rehabilitation (CR) was conducted using the RehaCom software (https://www.rehacom.fr), a modular and interactive program designed to enhance cognitive abilities. The system incorporates compensatory strategies, controlled stimuli, and real-time feedback to improve attention, memory, visuospatial processing, and executive functions—areas commonly affected by epilepsy and its treatment. A certified neuropsychologist and a specialist nurse, both licensed in the use of the software, selected specific modules tailored to each patient's individual deficits, enabling targeted and specialized training. The program is self-adaptive, meaning that tasks adjust in difficulty based on the patient's performance, becoming either easier or more challenging as needed [15,27]. The RehaCom screening module consists of nine components designed to detect and address various cognitive functions, including alertness, selective attention, divided attention, spatial numbers search, logical reasoning, word memory, working memory, field of view, and campimetry. Fig. 1 provides an example of the results screen from the program's scanning module. The results are displayed graphically as a bar graph, with bars extending to the left indicating performance below the average of volunteers. The farther to the left the bar extends, the poorer the patient's performance. Each bar is color-coded to represent the degree of deviation from the norm:

Red: A significant deviation from the mean, exceeding 2 standard deviations.

Yellow: A notable but not pathological deviation, exceeding 1 standard deviation.

Green: Performance within the normal range.

RehaCom scores are interpreted as follows: scores between 0 and −1 indicate good performance, scores between −1 and −2 suggest poor performance, and scores between −2 and −3 indicate significant difficulties. In this study, the treatment module was applied following the completion of the RehaCom screening module [15,27].

2.6. Study procedures

Each participant was interviewed face-to-face at the outpatient clinic at a time of their choosing. During the interview, participants were informed about the purpose and scope of the study, and informed consent was obtained. Based on the predetermined randomization list, participants were randomly assigned to either the intervention or control group. Pre-tests, including the MOXO and RehaCom screening

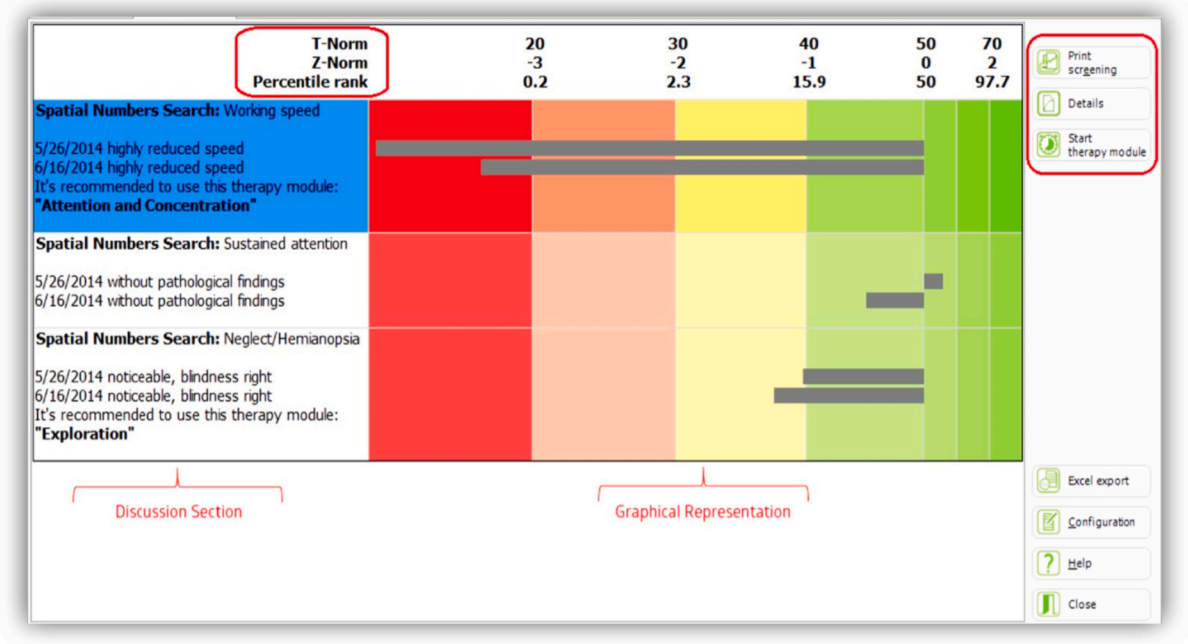

Fig. 1. RehaCom screening module score.

modules, were administered during the initial interview session. Post-tests were conducted after the sixth week to evaluate the outcomes. The study flow diagram is provided in Fig. 2.

2.7. Intervention group

Participants completed 12 standardized sessions, each lasting 45 min, over a six-week period. Modules designed to enhance cognitive abilities were utilized under the supervision of researchers (U.S.D-Z.S.), both licensed to administer the RehaCom application. At the end of each session, a neuropsychologist and a specialist nurse were available to provide guidance, encouragement, and feedback on participants' progress. The duration of the intervention was determined based on previous studies involving RehaCom and other cognitive rehabilitation programs [13–17,27].

The intervention took place in a quiet, private outpatient clinic room with only the researcher and the participant present. The environment was carefully controlled to ensure participant comfort, with no distractions, and the room's lighting and temperature were adjusted appropriately. The computer used for the intervention was equipped with an up-to-date browser, Flash Player, functional speakers, and a stable cable internet connection. In the intervention group, one patient who discontinued rehabilitation after two weeks and another who was diagnosed with a new neurological condition were excluded from the study.

2.8. Control group

Patients in this group were required to complete the pre- and post-tests at the same intervals as the intervention group. During the intervention, they underwent routine follow-up procedures at the clinic, without receiving any additional interventions. In the control group, two patients who did not participate in the post-test measurements and final screening were excluded from the study.

2.9. Data analysis

The data obtained in the study were analyzed using the free trial version of SPSS Statistics (Statistical Package for Social Sciences) for Windows 25.0 software. Descriptive statistical methods (frequency, percentage, minimum, maximum, median, mean, standard deviation) were used to evaluate the data. Chi-square analysis was conducted to determine differences in qualitative data between the groups. The normal distribution of the data used was tested by the Shapiro-Wilk test. Accordingly, parametric and nonparametric tests were performed. An independent sample *t*-test, the Mann-Whitney *U* test, was used to test whether the scores obtained from two unrelated samples of our quantitative variables differed significantly from each other. The Wilcoxon test was performed to test whether our quantitative variables differed from the two dependent groups. Reliability analysis was conducted to test the reliability of the scale. In the study, values with p-values below 0.05 were considered significant.

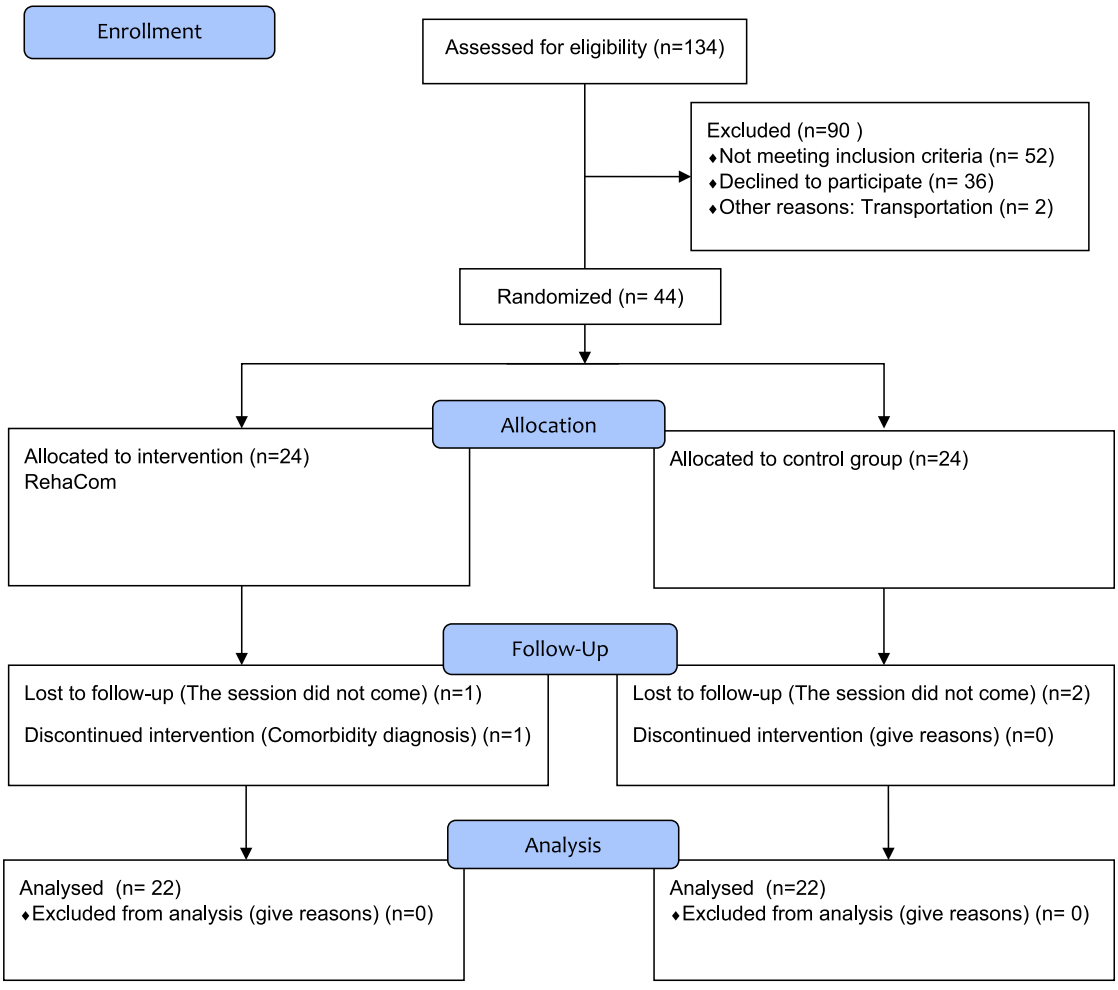

Fig. 2. Consort Diagram of the Study.

3. Results

The intervention and control groups demonstrated largely similar demographic and clinical characteristics. Both groups had comparable distributions in terms of gender, marital status, employment, and living arrangements. Most participants in both groups were on monotherapy for epilepsy and reported taking their medications regularly. The mean age and the mean age of epilepsy onset were also similar between the groups. However, significant differences were observed in education level and the presence of comorbidities. Participants in the intervention group were more likely to have a bachelor's degree or higher (77.3 % vs. 36.4 %, $p = 0.022$), and comorbidities were more prevalent in this group compared to the control group (31.8 % vs. 4.5 %, $p = 0.046$) (Table 1).

The distribution of the RehaCom screening module and MOXO test measurement scores of the participants is detailed in Table 2 and Table 3. In the experimental group, scores for alertness, selective attention, spatial number search, logical thinking, working memory, field of view, and campimetry increased significantly compared to the pre-test scores ($p < 0.05$). Additionally, MOXOA, MOXOT, MOXOI, and MOXOH scores in the intervention group showed a significant increase from the pre-test to the post-test ($p < 0.05$). The characterization of effect size (d) is as follows: d: 0.2–0.5 small effect; d: 0.5–0.8 moderate effect; d: ≥0.8 large effect. It was observed that the post-test MOXOA (1.004) showed a large effect, the post-test MOXOT (0.975) showed a large effect, and the post-test MOXOH (0.797) showed a moderate effect.

The distribution of participants' quality of life and self-management scores, including sub-dimensions, according to groups and measurements, is presented in Table 4. It was determined that the post-test ESMS total scores of the intervention and control groups showed a statistically significant difference ($p < 0.05$). Accordingly, the intervention group's post-test ESMS total score was found to be higher than that of the control group. In the information management and lifestyle management sub-dimensions of the ESMS, as well as in the seizure worry, quality of life, emotional well-being, energy/fatigue, cognitive functioning, medication effects, and social functioning sub-dimensions of the QOLIE, the intervention group scored significantly higher than the control group ($p < 0.05$). The post-test QOLIE total scores of the intervention and control groups also showed a statistically significant difference ($p < 0.05$), with the intervention group scoring higher than the control group. Furthermore, when the QOLIE sub-dimensions were examined, it was found that post-test scores for emotional well-being, energy/fatigue, cognitive functioning, medication effects, and social functioning showed statistically significant differences between the groups, with the intervention group scoring higher in all these dimensions ($p < 0.05$). However, it was found that the quality-of-life sub-dimension scores of the control group did not show a significant difference across the measurements ($p > 0.05$).

Table 1
Distribution of findings of descriptive characteristics of the participants according to groups (n = 44).

Variables		Control (n = 22)		Intervention (n = 22)	
		Number	%	Number	%
Gender	Female	12	54.5	13	59.1
	Male	10	45.5	9	40.9
Educational status	Primary school	3	13.6	0	0.0
	Secondary school	5	22.7	1	4.5
	High school	6	27.3	4	18.2
	Undergraduate and higher	8	36.4	17	77.3
Employment Status	Employed	12	54.5	16	72.7
	Unemployed	10	45.5	6	27.3
Income Status	High	5	22.7	6	27.3
	Moderate	8	36.4	13	59.1
	Low	9	40.9	3	13.6
Marital Status	Married	7	31.8	5	22.7
	Single	15	68.2	17	77.3
Person Living Together	Spouse-Child	6	27.3	6	27.3
	Parents	10	45.5	9	40.9
	Friend/Partner	0	0.0	2	9.1
	Alone	6	27.3	5	22.7
Seizure Type	JTK	19	86.4	12	54.5
	Focal	3	13.6	7	31.8
	JME	0	0.0	2	9.1
	Absence	0	0.0	1	4.5
Antiepileptic Drug Use Status	Monotherapy	18	81.8	19	86.4
	Polytherapy	4	18.2	3	13.6
Regular Use of Epilepsy Medications	Yes	20	90.9	17	77.3
	No	2	9.1	5	22.7
Frequency of seizures in the last year	No seizures	11	50.0	8	36.4
	Less than 1 seizure per month	8	36.4	14	63.6
	More than 1 seizure per month	3	13.6	0	0.0
Comorbid	Yes	1	4.5	7	31.8
	COPD	0	0.0	1	4.5
	DM	0	0.0	3	13.6
	HT	1	4.5	2	9.1
	SLE	0	0.0	1	4.5
	No	21	95.5	15	68.2
Regular Attendance at Controls	Yes	12	54.5	16	72.7
	No	10	45.5	6	27.3
Does Epilepsy Affect Your Daily Life?	Yes	15	68.2	11	50.0
	No	7	31.8	11	50.0
		$\bar{x}$	**SD**	$\bar{x}$	**SD**
Age		37.46	12.21	37.23	11.12
Age of onset of epilepsy		23.73	13.30	22.59	9.09

*$p < 0.05$; X^2: Chi-square test.

Table 2
Distribution of participants' RehaCom Screening test scores according to groups.

Variables		Control (n = 22)			Intervention (n = 22)		
		Median (min–max)	$\bar{x}$	SD	Median (min–max)	$\bar{x}$	SD
RehaCom Alertness	**Pre-test** **Post-test**	−0.73 (−4.17–0.64) −0.34 (−5–0.64)	−0.83 −0.73	1.18 1.28	−1.36 (−3.98–0.94) −0.56 (−1.58–0.33)	−1.37 −0.47	1.22 0.55
RehaCom Selective Attention	**Pre-test** **Post-test**	−1.3 (−2.79–0.97) −0.53 (−5–0.97)	−0.85 −0.99	1.23 1.66	−1.43 (−4.01–0.38) −0.13 (−1.84–0.74)	−1.82 −0.16	1.33 0.66
RehaCom Divided Attention	**Pre-test** **Post-test**	0.33 (−3.89–0.45) 0.26 (−3.1–0.45)	−0.17 −0.23	1.23 1.07	0.16 (−4.95–0.96) 0.26 (−5–0.44)	−0.69 0.01	1.61 1.12
RehaCom Spatial Numbers Search	**Pre-test** **Post-test**	−0.77 (−5–1.31) −0.43 (−5–2.59)	−0.80 −0.51	1.42 1.50	−1.11 (−5–1.6) −0.07 (−5–1.74)	−0.88 −0.15	1.34 1.27
RehaCom Logical Thinking	**Pre-test** **Post-test**	−1.04 (−3.46–0.94) −1.04 (−3.46–0.94)	−1.21 −1.15	1.48 1.51	−0.56 (−3.71–1.74) 0.26 (−1.12–1.68)	−0.87 0.19	1.41 0.80
RehaCom Word Memory	**Pre-test** **Post-test**	0.53 (−0.13–0.94) 0.53 (−0.13–0.94)	0.52 0.51	0.30 0.30	0.48 (−2.5–8.4) 0.56 (−0.8–1.48)	0.64 0.53	1.92 0.54
RehaCom Working Memory	**Pre-test** **Post-test**	−1.12 (−4.47–1.24) −1.12 (−4.47–1.24)	−0.71 −0.66	1.61 1.50	−0.99 (−4.12–1.24) 0.04 (−2.98–0.51)	−0.98 −0.38	1.42 0.88
RehaCom Field of View	**Pre-test** **Post-test**	0 (−3.57–0.57) 0 (−3.57–0.43)	−0.36 −0.25	0.87 0.80	0 (−2–0.34) 0 (−0.57–0.71)	−0.28 −0.01	0.58 0.30
RehaCom Campimetry	**Pre-test** **Post-test**	−0.14 (−4.17–0.71) −0.14 (−5–0.71)	−0.36 −0.48	0.92 1.15	0 (−1.75–0.14) 0 (−0.29–0.86)	−0.24 0.01	0.45 0.21

Table 3
Distribution of participants' MOXO test scores according to groups.

Variables		Control (n = 22)			Intervention (n = 22)				
		Median (min–max)	$\bar{x}$	SD	Median (min–max)	$\bar{x}$	SD	Test** p Values	Effect size, Cohen's d
MOXOA	**Pre-test**	4 (1–4)	3.05	1.13	3.5 (1–4)	2.73	1.39	z = -0.847 p = 0.397	–
	Post-test	3.5 (1–4)	2.91	1.19	1 (1–4)	1.73	1.16	z = -3.214 **p < 0.001***	$d = 1.004$
	Test Value* **	z = -1.000			z = -2.897				
	p	0.317			**0.004***				
MOXOT	**Pre-test**	4 (1–4)	3.18	1.10	4 (1–4)	3.00	1.27	z = -0.470 p = 0.638	
	Post-test	4 (1–4)	3.45	1.01	2 (1–4)	2.32	1.29	z = -2.895 **p = 0.004***	$d = 0.975$
	Test Value* **	z = -1.732			z = -2.438				
	p	0.083			**0.015***				
MOXOI	**Pre-test**	2 (1–4)	1.91	1.06	2 (1–4)	2.32	1.29	z = -1.005 p = 0.315	
	Post-test	1 (1–4)	1.77	1.11	1 (1–3)	1.36	0.58	z = -1.003 p = 0.316	
	Test Value* **	z = -0.736			z = -2.862				
	p	0.461			**0.004***				
MOXOH	**Pre-test**	4 (1–4)	2.86	1.39	2.5 (1–4)	2.36	1.29	z = -1.364 p = 0.173	
	Post-test	2 (1–4)	2.55	1.34	1 (1–4)	1.59	1.05	z = -2.526 **p = 0.012***	$d = 0.797$
	Test Value* **	z = -1.838			z = -2.257				
	p	0.066			**0.024***				

*p < 0.05; **z: Mann-Whitney; t: independent sample t ****z:Wilcoxon

4. Discussion

This randomized controlled trial investigated the effects of a 12-session computer-assisted cognitive rehabilitation program on cognitive status, quality of life, and self-management in individuals with epilepsy (PwE). In our study, while the control and intervention groups were similar in terms of sociodemographic and clinical characteristics, significant improvements were observed in the intervention group, which received the RehaCom cognitive rehabilitation intervention. These improvements were noted in areas such as attention, time management, logical thinking, working memory, quality of life, and self-management. These findings are consistent with the results of numerous randomized controlled trials involving cognitive rehabilitation in neurological diseases [13,14,16,17,27].

4.1. Effect of cognitive rehabilitation on cognitive areas

Changes in consciousness and attention in people with epilepsy (PwE) are associated with various factors such as seizure types, abnormalities in the frontal, temporal, and parietal lobes of the brain, inflammation, neurotransmitter imbalances, hypoxia caused by recurrent seizures, hyperactivity, cognitive fatigue, and psychosocial factors. Epileptic seizures are understood to result from irregularities in the brain's electrical activity, and these factors contribute to impairments in consciousness and attention processes [4–6]. In this context, cognitive rehabilitation is of great importance for enhancing cognitive functions and improving the quality of life in patients with epilepsy. These rehabilitation programs, tailored to individual needs, play a critical role not only in strengthening attention and memory strategies, problem-solving skills, and logical thinking abilities but also in supporting psychosocial adaptation [14,17].

Table 4
Distribution of participants' quality of life and self-management and sub-dimension scores according to groups.

Variables		Control (n = 22)			Intervention (n = 22)			Test**and p Values	Effect size, Cohen's d
		Median (min–max)	$\bar{x}$	SD	Median (min–max)	$\bar{x}$	SD		
ESM	**Pre-test**	41.5 (10–50)	38.82	12.43	38.5 (10–50)	33.64	14.71	z = -1.134, p = 0.257	
Medication	**Post-test**	43 (28–50)	42.23	5.24	45.5 (28–50)	43.27	6.13	z = -0.907, p = 0.364	
administration	**Test Value*** **	z = -0.356							
					z = -2.052				
	p	0.722							
					0.040*				
ESM	**Pre-test**	18.5 (8–30)	19.18	6.52	14.5 (9–27)	16.32	5.63	z = -1.457, p = 0.145	
Information management	**Post-test**	21.5 (9–29)	20.55	5.83	26.5 (15–35)	26.00	5.50	t = -3.192, **p = 0.003***	*d* = 0.961
	Test Value* **	z = -1.336							
					z = -3.573				
	p	0.181							
					0.000*				
ESM	**Pre-test**	27 (12–36)	25.27	6.20	27 (12–36)	24.50	7.76	z = -0.213, p = 0.831	
Safety management	**Post-test**	27 (22–36)	27.55	3.20	29 (19–36)	29.59	3.96	t = 1.884, p = 0.067	
	Test Value* **	z = -2.409							
					z = -2.960				
	p	0.016*							
					0.003*				
ESM	**Pre-test**	25 (8–28)	22.27	6.48	20.5 (8–28)	18.86	7.24	z = -1.819, p = 0.069	
Seizure management	**Post-test**	24.5 (16–28)	23.68	3.34	26 (11–30)	25.00	5.56	z = -1.802, p = 0.071	
	Test Value* **	z = -0.676							
					z = -2.863				
	p	0.499							
					0.004*				
ESM	**Pre-test**	20 (6–27)	19.27	6.55	16.5 (6–25)	15.18	5.82	z = -2.420, p = 0.016*	*d* = 0.660
Lifestyle management	**Post-test**	20 (14–26)	20.64	3.47	27 (16–29)	25.27	3.21	z = -4.115, **p < 0.000***	*d* = 1.385
	Test Value* **	z = -0.614							
					z = -3.916				
	p	0.539							
					0.000*				
ESM total	**Pre-test**	361 (48–158)	124.82	33.78	120.5 (48–151)	108.50	37.34	z = -1.767, p = 0.077	
	Post-test	138 (99–154)	134.64	14.39	150 (108–173)	149.14	15.71	t = -3.192, **p < 0.003***	*d* = 0.963
	Test Value* **	z = -0.561							
					z = -4.410				
	p	0.575							
					0.001*				
QOLIE	**Pre-test**	3.11 (0–7.6)	3.14	2.65	1.6 (0–6.8)	2.30	2.20	z = -1.079, p = 0.281	
Seizure Worry	**Post-test**	3.16 (0–7.6)	3.18	2.11	6.12 (2.05–7.6)	5.75	1.22	z = -3.817, **p < 0.001***	*d* = 1.491
	Test Value* **	z = -0.153							
					z = -3.685				
	p	0.878							
					0.000*				

Table 4 **continues**

QOLIE	**Pre-test**	7 (2.1–8.75)	6.16	1.94	5.6 (2.1–10.85)	5.57	2.58	z = -1.263, p = 0.207	
Total quality of life	**Post-test**	7 (4.55–9.45)	6.71	1.33	11.55 (9.1–14)	11.55	1.30	z = -5.685, **p < 0.001***	*d* = 3.680
	Test Value* **	z = -0.892							
					z = -4.116				
	p	0.372							
					0.000*				
	Pre-test	7.2 (0–11.4)	6.85	3.49	5.4 (0–12)	5.56	4.14	z = -1.205, p = 0.228	
QOLIE	**Post-test**	7.2 (4.2–12)	8.15	2.65	11.7 (6–14.4)	11.13	2.14	z = -3.488, **p < 0.001***	*d* = 1.237
Emotional well-being	**Test Value*** **	z = -1.185							
					z = -3.606				
	p	0.236							
					0.000*				
QOLIE	**Pre-test**	5.4 (0–7.8)	4.55	2.54	2.7 (0–9.6)	3.27	3.15	z = -1.725, p = 0.085	
Energy/fatigue	**Post-test**	5.4 (1.2–9.6)	5.45	2.29	8.4 (4.2–10.2)	8.02	1.48	z = -3.716, **p < 0.001***	*d* = 1.333
	Test Value* **	z = -1.129							
					z = 3.654				
	p	0.259							
					0.000*				
QOLIE	**Pre-test**	10.58 (3.6–20.33)	10.20	4.58	10.16 (2.7–20.03)	9.56	5.05	z = -0.412, p = 0.680	–
Cognitive functioning	**Post-test**	11.14 (5.1–22.8)	11.20	4.58	18.26 (15.38–25.88)	18.55	3.04	t = -6.270, **p < 0.001***	*d* = 1.891
	Test Value* **	z = -0.764							
					z = -4.075				
	p	0.445							
					0.000*				
QOLIE	**Pre-test**	0.83 (0–2)	0.85	0.64	0.83 (0–2.08)	0.74	0.66	z = -0.557, p = 0.577	
Effects of drugs	**Post-test**	0.83 (0–2.5)	0.87	0.57	1.88 (1.25–2.67)	1.91	0.41	t = -6.938, **p < 0.001***	*d* = 2.095
	Test Value* **	z = -0.059							
					z = -3.987				
	p	0.953							
					0.000*				

(*continued on next page*)

Table 4 (*continued*)

Variables		Control (n = 22)			Intervention (n = 22)			Test**and p Values	Effect size, Cohen's d
		Median (min–max)	$\bar{x}$	SD	Median (min–max)	$\bar{x}$	SD		
QOLIE	**Pre-test**	7.98 (0–16.8)	7.98	4.84	6.09 (0–16.8)	7.09	5.88	z = -0.530, p = 0.596	
Social function	**Post-test**	8.72 (2.1–18.9)	9.67	4.70	15.33 (11.97–20.16)	15.70	2.77	t = -5.187, **p < 0.001***	*d* = 1.563
	Test Value***	z = -1.245							
					z = -3.962				
	p	0.213							
					0.000*				
QOLIE total	**Pre-test**	38.92 (5.7–66.13)	39.73	17.57	33.01 (5.7–72.24)	34.09	21.74	z = 0.883, p = 0.377	
	Post-test	40.68 (20.02–76.48)	45.25	13.78	71.98 (57.59–89.36)	72.61	7.91	z = -5.189, **p < 0.001***	*d* = 2.435
	Test Value***	z = -0.863							
					z = -4.075				
	p	0.388							
					0.000*				

*p < 0.05**z: Mann-Whitney; t: independent sample t ****z:Wilcoxon;

In this study, post-test scores for alertness, selective attention, spatial number search, logical thinking, working memory, field of view, and campimetry in the intervention group showed significant increases compared to pre-test scores. Additionally, significant improvements were observed in attention parameters such as MOXOA, MOXOT, and MOXOH in the intervention group at post-test. The findings in the intervention group clearly demonstrate the effectiveness of the intervention applied in improving the cognitive skills included in the RehaCom screening module. The increase in alertness indicates an enhanced ability of participants to respond more effectively to environmental stimuli and manage their attention better. The rise in selective attention scores suggests that the intervention group's ability to focus on specific stimuli improved, thereby strengthening their capacity to process information in complex and distracting environments. The improvement in spatial number search skills reflects an enhancement in participants' ability to comprehend spatial relationships and visuospatial processing, significantly contributing to navigation and environmental awareness. The increase in logical thinking ability demonstrates that individuals improved their capacity for effective decision-making and problem-solving, which is essential for academic success and coping with daily challenges. The improvement in working memory indicates an enhanced ability to temporarily retain and process information, which, as a core component of cognitive functions, directly impacts performance on knowledge-based tasks. The improvement in the field of view reveals that participants gained better access to environmental information and developed more effective environmental awareness, leading to improved performance in motor skills and daily activities. The increase in campimetry scores is associated with an expanded visual field and enhanced visual perception, which improves individuals' ability to scan and observe their surroundings more effectively. A previous study reported that RehaCom was effective for cognitive rehabilitation in MS patients [28]. In this study, 22 patients with epilepsy (PwE) were randomly assigned to undergo 45-minute RehaCom sessions twice a week for 6 weeks. Another study found that RehaCom sessions lasting 60 min twice a week for 10 weeks improved cognitive functions such as verbal memory, visuospatial episodic memory, and executive functions in patients with MS [29]. A review involving 982 MS patients (78 % with RRMS) reported that computer-based cognitive training is effective for general and basic cognitive functions in adults with MS, although its effectiveness in progressive stages remains unclear [30]. Yeh et al. (2019) found that computerized cognitive training had positive effects on cognitive functions in post-stroke patients, even in short sessions of 30 min [31]. Gil-Pages et al. (2018) demonstrated that personalized computerized cognitive rehabilitation improved the quality of life and cognitive functions in chronic stroke patients [32]. Bonavita et al. (2015) emphasized that RehaCom positively affects cognitive dysfunctions by increasing cerebral activity in posterior brain regions, thereby improving neurocognitive functions [33]. These findings collectively support the effectiveness of the intervention and its potential to enhance participants' cognitive abilities. Similar results in the literature highlight the importance of cognitive rehabilitation and the need for a comprehensive approach to neurological conditions such as epilepsy.

Recent studies have demonstrated the positive effects of cognitive rehabilitation in addressing cognitive deficits commonly observed in people with epilepsy (PwE). Paiva et al. (2023) reported that targeted cognitive rehabilitation programs can significantly improve executive dysfunction, particularly in juvenile myoclonic epilepsy, highlighting enhanced attention and decision-making abilities. Similarly, Puteikis et al. (2023) emphasized that structured interventions focusing on cognition and psychosocial well-being lead to better quality of life outcomes for PwE. Furthermore, Sharma et al. (2024) explored neuropsychological rehabilitation strategies in epilepsy and observed improvements in memory, attention, and self-management skills, showcasing the broader applicability of these interventions in resource-limited settings. Complementary to these findings, Zaldumbide-Alcocer et al. (2024) demonstrated the efficacy of LEGO®-based cognitive therapy in pediatric epilepsy, indicating that innovative rehabilitation methods can enhance cognitive functions and engagement. These studies collectively underline the transformative potential of cognitive rehabilitation in improving both cognitive and psychosocial outcomes for PwE, reinforcing the importance of integrating such interventions into comprehensive epilepsy care.

4.2. *Effect of cognitive rehabilitation on quality of life and Self-Management*

Epilepsy self-management involves adaptive behaviors developed by people with epilepsy (PwE) to control seizures. While the most common form of management is through anti-epileptic drugs, these medications fail to control seizures in approximately 30 % of patients. Self-management in PwE consists of five core components: medication management, information management, safety management, seizure management, and lifestyle management [12,38,39]. In this study, 15.9 % of PwE reported not taking their medications regularly, 36.4 % did not attend regular physician check-ups, and 59.1 % stated that the disease affected their daily lives. Faught et al. found that approximately 26 % of adults with epilepsy do not take their medications regularly, which increases their reliance on healthcare services [40]. In a study conducted in South Carolina, more than half (58.8 %) of participants with epilepsy reported having difficulty managing their epilepsy daily. Factors such as forgetfulness, fatigue, feelings of ignorance, and other unhealthy behaviors can be improved through self-management [41]. Evidence-based epilepsy self-management programs have been shown to enhance individuals' self-esteem, medication adherence, mood, memory, and quality of life [39]. The findings of this study demonstrate a significant effect of the RehaCom application on epilepsy self-management and its sub-dimensions ($p < 0.05$). In the intervention group, high effect sizes ($d = 0.961$ and $d = 1.385$) were particularly

observed in the information management and lifestyle management subdimensions. While some improvements were also noted in the control group, the difference remained significant compared to the intervention group. Effective epilepsy self-management enables individuals to lead more normal lives in school, work, and social settings. However, PwE face concerns related to obtaining a driver's license, finding employment, accessing education, and securing social benefits. Previous studies have shown that epilepsy self-management is a complex process influenced by a person's perceived health and all levels of their environment, from interpersonal to societal [12,34–41].

The quality of life in people with epilepsy is influenced by various factors such as seizure worry, emotional well-being, energy/fatigue levels, social and cognitive functioning, and the side effects of medication. Evaluating these factors collectively is essential for understanding the overall quality of life of patients [5,9,10,19]. Computer-assisted rehabilitation programs have been shown to be effective in improving patients' overall quality of life [17]. The findings of this study revealed the positive impact of the RehaCom intervention on the quality of life of PwE.

5. Limitations

Although many factors influence the cognitive status, quality of life, and self-management of PwE, we ensured meticulous adherence to procedures to complete the rehabilitation process. However, we would have preferred the sample to include a broader group of participants. A larger sample would enhance the generalizability of the results and provide more robust support for the findings. Nonetheless, not all patients were able to commit to such an intensive program. Only 44 PwE were encouraged to fully complete the intervention, which required traveling to the hospital twice a week and incurring travel expenses. Unfortunately, we inevitably lost some participants due to factors such as economic challenges, comorbidities, demanding work schedules, personal reasons, and the duration of the intervention. Additionally, there was no long-term follow-up or evaluation process in our study. While 12 weeks of cognitive intervention was sufficient to assess the short-term effectiveness of the rehabilitation modality, we did not have the opportunity to evaluate its long-term effects. We also did not use MRI (Magnetic Resonance Imaging) or fMRI (Functional Magnetic Resonance Imaging) methods to assess the effectiveness of cognitive rehabilitation performed with RehaCom after treatment. We believe that future MRI/fMRI studies will provide a more detailed understanding of the long-term therapeutic effects of RehaCom on each cognitive function and the brain regions involved in these functions.

6. Conclusions

The novelty of this study lies in its use of various cognitive tests to evaluate cognitive performance. Additionally, assessing potential cognitive issues in participants through the Mini Mental State Examination before starting the intervention ensured the creation of a homogeneous group. Numerous PwE have explored the effects of education, support groups, and cognitive-behavioral therapies. However, this study presents the results of an intervention that has not been previously applied to PwE in the literature. This provides an opportunity to go beyond existing research and propose an innovative approach. To date, no studies have been conducted to evaluate the effects of RehaCom training on cognitive functions in PwE. In this study, the RehaCom program was found to help individuals manage seizure-related anxiety, enhance emotional well-being, and improve social and cognitive functioning. Furthermore, the program increased ESMS and QOLIE scores, attention, and quick/accurate responsiveness while reducing symptoms such as impulsivity and hyperactivity in PwE. As a result, it was determined that computer-based rehabilitation programs positively impact cognitive impairments in PwE, which significantly affect quality of life.

Funding Information

This work was supported by Selcuk University Scientific Research Projects Unit, award number 24401024 (principal investigators: U.S.D). Opinions, interpretations, conclusions, and suggestions belong to the author.

8. Ethics statement

Prior to conducting the study, ethical approval (IRB: 2023/09) was obtained from the Selçuk University Non-Interventional Ethics Committee, and institutional permission (No: 489759) was secured from the Selçuk University Faculty of Medicine. All stages of the study were conducted in compliance with the Helsinki Declaration of Human Rights and ethical principles. Participants were informed about the purpose of the study and the data collection tools, and their consent was obtained. Permission to use the scales utilized in the study was obtained from their authors via email. Furthermore, license permissions for the online test and program used in the study were obtained from the respective organizations. Clinical Trial Registration: NCT06376370.

CRediT authorship contribution statement

Ulku Saygili Duzova: Conceptualization, Data curation, Formal analysis, Supervision, Validation, Visualization, Software, Writing – original draft, Writing – review & editing. **Zuhal Seflek:** Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **Fettah Eren:** Writing – review & editing, Writing – original draft, Methodology. **Serefnur Ozturk:** Writing – review & editing, Writing – original draft, Conceptualization. **Murat Faruk Tutar:** Writing – review & editing, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

This project was supported by the Scientific Research Projects Unit of Selçuk University with registration number 24401024, and the RehaCom Turkey Konya representative provided the computer-aided rehabilitation program, offering training, meetings, and course opportunities.

Data availability

Data will be made available on request.

References

[1] Paramonova AI, Lysova KD, Timechko EE, Senchenko GV, Sapronova MR, Dmitrenko DV. Cognitive impairment in childhood-onset epilepsy. Epilepsy and Paroxysmal Conditions 2024;16(1):54–68. https://doi.org/10.17749/2077-8333/epi.par.con.2024.176.
[2] Helmstaedter C, Witt JA. Epilepsy and cognition – a bidirectional relationship? Seizure. 2017;49:83–89. 10. 1016/j. seizu re. 2017. 02. 017.
[3] Ren Z, Zhao Y, Han X, Yue M, Wang B, Zhao Z, et al. An objective model for diagnosing comorbid cognitive impairment in patients with epilepsy based on the clinical-EEG functional connectivity features. Front Neurosci 2022;16:1060814. https://doi.org/10.3389/fnins.2022.1060814.
[4] Kleen JK, Scott RC, Lenck-Santini PP, Holmes GL. Cognitive and behavioral comorbidities of epilepsy . Jasper's Basic Mechanisms of the Epilepsies [Internet]. Noebels JL, Avoli M, Rogawski MA, Olsen RW, Delgado-Escueta AV (ed): National Center for Biotechnology Information (US), Bethesda; 2012.
[5] Austin JK. The 2007 Judith Hoyer lecture. Epilepsy comorbidities: lennox and lessons learned. Epilepsy Behav 2009;14(1):3–7. https://doi.org/10.1016/j.yebeh.2008.10.019.

[6] Holmes GL. What is more harmful, seizures or epileptic EEG abnormalities? Is there any clinical data? Epileptic Disord 2014;1:S12–22. https://doi.org/10.1684/epd.2014.0686.
[7] Holmes GL. Cognitive impairment in epilepsy: the role of network abnormalities. Epileptic Disord 2015;17:101–16. https://doi.org/10.1684/epd.2015.0739.
[8] Helmstaedter C, Aldenkamp AP, Baker GA, Mazarati A, Ryvlin P, Sankar R. Disentangling the relationship between epilepsy and its behavioral comorbidities - the need for prospective studies in new-onset epilepsies. Epilepsy Behav 2014;31:43–7. https://doi.org/10.1016/j.yebeh.2013.11.010.
[9] Rabiei L, Lotfizadeh M, Karimi Z, Masoudi R. The effects of self-management education and support on self-efficacy, self-esteem, and quality of life among patients with epilepsy. Seizure 2022;102:96–104. https://doi.org/10.1016/j.seizure.2022.09.023.
[10] Mollaoğlu M, Durna Z, Bolayir E. Validity and Reliability of the Quality of Life in Epilepsy Inventory (QOLIE-31) for Turkey. Noro Psikiyatr Ars 2015;52(3):289–95. https://doi.org/10.5152/npa.2015.8727.
[11] Goh SL, Harding KE, Lewis AK, Taylor NF, Carney PW. Self-management strategies for people with epilepsy: an overview of reviews. Epilepsy Behav 2024;150:109569. https://doi.org/10.1016/j.yebeh.2023.109569.
[12] Yeni K, Tülek Z, Bebek N. Epilepsi özyönetim ölçeği geçerlik ve güvenirlik çalışması. Epilepsi Journal of the Turkish Epilepsi Society. 2020;26(1):12–9. 10.14744/epilepsi.2019.67299.
[13] Li C, Bi Q, Hu B, Sun L. Effect of self-management interventions for adults with epilepsy: a systematic review and meta-analysis. Ann Palliat Med 2021;10(12):12086–94. https://doi.org/10.21037/apm-21-2404.
[14] Naeeni Davarani M, Arian Darestani A, Hassani-Abharian P, Vaseghi S, Zarrindast MR, Nasehi M. RehaCom rehabilitation training improves a wide-range of cognitive functions in multiple sclerosis patients. Appl Neuropsychol Adult 2022;29(2):262–72. https://doi.org/10.1080/23279095.2020.1747070.
[15] Dos Santos M, Hardy-Léger I, Rigal O, Licaj I, Dauchy S, Levy C, et al. Cognitive rehabilitation program to improve cognition of cancer patients treated with chemotherapy: a 3-arm randomized trial. Cancer 2020;126(24):5328–36. https://doi.org/10.1002/cncr.33186.
[16] Veisi-Pirkoohi S, Hassani-Abharian P, Kazemi R, Vaseghi S, Zarrindast MR, Nasehi M. Efficacy of RehaCom cognitive rehabilitation software in activities of daily living, attention and response control in chronic stroke patients. J Clin Neurosci 2020;71:101–7. https://doi.org/10.1016/j.jocn.2019.08.114.
[17] İçellioğlu S, Bingöl A, Kurt E, Yeni SN. Bilgisayar temelli rehabilitasyonun epilepsi hastalarının bilişsel işlevlerine etkileri. Dusunen Adam J Psych Neurol Sci 2017;30:354–63. https://doi.org/10.5350/DAJPN2017300410.
[18] Cramer JA, Perrine K, Devinsky O, Meador K. A brief questionnaire to screen for quality of life in epilepsy: the QOLIE-10. Epilepsia 1996;37(6):577–82. https://doi.org/10.1111/j.1528-1157.1996.tb00612.x.
[19] Mollaoğlu M, Durna Z, Eşkazan E. Epilepsili Hastaların Yaşam Kalitesinin QOLIE-89 (Epilepside Yaşam Kalitesi Ölçeği) ile Değerlendirilmesi. Epilepsi 2001;7:73–80.
[20] DiIorio C, Shafer PO, Letz R, Henry TR, Schomer DL, Yeager K. Project EASE study group. Project EASE: a study to test a psychosocial model of epilepsy medication managment. Epilepsy Behav 2004;5(6):926–36. https://doi.org/10.1016/j.yebeh.2004.08.011.
[21] García Beristain JC, de Celis AB, Barragan Perez E, Dies-Suarez P, Hidalgo-Tobón S. BOLD activation during the application of MOXO-CPT in school patients with and without attention deficit hyperactivity disorder. J Atten Disord 2024;28(3):321–34. https://doi.org/10.1177/10870547231217093.
[22] Berger C, Lev A, Braw Y, Elbaum T, Wagner M, Rassovsky Y. Detection of Feigned ADHD Using the MOXO-d-CPT. J Atten Disord 2021;25(7):1032–47. https://doi.org/10.1177/1087054719864656.
[23] Kar Ş, Er E, Ata A, İnal-Kaleli İ, Özcan T, Köse S, et al. Effect of metabolic control on cognitive functions in children and adolescents with type 1 Diabetes Mellitus. J Pediatr Endocrinol Metab 2023;36(7):636–42. https://doi.org/10.1515/jpem-2023-0027.
[24] Büyükkaragöz B, Soysal Acar AŞ, Ekim M, Bayrakçı US, Bülbül M, Çaltık Yılmaz A, et al. Utility of continuous performance test (MOXO-CPT) in children with predialysis chronic kidney disease, dialysis and kidney transplantation. J Nephrol 2022;35(7):1873–83. https://doi.org/10.1007/s40620-022-01382-1.
[25] Folstein MF, Folstein SE, McHugh PR. Mini-mental state A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12(3):189–98. https://doi.org/10.1016/0022-3956(75)90026-6.
[26] Ertan T, Eker E, Güngen C. The Standardized Mini Mental State Examination forilliterate Turkish elderly population. 2th International Symposium on Neurophysiological and Neuropsy- chological Assesment of Mentaland Behavioral Disorders. 1999;28-30, Bursa, Turkey.
[27] Amiri S, Hassani-Abharian P, Vaseghi S, Kazemi R, Nasehi M. Effect of RehaCom cognitive rehabilitation software on working memory and processing speed in chronic ischemic stroke patients. Assist Technol 2023;35(1):41–7. https://doi.org/10.1080/10400435.2021.1934608.
[28] Campbell J, Langdon D, Cercignani M, Rashid W. A randomised controlled trial of efficacy of cognitive rehabilitation in multiple sclerosis: a cognitive, behavioural, and MRI Study. Neural Plast 2016:4292585. https://doi.org/10.1155/2016/4292585.
[29] Messinis L, Nasios G, Kosmidis MH, Zampakis P, Malefaki S, Ntoskou K, et al. Efficacy of a computer-assisted cognitive rehabilitation intervention in relapsing-remitting multiple sclerosis patients: a multicenter randomized controlled trial. Behav Neurol 2017:5919841. https://doi.org/10.1155/2017/5919841.
[30] Lampit A, Heine J, Finke C, Barnett MH, Valenzuela M, Wolf A, et al. Computerized cognitive training in multiple sclerosis: a systematic review and meta-analysis. Neurorehabil Neural Repair 2019;33(9):695–706. https://doi.org/10.1177/1545968319860490.
[31] Yeh TT, Chang KC, Wu CY, Chen CJ, Chuang IC. Clinical efficacy of aerobic exercise combined with computer-based cognitive training in stroke: a multicenter randomized controlled trial. Top Stroke Rehabil 2022;29(4):255–64. https://doi.org/10.1080/10749357.2021.1922045.
[32] Gil-Pagés M, Solana J, Sánchez-Carrión R, Tormos JM, Enseñat-Cantallops A, García-Molina A. A customized home-based computerized cognitive rehabilitation platform for patients with chronic-stage stroke: study protocol for a randomized controlled trial. Trials 2018;19(1):191. https://doi.org/10.1186/s13063-018-2577-8.
[33] Bonavita S, Sacco R, Della Corte M, Esposito S, Sparaco M, d'Ambrosio A, et al. Computer-aided cognitive rehabilitation improves cognitive performances and induces brain functional connectivity changes in relapsing remitting multiple sclerosis patients: an exploratory study. J Neurol 2015;262(1):91–100. https://doi.org/10.1007/s00415-014-7528-z.
[34] Luisa Maia Nobre Paiva M, Serafim A, Vincentiis S, Alessi R, Marin R, Braga Melo M, et al. A cognitive rehabilitation program to improve hot and cool executive dysfunction in juvenile myoclonic epilepsy: Preliminary findings. Epilepsy Behav 2023;144:109281. https://doi.org/10.1016/j.yebeh.2023.109281.
[35] Puteikis K, Jakonienė A, Jasionis A, Wolf P, Mameniškienė R. Rehabilitation of cognition and psychosocial well-being - a better life with epilepsy (ReCaP-ABLE): A protocol for a randomized waitlist-controlled trial. Front Neurol 2023;14:1273550. https://doi.org/10.3389/fneur.2023.1273550.
[36] Sharma S, Nehra A, Pandey S, Tripathi M, Srivastava A, Padma MV, et al. Neuropsychological rehabilitation for epilepsy in india: looking beyond the basics. Epilepsy Behav 2024;153:109703. https://doi.org/10.1016/j.yebeh.2024.109703.
[37] Zaldumbide-Alcocer FL, Labra-Ruiz NA, Carbó-Godinez AA, Ruíz-García M, Mendoza-Torreblanca JG, Naranjo-Albarrán L, et al. Neurohabilitation of cognitive functions in pediatric epilepsy patients through LEGO®-based therapy. Brain Sci 2024;14(7):702. https://doi.org/10.3390/brainsci14070702.
[38] Fraser RT, Johnson EK, Lashley S, Barber J, Chaytor N, Miller JW, et al. PACES in epilepsy: results of a self-management randomized controlled trial. Epilepsia 2015;56(8):1264–74. https://doi.org/10.1111/epi.13052.
[39] Helmers SL, Kobau R, Sajatovic M, Jobst BC, Privitera M, Devinsky O, et al. Self-management in epilepsy: Why and how you should incorporate self-management in your practice. Epilepsy Behav 2017;68:220–4. https://doi.org/10.1016/j.yebeh.2016.11.015.
[40] Faught RE, Weiner JR, Guérin A, Cunnington MC, Duh MS. Impact of nonadherence to antiepileptic drugs on health care utilization and costs: findings from the RANSOM study. Epilepsia 2009;50(3):501–9. https://doi.org/10.1111/j.1528-1167.2008.01794.x.
[41] Wagner JL, Brooks B, Smith G, St Marie K, Kellermann TS, Wilson D, et al. Determining patient needs: a partnership with South Carolina advocates for epilepsy (SAFE). Epilepsy Behav 2015;51:294–9. https://doi.org/10.1016/j.yebeh.2015.08.007.