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Investigation of the Effects of Cognitive Rehabilitation Training on the Memory Deficits of Adults with Attention Deficit Hyperactivity Disorder

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Quantitative Study

Abstract

Background: In adults with attention deficit hyperactivity disorder (ADHD), problems with executive functions are common. The present research aims to investigate the effects of cognitive rehabilitation training on the memory deficits of adults with ADHD.

Methods: The current semi-experimental research utilized a pre- and post-test design and a control group. All patients between the ages of 25 and 50 referred to Alrashad Hospital for Mental Health in Baghdad, Iraq, in 2022, were included in the statistical population. The statistical sample of 64 patients was chosen using a simple random sampling method and randomly assigned into both experimental and control groups (32 people per group). Barkley Adult ADHD Rating Scale-IV (BAARS-IV) and Wechsler Memory Scale (WMS) were used to collect data. To perform the analysis of covariance (ANCOVA), SPSS software was utilized, and the significance level of the results was less than 0.05.

Results: Cognitive rehabilitation training was effective in improving auditory memory ($F = 7.76$, $P < 0.001$), visual memory ($F = 5.17$, $P < 0.001$), visual working memory ($F = 11.36$, $P < 0.001$), immediate memory ($F = 9.28$, $P < 0.001$), and delayed memory ($F = 7.12$, $P < 0.001$).

Conclusion: Cognitive rehabilitation training improves the memory deficits of adults with ADHD. Thus, psychologists can utilize cognitive rehabilitation training in conjunction with other treatment methods to enhance the memory of adults with ADHD.

Keywords: Cognitive training; Memory disorders; Attention

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Introduction

Attention deficit hyperactivity disorder (ADHD) is a usual neurotic disturbance that begins in babyhood and lasts into adulthood (Tajik-Parvinchi, Wright, & Schachar, 2014; Naji, Rahnamay-Namin, Roohafza, & Sharbafchi, 2020). This disorder is distinguished by three major characteristics: hyperactivity, impulsivity, and attention deficit (Faghihi, Goli, Talighi, & Omidi, 2019). Other features of this disorder include emotional instability, unexpected and intense anger, intense emotional responses, confusion in doing things, instability in interpersonal relationships, inefficiency, and career and academic failures, among others (Najarzadegan, Nejati, Amiri, & Sharifian, 2015). It was once thought that hyperactivity disorder improved after adolescence, but it is now known that it continues into youth and adulthood in more than 60% of cases (Shariat, Amini, & Mohebati, 2023).

Executive functions include activity continuity, attention maintenance, planning, organization, problem-solving, and proper information processing (Ali, Viczko, & Smart, 2020). Although, according to the findings of numerous studies, people with ADHD have a deficit in executive functions, this is the case (Emadian, Bahrami, Hassanzadeh, & Banijamali, 2016; Albahadlv et al., 2023). Several administrative functions, like attention, active memory, inhibition and control of stimuli, cognitive flexibility, problem-solving, planning, and organization, assist the brain's superior cognitive abilities, such as language, perception, and thinking (van Dun, Overwalle, Manto, & Marien, 2018). Executive functions play a crucial role in regulating and self-regulating behavior, as well as in developing cognitive and social skills. They are essential for adaptation and successful performance in the real world (Bangirana, Giordani, John, Page, Opoka, & Boivin, 2009; Mosaiebi & Mirmahdi, 2017; Pahlevanian, Alirezaloo, Naghel, Alidadi, Nejati, & Kianbakht, 2017; Aivazy, Yazdanbakhsh, & Moradi, 2019).

Each of the numerous treatment options for ADHD has adverse effects. It is a common practice to prescribe stimulants to treat this disorder (Rodrigo-Yanguas, Gonzalez-Tardon, Bella-Fernandez, & Blasco-Fontecilla, 2022). Although these medications are effective at alleviating the symptoms of ADHD, they are correlated with potential side effects like growth retardation, insomnia, and heart arrhythmia; therefore, alternative treatments with fewer side effects must be sought (Beirami, hashemi, khanjaani, nemati, & rasoulzadeh, 2021; Mozaffari, Hassani-Abharian, Kholghi, Vaseghi, Zarrindast, & Nasehi, 2022; Denny et al., 2023).

Cognitive rehabilitation training is a technique that aims to strengthen the human cognitive system, including the ability to solve problems, focus and attention, visual and auditory processing, visual and auditory memory, the capacity to comprehend three dimensions, abstract perception, reasoning memory, and so on (Mahardika, Yunitasari, & Rachmawati, 2021). Cognitive rehabilitation training focuses on improving cognitive functions by providing performance-oriented therapeutic activities based on the principle of the brain's neuroplasticity (Bangirana, Boivin, & Giordani, 2013). These programs can adjust the assignment's difficulty level from easy to difficult based on individual differences and problems (Bongers, Benninga, Maurice-Stam, & Grootenhuis, 2009; Askari, Tajeri, Sobhi-Gharamaleki, & Hatami, 2021).

In this method, the therapist considers the data gleaned from the evaluation of the sessions, designs tasks to strengthen the brain's cognitive functions, and increases the rate of hardness of the tasks as the patient improves (Soroush-Vala, Rahmanian, Jadidi, & Hassanvandi, 2023).

There have been few studies on the effects of cognitive rehabilitation training on adult memory deficits. Given the prevalence of ADHD and the problems that hyperactivity causes in various areas of adult life, it is critical to research to find the best treatment for these patients. As a result, the current research aims to investigate the effects of cognitive intervention on the memory deficits of adults with ADHD. So far, a similar study has yet to be conducted in Iraq, considering the study's innovation.

Methods

The current semi-experimental research utilized a pre- and post-test design and a control group. All patients between the ages of 25 and 50 referred to Alrashad Hospital for Mental Health in Baghdad, Iraq, in 2022, were included in the statistical population. A simple random sampling method was used to select a statistical sample of 64 patients, then randomly assigned into experimental and control groups (32 individuals per group). After the research was completed, the intended intervention was also presented to the control group.

Inclusion criteria included hyperactivity disorder based on a psychiatrist's evaluation, a Barkley Adult ADHD Rating Scale-IV (BAARS-IV) score of 80 or higher, not taking psychiatric drugs in the past year, not having participated in a similar intervention in the past year, and the age range of 25-50 years old. Exclusion criteria included refusal to participate in the research, inability to complete questionnaires, and absenteeism for more than two sessions. Following ethical considerations, the participants were assured that their identities would remain confidential. After selecting the sample, cognitive rehabilitation training was provided to experimental group members. Data were collected utilizing a demographic questionnaire, the BAARS-IV, and the Wechsler Memory Scale (WMS).

BAARS-IV is a 30-item self-report scale developed by Barkley in 2011. This scale assesses three subscales: attention deficit, hyperactivity disturbance, and impulsivity. The questions are filled using a 4-point Likert scale. Internal consistency reliability examined utilizing Cronbach's alpha with the above sample was 0.89 for the whole scale and 0.88, 0.79, and 0.84 for attention deficit, hyperactivity disturbance, and impulsivity subscales, respectively.

Wechsler developed the WMS in 1945 to assess adults' memory. Anyone between 16 and 90 years old can do the scale. The latest version is the fourth edition, which came out in 2009. Five index scores show how well a person did: auditory memory, visual memory, visual working memory, immediate memory, and delayed memory (Carlozzi, Grech, & Tulsky, 2013). The content validity index (CVI) in the current study was 0.81, and it was approved by four professors from the College of Nursing, University of Baghdad. The internal consistency method yielded reliability with a Cronbach's alpha of 0.79.

In this research, cognitive rehabilitation training based on the Sohlberg and Mateer (2001) protocol emphasized memory training and attention stability. The cognitive rehabilitation training for the intervention group consisted of 11 sessions focusing on memory and attention (one session per week for 60 minutes). Table 1 describes cognitive rehabilitation training sessions.

Inferential statistical methods such as analysis of covariance (ANCOVA) were used to analyze the data. Besides, the Kolmogorov-Smirnov test, Levene's test, and Box's M test were utilized. SPSS software (version 23, IBM Corporation, Armonk, NY, USA) was used to perform the desired statistical analyses, and the significance level of the results was less than 0.05.

Table 1. Description of cognitive rehabilitation training sessions

Session	Description
1	Implementing the pre-examination stage of expressing ethical concerns and research goals
2	Exercises in sustained attention and memory cards with shapes
3	Exercising the distinction between pictures and memory cards using sentences
4	Performing word-based selective attention, puzzle, and memory card exercises
5	Exercises in visual and auditory memory
6	Exercising particular attention and concentration
7	Exercising numerical memory, short-term memory, and visual memory
8	Practices in numerical memory and long-term memory
9	Performing auditory memory exercises and shifting attention from one stimulus to another
10	Doing shape memory and long-term memory training exercises
11	Post-test phase implementation

Results

In table 2, demographic variables are listed. Table 2 shows that 33 people (51.6%) were over 35. The mean age of people in the experimental and control groups was 33.29 ± 6.54 and 37.61 ± 7.18 years, respectively. In addition, 41 people (64%) were men, 45 people (70.3%) were married, 34 people (53.1%) had secondary education, 46 people (71.9%) were employed, and 56 people (87.5%) lived in cities. The research subjects were identical, and neither the chi-square test nor the independent t-test found any differences regarding demographic variables for both groups (P > 0.05).

Before beginning the intervention, both experimental and control groups underwent a pre-test phase. After the conclusion of the intervention sessions in the experimental group, both groups participated in the post-test phase. Table 3 separately provides the mean and standard deviation (SD) of the WMS subscales for the two experimental and control groups. Table 3 demonstrates that the control group's pre-test and post-test findings did not change (P > 0.050), whereas the experimental group's post-test mean value increased (P < 0.001). Consequently, cognitive rehabilitation training reduced memory deficits.

The assumption that the grades were normally distributed was examined utilizing the Kolmogorov-Smirnov test. If the significance level of the result is greater than 0.05, the hypothesis of normality of the distribution of subscales is met; otherwise, this assumption is not met. Table 4 shows the findings of this hypothesis.
Levene's test showed the homogeneity of memory deficit subscales (F = 1.53, P = 0.37). The Box's M test findings also indicated the homogeneity of the variance–covariance matrix (F = 1.78, P = 0.16).

Table 2. Demographic variables of the individuals

Variable		Experimental group [n (%)]	Control group [n (%)]	P-value
Gender	Men	19 (59.4)	22 (68.7)	0.71
	Women	13 (40.6)	10 (31.3)	
Age (year)	< 35	17 (53.1)	14 (43.8)	0.54
	> 35	15 (46.9)	18 (56.2)	
Marital status	Married	8 (25.0)	11 (34.4)	0.19
	Single	24 (75.0)	21 (65.6)	
Education	Illiterate	2 (6.3)	3 (9.4)	0.13
	Secondary	16 (50.0)	18 (56.2)	
	College	14 (43.7)	11 (34.4)	
Job	Employed	21 (65.6)	25 (78.1)	0.62
	Unemployed	11 (34.4)	7 (21.9)	
Living place	Urban	26 (81.2)	30 (93.7)	0.78
	Village	6 (18.8)	2 (6.3)	

Table 3. Mean and standard deviation (SD) of the subscales of memory deficits in pre- and post-test

Variable	Phase	Experimental group (mean ± SD)	Control group (mean ± SD)	P-value
Auditory memory	Pre-test	15.73 ± 1.66	15.92 ± 1.74	0.180
	Post-test	15.41 ± 1.53	19.26 ± 1.94	< 0.001
Visual memory	Pre-test	11.17 ± 1.82	11.24 ± 1.73	0.630
	Post-test	10.91 ± 1.65	14.71 ± 2.38	< 0.001
Visual working memory	Pre-test	11.68 ± 1.74	11.53 ± 1.89	0.560
	Post-test	11.43 ± 1.59	15.46 ± 2.54	< 0.001
Immediate memory	Pre-test	14.61 ± 1.86	14.76 ± 2.07	0.290
	Post-test	14.23 ± 1.73	19.14 ± 2.35	< 0.001
Delayed memory	Pre-test	16.29 ± 2.19	16.42 ± 2.51	0.140
	Post-test	16.47 ± 2.36	22.34 ± 2.65	< 0.001

SD: Standard deviation

The findings of the ANCOVA to investigate the effects of cognitive intervention on the subscales of memory deficits are displayed in table 5.

The findings of a one-way ANCOVA examining the significance of subscale differences between both groups are presented in table 6. According to table 6, the independent variable (intervention) after the intervention produced a statistically significant difference in the subscales of memory deficits (P < 0.001). Therefore, when the intervening variable (pre-test) was controlled, the intervention significantly decreased the patients' mean values on the desired subscales.

Discussion

The current research aims to investigate the effects of cognitive rehabilitation training on the memory deficits of adults with ADHD. In the experimental group, cognitive rehabilitation training improved auditory memory, visual memory, visual working memory, immediate memory, and delayed memory in adults with ADHD. The current research findings were consistent with those of other studies in this field (Virta et al., 2008; Narimani, Soleymani, & Tabrizchi, 2015; Nejati, 2020).

Memory is one of several determinants of high-level cognitive brain functions like reasoning, intelligence, and language comprehension (Cermak & Maeir, 2011). To explain the efficacy of cognitive rehabilitation training, it is possible to say that rehabilitation exercises cause continuous and extensive changes in the brain level and that new behavior leads to the reconstruction or reorganization of damaged brain cycles. Targeting a particular cognitive process that predicts or affects a variety of other cognitive processes, for instance, will improve all the skills affected by that process.

Table 4. Evaluating the normality of the distribution of the subscales in the pre- and post-test

Variable	Phase	Experimental group		Control group	
		Z-value	P-value	Z-value	P-value
Auditory memory	Pre-test	0.107	0.28	0.219	0.34
	Post-test	0.103	0.16	0.174	0.21
Visual memory	Pre-test	0.245	0.57	0.271	0.67
	Post-test	0.162	0.36	0.294	0.81
Visual working memory	Pre-test	0.183	0.28	0.147	0.36
	Post-test	0.109	0.22	0.116	0.23
Immediate memory	Pre-test	0.172	0.43	0.204	0.39
	Post-test	0.120	0.37	0.167	0.25
Delayed memory	Pre-test	0.193	0.37	0.173	0.36
	Post-test	0.148	0.24	0.154	0.27

Table 5. Analysis of covariance (ANCOVA) findings for the effects of cognitive intervention on the subscales of memory deficits

Source of variation	SS	df	MS	F
Pre-test	74.68	1	74.68	11.26
Dependent variable	726.19	1	726.19	109.53
Error	612.51	24	25.52	
Total	673.04	27		

SS: Sum of squares; df: Degree of freedom; MS: Mean square

In other words, the broad transfer of how these exercises are presented is such that the individual's cognitive abilities are challenged. As a result of repeated successes during these challenges, cognitive skills are enhanced (Kianbakht et al., 2015).

In cognitive rehabilitation training, there is a type of treatment whose primary objective is to correct the patient's cognitive performance deficiencies, such as attention and concentration, memory, performance improvement, and social comprehension (Lindstedt & Umb-Carlsson, 2013). Rehabilitative treatment, in the sense that it solely and primarily focuses on cognitive abilities, particularly memory, causes individuals to become more aware of their memory and cognitive skills and to find more appropriate solutions to problems relating to working memory. In the current research, based on the theoretical foundations of Sohlberg and Mateer's cognitive rehabilitation training (2001), various exercises were conducted to enhance attention, concentration, and memory. According to the present study's findings, training in these techniques and skills has decreased memory defects. In other words, cognitive rehabilitation training treats cognitive deficits that involve restoring dysfunction or increasing compensation for damaged areas through strategy training or repetition and practice (Najian & Nejati, 2017).

In addition, the principles of neural and brain plasticity can be mentioned when describing the efficacy of cognitive intervention on the executive functions of planning and problem-solving. Neuropsychological studies indicate that abnormalities of the prefrontal cortex, a brain region involved in administrative procedures, contribute to the pathology of ADHD (Simone, Viterbo, Margari, & Iaffaldano, 2018). Although the brain is a dynamic organ capable of neural regeneration and extensive neurological organization throughout life, this is the case. Every learning experience and behavioral change is accompanied by structural alterations in the brain, particularly in dendritic and synaptic fibers. Consequently, with the cognitive rehabilitation training and learning program's exercises, the brain and its activities manifest with progressive growth and development, and brain and executive functions improve.

In brain regeneration, other brain regions can gradually assume the functions of damaged areas and form new neural pathways. Therefore, cognitive rehabilitation training intervention can assist the brain in preventing and compensating as much as possible for the adverse effects of brain damage by creating alternative neural pathways (Slomine & Locascio, 2009).

Table 6. One-way analysis of covariance (ANCOVA) results for the effects of cognitive rehabilitation training on memory deficit subscales

Source of variation	Subscales	SS	df	MS	F	P-value
Dependent variable	Auditory memory	26.71	1	26.71	7.76	< 0.001
	Visual memory	18.23	1	18.23	5.17	< 0.001
	Visual working memory	41.12	1	41.12	11.36	< 0.001
	Immediate memory	32.57	1	32.57	9.28	< 0.001
	Delayed memory	24.08	1	24.08	7.12	< 0.001

SS: Sum of squares; df: Degree of freedom; MS: Mean square

According to the principle of brain plasticity and self-repair, cognitive rehabilitation training induces stable synaptic changes in low-activity brain regions. Structured stimulation through learning experiences and targeted brain exercises has been linked to improving neuronal behavior function. Therefore, cognitive and behavioral symptoms improve due to rehabilitation programs that repair the damaged brain regions responsible for cognitive and behavioral deficits.

Cognitive strategies are actions and thoughts that improve storing and retrieving information from memory (Lee, Li, Yeh, Huang, Wu, & Du, 2017). These techniques assist the individual in preparing new information to be combined with previously learned knowledge stored in long-term memory. Since these strategies were taught in the present study's training sessions, it is reasonable to assume that the memory deficits of the subjects have diminished. Because in the training sessions, emphasis was placed on strengthening short- and long-term memory skills, multi-step commands, and auditory and visual memory, it has significantly reduced memory defects and enhanced various aspects of patients' memories.

Among the limitations of the current research is that it was executed in a hospital. Another limitation of the current research is the small size of the statistical sample. It is suggested that future studies use different educational intervention methods and compare the results to the current study. Research should also be conducted on other age groups, such as children and older people. It is also suggested that a similar study be conducted on other societies with varying cultural levels.

Conclusion

The findings indicated that cognitive rehabilitation training improved the memory of adults with ADHD. According to the findings, the cognitive rehabilitation training reduced memory defects by improving the damaged areas through strategy training or repetition and practice. Consequently, cognitive rehabilitation training improved auditory memory, visual memory, visual working memory, immediate memory, and delayed memory

Conflict of Interests

Authors have no conflict of interests.

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