



Research paper

Working Memory of Children with Attention Deficit/Hyperactivity Disorder: Comparing the Effectiveness of Computerized Cognitive Games with Play Therapy Based on Cognitive Rehabilitation

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Abstract

The purpose of this study was to compare the effectiveness of computerized cognitive games (CCG) and play therapy based on cognitive rehabilitation on the working memory of children with attention deficit/hyperactivity disorder (ADHD). This research was carried out using a semi-experimental method and a pre-test-post-test-follow-up design with a control group. 24 cases were selected by available method suffering from ADHD, referred to Razi Counseling Center in Karaj city. Samples were randomly replaced in CCG, play therapy based on cognitive rehabilitation and control groups (8 cases in each group). The experimental groups received 12 sessions of intervention. Karchner's N-back test was used to collect data. According to the research results, CCG had a more significant effect on the working memory of ADHD children, and psychologists are recommended to pay more attention to this intervention to strengthen working memory.

Keywords: ADHD, computerized cognitive games, rehabilitation play therapy cognitive, working memory

Introduction

Attention-deficit/hyperactivity disorder (ADHD) has a serious negative impact on the lives of children and their families (Tsai et al., 2021). Children's attention deficit/hyperactivity disorder as a neurodevelopmental disorder is closely related to executive function disorders, especially with working memory (Jaquerod et al., 2020). Working memory is one of the executive functions that is the central core of many cognitive functions. There is cross-sectional evidence indicates cortical underdevelopment in areas related to working memory in children with ADHD (Anderson & Bolden, 2018). The cognitive rehabilitation (CR) approach has been proposed as an effective and uncomplicated approach in rehabilitating and strengthening cognitive components. Cognitive rehabilitation is a method of treating cognitive impairment, which includes improving poor performance or increasing compensation due to lack of attention, through strategy training or repeated skills (Soltanipour et al., 2021). Reviewing evidence showed two major approaches exist in CR interventions, which include computer-based cognitive rehabilitation and play therapy. Although a study not found comparing play therapy based on cognitive rehabilitation and

CCG, and on the other hand, the review of interventions shows that mainly play therapy interventions were not based on CR. Therefore, two hypotheses were proposed in the current research: first play therapy based on CR and CCG were effective on the working memory of children with ADHD; the effectiveness of CCG therapy was more effective than play therapy rehabilitation on the working memory of children with ADHD.

Method

The present study was a semi-experimental study, a pre- post-test with a control group and a one-month follow-up design. The statistical population includes all children aged 7 to 12 years with attention deficit hyperactivity disorder who referred to the Razi counseling center in Karaj city in 2021-2022. A number of 24 children were selected based on the criteria of the research through available sampling and were randomly assigned to three groups of play therapy intervention based on cognitive rehabilitation, CCG and control group (n1=n2=8). The interventions included 12 sessions (45 minutes each session), all of which were held by the researcher at the Razi Clinic. In computerized cognitive rehabilitation group program were used based on Torkel Klingberg and his colleagues, designed at the Karolinska Institute (2007). Play therapy sessions based on cognitive rehabilitation, adapted from reliable research sources (Yahyavizanjani, et al., 2020; Karamalian, et al., 2018), the package was prepared by the researchers and its formal and content validity was confirmed by 5 experts in this field.

Tools

Raven's IQ Test: This test contains 36 geometric shapes that are used to check children's IQ (Cotton et al., 2008). The internal consistency coefficient of this questionnaire was obtained by Cronbach's alpha method in this study ($\alpha= 0.72$).

Karchener N-Beck test (1985) is used to measure working memory performance. It contains a set of 32 meaningless images. The internal consistency coefficient of this questionnaire was obtained by Cronbach's alpha method in this study equal to 0.70.

Results

Examining the demographic findings showed that the two groups were homogeneous in terms of the number of girls and boys ($P<0.05$). Below is the mean and standard deviation of working memory test components by groups and measurement stages. The results on table1 show that the average correct answer and reaction time have improved in the CCG and cognitive rehabilitation groups; But the changes in the control group were not noticeable.

Table 1: Mean and standard deviation of working memory

Variable	Group	Pre test		Post test		Follow up	
		M	SD	M	SD	M	SD
Correct Answer	CCG	55.00	1.51	75.38	3.25	74.88	3.48
	CR	56.25	2.82	67.63	3.02	66.88	3.36
	Control	56.75	3.37	57.13	3.23	55.63	2.33
Reaction Time	CCG	189.63	3.93	139.13	14.28	139.75	14.83
	CR	188.25	4.95	171.88	6.60	173.00	5.93

Control	186.13	5.72	186.25	4.98	187.50	4.75
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First, the assumptions were checked and confirmed. The findings of Table 2 showed that the effectiveness of the two therapeutic methods of computerized cognitive games and cognitive rehabilitation on working memory was significantly different ($p < 0.05$).

Table 2. Summary of the univariate covariance analysis

Source	Stage	Sum	df	Mean	F	P	eta
Correct Answer	Post test	1457.42	2	728.71	153.03	0.001	0.93
	Follow up	1553.94	2	776.97	113.12	0.001	0.91
Reaction Time	Post test	9297.44	2	4648.72	61.44	0.001	0.86
	Follow up	9472.36	2	4736.18	59.88	0.001	0.85

In order to determine the pairwise differences of the groups, the Bonferroni post hoc test was used. The CCG program and play therapy CR were effective on the correct answer and reaction time, and the effectiveness of the interventions was stable in the follow-up phase. Examining the averages indicated that in the CCG group, the average scores were significantly higher than in the CR play therapy group ($p < 0.05$).

Discussion and Conclusion

The results showed that CCG were more effective in improving working memory than play therapy based on CR. It can be said that the reason for the difference in the effectiveness of CCG therapy with game therapy based on CR is the way of interventions. This is because the CCG therapy was done individually and inhibition in this intervention happened less, and this caused a greater impact of this intervention on concentration and working memory. In addition to focusing on their specific goal, which is to increase cognitive functions, computer games give the child the freedom to choose the desired faces for the game, choose colors, clothes, language, graphic designs, the directions necessary to move in the game spaces, and finally choose how to play the game. Due to the limited access to the sample, it was not possible to control the influencing factors on the participants such as family and economic factors, which may limit the generalization of the findings let alone, most of the children have experience of using computer games

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Conflicts of interest

Authors found no conflict of interests.



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