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Original Article

The effectiveness of an educational board game on the symptoms of attention deficit and hyperactivity disorder in children with ADHD

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Abstract

This study designed an educational board game and investigated its effectiveness on the symptoms of attention deficit and hyperactivity disorder (ADHD) in children. The population included 40 children aged seven to nine years in Baharestan County, Tehran Province in 2023 and selected by purposeful sampling and divided into two experimental and control groups randomly. The educational game was employed for 10 sessions in the experimental group. The instruments included the SNAP-IV questionnaire and diagnostic interview. Data was analyzed using repeated measures variance test in SPSS 23 software. The results showed that the educational board game had a significant effect on reducing children's hyperactivity symptoms and there was a significant difference between the experimental and control groups. Also, these effects remained stable in the follow-up phase. According to the findings, it can be generally concluded that game therapy, including physical games and cognitive games such as educational board games, can be used alongside first-line treatments as a complement or as an independent intervention for these children.

Keywords

ADHD
Children with ADHD
Educational board game

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Introduction

The importance of childhood problems, for the individual, the family, and society has led to this disorder receiving more and more attention from psychologists. Therefore, in recent years, we have seen increasing attention to childhood psychological disorders. One of the most important and influential childhood disorders is ADHD. It is one of the most common developmental and neurological disorders in childhood and school days, which, in addition to causing various problems for the child and her family, has a great impact on the development of other psychological disorders in adulthood. This disorder was first identified in 1845 by a German physician named Henry Fauman (Safarieh, 2020). This disorder is characterized by symptoms of inattention, impulsivity, and hyperactivity that lead to inadequate performance in multiple situations (Efron, 2019). According to DSM-5, onset before the age of 12 and the manifestation of one of the 6 symptoms associated with ADHD in more than one setting, such as kindergarten, school, home, or during psychological evaluation and examination, is required for evaluation and diagnosis (American Psychological Association, 2013). Overall, this disorder is characterized by three main features: attention deficit, hyperactivity, and impulsivity (Hogan, 2017). The DSM-5 reports a prevalence rate of 2.5% for adults and 5% for children, and its symptoms usually begin before the age of 3 (American Psychological Association, 2013). Also, the prevalence rate in boys is 2 to 9 times higher than in girls, with a predominant symptom of hyperactivity and in girls with a predominant symptom of inattention (Primich et al., 2012). In a study conducted in Iran, based on the Connors Parent Version Questionnaire, 33.6% of girls, 60.5% of boys, and 97.5% of all elementary school students were diagnosed with ADHD (Piroti et al., 2022). These children show significant differences in executive functions such as working memory, inhibition, cognitive flexibility, attentional guidance, and impulse control and planning compared to other children (Antshel et al., 2019). This disorder is actually a disruptive behavior disorder that manifests itself in early childhood. A child or adolescent with ADHD often has difficulty in academic performance and controlling behavior, such as neglecting positive relationships with family members and peers (Narimani et al., 2020; Halpern et al., 2020). Children who suffer from ADHD play for a shorter time, have difficulty with social skills, and display inconsistent behaviors. Such children are easily distracted, have

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school-related problems, have little motivation to progress, are rejected by their friends, and suffer from low self-esteem and anxiety. On the other hand, it has been found that children and adolescents with greater anxiety have difficulty with response control, cognitive flexibility, and hypervigilance (Asadi-rajani et al., 2024). The excessive mobility of these children causes problems not only for them but also for those around them, classmates, school parents, and teachers, although symptoms may change over time (Mulraney et al., 2016). Therefore, early and timely diagnosis of behavioral problems that manifest themselves in the preschool years is very important because almost all experts in the field of mental health emphasize that the early years are important in later adaptation to this disorder and that the presence of problems in these years lays the foundation for disruption in later years.

There are various pharmacological and non-pharmacological treatments and interventions to improve the symptoms of ADHD, among which pharmacotherapy is the first line of intervention due to its faster effect, although most therapists prefer to have another alternative intervention due to side effects, short-term effect, and limited effect on behavioral symptoms (Azimi, 2012). On the other hand, since the desire to participate in various group activities is low in people with ADHD, one of the types of intervention methods that is important today as an alternative or as a complement to various pharmacological and non-pharmacological treatments is play therapy (Jeong et al., 2023). Play has the potential to lead to happiness, enjoyment, and establishing relationships with others in these children, and as a means of entertainment, it can also be educational and constructive (Farhat et al., 2016). During play therapy, the child is given the opportunity to develop in ideal conditions. Play can also be a tool for understanding children with disabilities. Play provides children with strategies for dealing with life's problems and what they cannot change, and gives them a more positive outlook on life in the future (Jephcott, 2017). By creating practice opportunities for children at an early age of development through play and fun activities, higher cognitive levels such as executive functions can be strengthened (Diamond, 2013). Through cognitive exercises, many components of executive functions can be affected, because cognitive games are an approach to rehabilitating the damaged cognitive field, which is formed with the help of actions and the recreation of structured stimuli, and its goal is to strengthen the person's performance in performing everyday functions (Najjarzadegan et al., 2015). The findings of the 2014 study by Asghari-Nekah et al., which examined the effect of executive function-based play therapy, showed that this type of play therapy reduces symptoms of pre-activity and attention deficit by improving executive functions such as planning, response inhibition, and working memory (Asghari-Nekah et al., 2014). The results of another study showed that there was a significant difference between the experimental and control groups in some components of cognitive flexibility and selective attention (Mirzaei et al., 2024). In general, a review of previous research on the effect of therapeutic games on improving attention, visual-spatial memory, and executive cognitive functions shows that, except for a few limited studies, in most of the reviewed studies, play therapy, including computer games, physical activity games, and paper games, is particularly effective in improving symptoms of ADHD in children and can be used alongside first-line treatments as a complement or as an independent intervention for these children.

In the past few years, the problems of children's mental health have received a lot of attention, and important progress has been made, but there are still shortcomings and deficiencies. Global studies also indicate that play therapy has been able to improve children's attention and attention to an acceptable degree (Darvish et al., 2022). Therefore, studies in the field of different approaches to treating children's behavioral disorders are very important. In particular, research on rehabilitation through play to treat this disorder is very important, since it does not have the problems of drug use; and also because there is a lack of studies in this field in our country, and existing cognitive packages and games often require a play therapist or specialist, and this is due to the high cost and limited access of the target community to these specialists in improving children's cognitive and behavioral disorders. It was decided to design a new cognitive package in the form of a game and use it as an intervention for children with ADHD, and at the same time, the research gap will be partially filled. This game will emphasize cognitive elements to maintain attention and focus, and given the happy and childlike design as well as the competition to win, it can be an effective intervention to improve and strengthen children's attention, focus, and executive functions. Other advantages of this game include its ease, simplicity, affordability, and the absence of the need for a specialist or play therapist, so that parents, coaches, and teachers can also implement this intervention in the same way as a play therapist. Considering the presented material, the main question of the present study is whether the educational board game has validity and can it be effective on the symptoms of children with ADHD?

Method

Participants

The research method is a pilot study with pre-test, post-test, and one-month follow-up with a control group. The population of this study was all students with ADHD aged 7-9 years in Baharestan County, Tehran Province in 2023. Because the minimum number of subjects required for pilot studies is 20 (Delavar, 2001), the sample size in this study was 40 children with ADHD who were selected from Ammar Yaser and Hekmat elementary schools (two shifts) using purposeful sampling method (Saadipour, 2014). Then, the children were screened using the SNAP questionnaire, and those children who scored higher than the cutoff score on this scale were selected using a purposeful method and assigned to two groups of 20 (total of 40) to receive the

educational board games and control. By the end of the study, one person from the educational board game group and two from the control group dropped out, and the groups were 19 and 18 people, respectively, and the total number of subjects was 37.
Being 7 to 9 years old, receiving a diagnosis of ADHD, not having a physical or psychological illness, and verbal consent of the child and written consent of the child's parents were the criteria for entry into the study. On the other hand, missing more than 3 sessions, receiving other treatment for ADHD, not having the motivation to continue the study, and failure to complete and perform the research instruments were the criteria for exiting the study. In order to analyze the data extracted from the research, along with descriptive statistics components, repeated measures variance test and tests related to parametric assumptions were used in SPSS version 24 software.

Instrument

Rating scale (SNAP-IV):

In this study, the SNAP-IV rating scale was used to screen individuals by their teachers. This scale was first developed in 1980 by three authors named Swanson, Nolan, and Pelham based on the DSM and was known as SNAP by the initials of the test creators. Simultaneously with the revision of the DSM criteria and the compilation of DSM-IV, the aforementioned scale was also rewritten and published in 2001 (Swanson et al.., 2012). SNAP-IV includes 18 items for the ADHD category, which is divided into two sets of symptoms for the inattention and hyperactivity/impulsivity domains. For the inattention dimension, the average of 9 items related to inattention is calculated, and for the hyperactivity/impulsivity dimension, the average of 9 items related to hyperactivity/impulsivity is calculated, and the total score is obtained by calculating the average of 18 items. In Iran, the validity and reliability of the parent form of the SNAP-IV rating scale was also investigated on children aged 7 to 12 in Tehran. The findings of this study showed that the criterion validity of the test was 0.48 and the reliability coefficient was 0.90 by Cronbach's alpha method and 0.76 by the split-half method (Emami et al., 2015).

Diagnostic interview:

In addition to the SNAP-IV questionnaire, the educator and teacher version, an unstructured diagnostic interview will also be used to increase the accuracy and more precise examination of symptoms and ultimately diagnose children with ADHD.

Procedure

The process of designing and creating an educational board game was carried out in six stages as follows.

First stage: In order to design and create this game, various theories, sources, and research in the field of cognitive games and cognitive rehabilitation were studied and research related to this topic was reviewed.
Second stage: Depending on the findings of previous studies on the subject of cognitive-executive functions, more important functions such as working memory, attention, and selective response inhibition were selected from among executive functions.
Third stage: In this stage, with the help and guidance of several child experts, ideas were generated and content, questions, and images suitable for the game cards were produced. Initially, about 450 cards were prepared, which were divided into three sets of 150 cards corresponding to the three groups of 7-year-olds, 8-year-olds, and 9-year-olds.
Fourth stage: In this part, the content validity of the educational game was analyzed and reviewed with the help of psychiatrists and psychologists approved in this field. In line with this goal, the educational game was reviewed by several experts in the field of children and adolescents, and its possible problems in implementation were resolved, and their criticisms and suggestions were also taken into account. (In addition to content validity, the construct validity of the educational game, its impact on increasing attention and executive functions were also analyzed and examined).
Fifth Stage: In this stage, the method of playing the game was explained to the subjects. The board game is a game similar to Manch that is played by four players. The difference is that the movement of the pieces on the board is not based on the throwing of dice. Rather, each subject who can complete the task written on his card moves one space forward. The game cards are also presented randomly and are shuffled several times before the start of each game.
Sixth Stage: The final stage was the preliminary implementation of the game. Each game lasts approximately between 20 and 35 minutes depending on the skill and speed of the subjects. The purpose of this stage was only to modify the educational game and adapt it to the characteristics of the age group of children in question and to anticipate possible obstacles and problems. In this way, the educational game was played for 10 days (one time each day) on a group of children and its problems and shortcomings were solved. After fixing its problems and shortcomings, the final form of the game was prepared and ready for implementation. Finally, after the preliminary implementation and observing the feedback and the way the children cooperated and participated, as well as further review and consultation with experts, a number of cards were eliminated and in the end, 360 cards remained, which were converted into three sets of 120 cards appropriate for the three groups of 7-year-olds, 8-year-olds, and 9-year-olds.
The intervention programs used in this study are listed in Table 1.

Table 1. Educational board game sessions

Session Number	Session Description
1	In this session, familiarization and emotional relationship with the subjects were established, and daily life and identification of thoughts and feelings were discussed. Explanations were also given regarding the game, goals, and how to play. At the end of the session, the children were shown the game board and a few examples of cards.
2	In this session, first, in order to get to know the children better, an educational board game was played with each child individually for a few minutes.
3-15	Children played in groups of 4.

Results

Table 2 shows the mean and standard deviation of hyperactivity symptoms in children with ADHD, divided into the educational board game group, the control group, and all subjects. The repeated measures analysis of variance test was used to analyze the research hypotheses. To use this test, the assumptions of normality of the distribution of scores and homogeneity of variances must be examined. To examine normality, the Shapiro-Wilk test was used, and since this variable is not significant in all stages (P<0.05), it can be concluded that the distribution of scores in this variable is normal. On the other hand, the Levine test was used to examine the homogeneity of variances. The results of the Levine test showed that in all three stages, the significance level was above 0.05 and the assumption was met.

Table 2. mean and standard deviation of hyperactivity symptoms

Variable	Group	Stage					
		Pretest		Posttest		Follow-up	
		M	SD	M	SD	M	SD
Hyperactivity Symptoms	Educational Board Game	43.21	14.48	28.26	7.90	28.63	8.42
	Control	43.83	11.95	43.61	11.86	43.61	12.17
	Total	43.47	13.21	35.93	9.88	36.12	10.29

The results of the Mauchly's Sphericity Test for the hyperactivity symptoms variable are significant (p>0.001), which indicates that the covariances of the measurements of this variable are not the same in the three stages of assessment; therefore, to examine the within-group effect test of this variable, since the assumption of equal covariances was not valid, the Greenhouse-Geisser alternative test is reported, the results of which are shown in Table 3.

Table 3. Within-group effect test of repeated-measures analysis of variance for the variables in the study

variable	Test	source of variance	SS	Df	MS	F	Sig	Eta
Hyperactivity Symptoms	Greenhouse-Geisser	Time	1384.412	1.112	1245.173	58.942	0.001	0.627
		Time * group	1303.548	1.112	1172.441	55.499	0.001	0.613
		error	822.074	38.914	21.126			

The results of Table 3 show that the educational board game has a significant effect on the variable of hyperactivity symptoms. Now, in order to find out the exact time and extent of the difference, a test of comparison of means was performed, the results of which are presented in Table 4.

Table 4. Results of the Bonferroni post hoc test to examine the persistence of the intervention effect

variable	Steps	Adjusted Mean	Difference of Steps	Difference of Mean	Sig
Hyperactivity Symptoms	Pretest	43.47	Pretest - Posttest	7.585	0.001
	Posttest	35.93	Pretest - Follow-up	7.401	0.001
	Follow-up	36.12	Posttest - Follow-up	0.261	1

In order to investigate at what stage the interventions had an effect and compare them, the Bonferroni post hoc test was used, and the results of Table 4 showed that the difference in the mean scores of the hyperactivity symptoms variable in the pre-test stage with the post-test and follow-up stages was significant, indicating a significant effect of this intervention on the hyperactivity symptoms variable. On the other hand, the difference in the mean scores of the hyperactivity symptoms variable in the post-test stage with the follow-up stage was not significant, indicating the stabilization and durability of the effect of the research intervention.

Discussion

The aim of the present study was to design an educational board game and investigate its effectiveness on symptoms of ADHD disorder in children with ADHD. The F value calculated for the effect of the three measurement stages for the hyperactivity symptoms variable is significant, as a result, there is a significant difference between the mean scores of hyperactivity symptoms in the three stages of pre-test, post-test and follow-up. This means that the educational board game intervention was effective in the scores of hyperactivity symptoms. These findings align with previous research conducted by Bartosh et al. (2019),

Jephcott (2017), El-Nagger et al. (2016), Welch (2015), and Zeynali et al. (2019).

In explaining these findings, it can be said that appropriate activities such as board games can improve executive functions in children. Educational board games as intervention tools can play an effective role in improving symptoms of hyperactivity and attention deficit in children with ADHD. These games are designed to keep children engaged in learning activities and reinforce positive behaviors through motivational mechanisms. In particular, these games can help improve children's concentration and attention skills by creating challenges and providing rewards.

Studies have shown that the use of educational board games can reduce hyperactive behaviors and increase attentional abilities in children with ADHD. For example, research by Beattie et al. (2019) demonstrated that an educational board game program can improve executive function and reduce impulsive behaviors in children with ADHD. This study, using an experimental design, examined the positive effects of these types of games on a group of children and the results showed that after participating in these programs, children showed significant improvement in controlling their behaviors. From the perspective of teachers, educational board games can be used as a useful tool in the classroom. Teachers can use these games to strengthen social skills, problem-solving, and self-control in children. The results of a study conducted by Chacko et al. (2018) showed that educational board games not only help improve children's attention and concentration but can also help reduce children's stress and anxiety. Teachers in this study observed that children exhibited more positive behaviors and better social interactions after participating in these games.

Additionally, recent research has shown that educational board games can foster critical social skills such as teamwork, communication, and conflict resolution. These games create a structured environment in which children learn to cooperate and negotiate with peers, which is especially beneficial for individuals with ADHD who may struggle with social cues and interpersonal interactions. According to a systematic review by Zhao et al. (2021), participating in board games can lead to increased social competence, enabling children with ADHD to strengthen their relationships and participate more effectively in group activities.

Furthermore, implementing these educational board games in a therapeutic setting can provide an engaging platform for behavioral interventions. Play therapy has been shown to be particularly effective for children with ADHD, as it not only engages their interest but also directs their energy toward more constructive behavior. This integration is consistent with evidence that game-based learning can create a more inclusive and supportive learning environment, ultimately benefiting both students with ADHD and their typical peers by promoting collaboration and understanding in the classroom environment.

Conclusion

Overall, this study examined how to design and build, as well as the effectiveness of educational board games on the symptoms of hyperactivity in children with ADHD. The results of this study showed that educational board games are effective in reducing hyperactivity symptoms, and the reviewed studies indicated that various types of game therapy, including computer games, physical activity games, and paper games, are particularly effective in improving the symptoms of ADHD in children and can be used as a complement or as an independent intervention for these children alongside first-line treatments.

This study also had the following limitations:

By the end of the study, one participant from the educational board game group and two from the control group dropped out, leaving 19 and 18 participants respectively, with a total of 37 subjects. The study focused solely on male students; therefore, caution must be exercised when generalizing findings to females with ADHD. Difficulty in securing the participation of schools in referring students with ADHD posed a challenge. Due to the innovative nature of the board game intervention, the involvement of an assistant was not feasible. The target age group (7–9 years old) presented challenges in obtaining parental consent for their children's participation.

Based on these limitations, the following suggestions are made: Future studies should include female participants to explore gender-specific outcomes. Further investigations should examine additional ADHD-related variables using the board game intervention. Broader studies could incorporate other tests under conditions similar to this research. It is recommended to implement board game in child counseling centers, preschools, and primary schools to enhance children's attention.

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