



## Effectiveness of treatment based on parent-child interaction with virtual education method on the executive functions of students with hyperactivity and attention deficit disorder

Sahar. Bayat<sup>1</sup>, Mansoureh. Shahriari Ahmadi\*<sup>2</sup> & Mahnaz. Estaki<sup>3</sup>

1. Ph.D student, Department of Psychology, Central Tehran Branch, Islamic Azad University, Tehran, Iran.
2. \*Corresponding author: Assistant Professor, Department of Psychology, Central Tehran Branch, Islamic Azad University, Tehran, Iran.
3. Assistant Professor, Department of Psychology, Central Tehran Branch, Islamic Azad University, Tehran, Iran.

### ARTICLE INFORMATION

#### Article type

Original research

Pages: 97-108

Corresponding Author's Info

Email:

Mansureshahriari@yahoo.com

#### Article history:

Received: 2022/07/25

Revised: 2022/11/15

Accepted: 2022/11/24

Published online: 2023/06/10

#### Keywords:

parent-child interaction, virtual education, executive functions, hyperactivity and attention deficit.

### ABSTRACT

**Background and Aim:** People with attention deficit hyperactivity disorder are characterized by hyperactivity, impulsivity and inattention. The present study was conducted with the aim of the effectiveness of parent-child interaction therapy with virtual education method on the executive functions of students with hyperactivity and attention deficit disorder. **Methods:** The research method was quasi-experimental, with a pre-test and post-test design with a control group. The statistical population of the study was all children aged 10 to 12 years in the 19th district of Tehran in 2021 who were suffering from hyperactivity and attention deficit. The sample size of 30 people was determined by the purposeful sampling method, this number of people was divided into two groups by the matching method, the number of each group was 15 people, and an experimental group received treatment based on parent-child interaction through virtual training. And the control group did not receive any treatment program. The research tool was the executive functions questionnaire of Gerard et al. (2000). The method of data analysis was univariate and multivariate covariance analysis and Spss.22 software. **Results:** The findings of the research showed that the treatment based on parent-child interaction with the virtual education method is effective on the executive functions of students with hyperactivity and attention deficit ( $p < 0.05$ ). **Conclusion:** It can be concluded that the treatment based on parent-child interaction with the virtual education method can be effective in improving the executive functions of students with hyperactivity and attention deficit disorder.



This work is published under CC BY-NC 4.0 licence.

© 2023 The Authors.

#### How to Cite This Article:

Sahar, B., Shahriari Ahmadi, M., & Estaki, M. (2023). Effectiveness of treatment based on parent-child interaction with virtual education method on the executive functions of students with hyperactivity and attention deficit disorder. *jayps*, 4(3): 97-108.

## Introduction

People with attention deficit hyperactivity disorder are characterized by hyperactivity, impulsivity and inattention. Considerable research has been done in the field of cognitive defects of this disorder. Among the areas that have been paid attention to in these studies is the defect in executive functions (Setin et al., 2022). Executive function is a high cognitive and metacognitive function that includes a set of high abilities, inhibition, self-initiation, strategic planning, cognitive flexibility and impulse control (Alizadeh, 2016). Functions such as organization, decision-making, active memory, retention and transformation, movement control, feeling and perception of time, predicting the future, reconstruction, inner language and problem solving can be considered among the most important neurological executive functions. They help people in life and doing learning tasks and intellectual actions (Boris et al., 2019).

Barkley (1997) in his theory about attention deficit hyperactivity disorder pointed to a deficit in inhibitory control as the main core of the breakdown of processing processes in executive function tasks. Neurocognitive executive functions are important structures that are related to psychological processes responsible for controlling consciousness and thinking in action. Although executive functions have been primarily studied from a neurological perspective, their development and pathology have been the subject of interest for many experts in recent years (Ghamari Givi et al., 2019). Songa Barak (2013) in his model to explain the cognitive failure of children suffering from attention deficit hyperactivity disorder proposes the dual path model. The first path is executive dysfunction and is related to a deficit in response inhibition, and the second path is motivational dysfunction, which is related to a weak reward process in these children. According to Soto et al.'s (2020) research, the most stable and strongest deficit of executive function in patients with attention deficit hyperactivity disorder is response inhibition, working memory, planning, and alertness. Based on the results of the above research, the scores obtained by the test group in active memory and visual attention and Tower of London test were lower than expected. On the other hand, when the intelligence component was controlled, no significant relationship was found between the reports and assessments of teachers

and parents about the symptoms of attention deficit hyperactivity disorder and inability to perform executive function tasks. At the same time, children with learning disabilities also suffer from impaired executive functions (Wafa et al., 2020). Various studies on the relationship between executive functions and children's skills show that executive functions are a good predictor of performance (Davidson & Amso, 2012). From the point of view of neuropsychology, executive functions are among the actions that patients with frontal lobe injuries are not able to perform well. It has been found in various studies that people with attention deficit-hyperactivity disorder have defects in most abilities related to executive functions (Tehrani Dost & Radgudarzi, 2013). In general, attention deficit/hyperactivity disorder is a harmful behavioral pattern that is often associated with learning problems, either as the main cause of the problem or as a side problem, hyperactivity. Some students with learning problems show a high level of physical activity in an extreme manner. Currently, it is believed that about 3-5% of school children have symptoms of this disorder (Ghani Lou Sharifi, 2016). Studies have shown that the academic performance of children with attention deficit hyperactivity disorder is generally lower than normal children. Researchers have observed the prevalence of academic and learning disabilities in the group of children with attention deficit hyperactivity disorder (ADHD) almost to those who are at the age before the clinical diagnosis of attention deficit hyperactivity disorder (ADHD) (Robinson and Tripp, 2017). In the study of Costa and his colleagues (2014), it has been shown that among the problems of 6-14-year-old children with hyperactivity and attention deficit, the inattention dimension had a greater impact on academic performance than other problems. However, in none of the previous studies, the relationship between cognitive functions according to the cognitive theory of Pass (1994) and the academic performance of children with attention deficit hyperactivity disorder has not been studied in detail. Mainly in the studies, the relationship between some cognitive functions such as attention deficit, response inhibition, working memory and set change with academic performance is considered (Andrevis, 2021). One of the problems that families of children with attention deficit hyperactivity disorder face

is how to communicate and control these children. This causes many problems and challenges for parents in most families, and these challenges in the field of interaction with children are considered as an important source of family stress (Zoghi Padayar & Yaqoubi, 2015). When the parents of normal children endure a lot of stress and psychological pressure against the demands and needs of their children, surely the parents of children with attention deficit hyperactivity disorder are facing far more parenting challenges. These families are forced to use more interventions related to children's behaviors at home and school (Fawn, 2021).

In the past, therapeutic approaches to children were mainly child-centred (e.g., play therapy, individualized approaches), but recently there has been a great trend toward treating children's behavioural problems through parental involvement. (Orguetza & Timmer, 2012). Recently, treatments have been developed for children with behavioural problems that have both immediate changes and long-term treatment goals (Iger & Engold, 2016). One of the factors that led to the development of these treatments is the persistent nature of these disorders, and Lambert et al. (2010) found that early destructive behaviours remain stable during developmental stages, which is a powerful predictor of later delinquency and criminal behaviours. These two factors necessitate the need for useful and durable treatments. Parent-child interaction therapy was developed by Eiberg (1970). This treatment is conceptually drawn from Bamrid's longitudinal research on authoritative parenting style and approaches such as behaviour therapy, play therapy, social learning theory and attachment theory. It teaches parents to interact with their children warmly, attentively and computer-responsively. This treatment is designed for serious behavioural problems in children aged 2 to 7 years (Chaffin et al., 2014). This method shows that negative parent-child interaction patterns may significantly affect children's harmful behaviours. Therapists guide parents while interacting with their children during treatment and teach parents strategies to strengthen their child's positive behaviours (Akbarzadeh & Hassanzadeh, 2020). Therapy based on parent-child interaction can be implemented in different ways. Most researchers have reported significant relationships between the communication style of parents and children and the cognitive, emotional, and academic

development levels of children, and it has been found that intervention programs are very effective in improving the interaction style of parent-child relationships (Hosogan, 2018). According to these interpretations, education and wide dissemination of studies based on parent-child interaction programs can be useful for many families. One method is a non-attendance or virtual program in which the family can play the role of the therapist and use all the tools used (virtual and online) in this approach to better advance the treatment process (DuPaul et al., 2018). Therefore, it can be acknowledged that the innovation of this program creates a creative application and promises to be made available to everyone so that everyone can make the most of its benefits (Minnen et al., 2022).

The results of Al-Sahi et al.'s research (2021) showed that by using parent-child interactive therapy in children with attention problems, hyperactivity and impulsivity, the number of behavioural problems in children could be reduced. Also, Mikami and Lerner's research results (2015) showed that child-parent communication training in an absent manner could reduce the symptoms of attention-deficit/hyperactivity disorder in children and increase parental self-efficacy in the parents of these children. The research results of Rahmati Qajari et al. (2022) showed that the treatment based on parent-child interaction is effective on the adaptation and emotional regulation skills of children with oppositional defiant disorder. The results of Ghasemi et al.'s research (2020) showed that the treatment based on the child's parent's interaction reduces the symptoms of children's separation anxiety disorder and the anxiety and overprotectiveness of their mothers. The research results of Akbarzadeh and Hassanzadeh (2020) showed that the in-person-virtual program of parent-child interaction therapy based on the Ayberg approach was significantly effective in the components of dependence, conflict, closeness and relationship between parent and child. Many training methods, including virtual training and face-to-face parent-child interaction program, are focused on training and dissemination on time and, as observed, do not lead to the same effects in society (Shirzadi et al., 2020). However, in the present study, the virtual training method was chosen for treatment based on parent-child interaction, which can effectively improve executive functions. The reason for choosing

children with attention deficit hyperactivity disorder in this age group was because children in late childhood and early adolescence are very vulnerable to the family environment and parental neglect. Elementary age is the right time to diagnose children's problems and timely intervention to reduce and prevent their emotional, behavioural, academic, personality and social problems. On the other hand, the prevalence rate of problems of cognitive and metacognitive functions and its harmful effects are high, and children and students with attention deficit hyperactivity disorder are important for the society. The research conducted in Iran in the field of improving the performance of children with special needs is very limited. Moreover, so far, the effectiveness of these treatment programs on executive functions in the statistical population of children with hyperactivity and attention deficit has not been investigated, especially after the corona epidemic, which changed the educational methods in the world. The information obtained from conducting such research can provide students with self-evaluation and a better understanding of their personal and social situation, and a better understanding of their individual and academic capabilities, and provide the opportunity to implement therapeutic methods in the individual-social behaviours of children; Therefore, according to the above-mentioned materials, the present study was conducted to investigate the effectiveness of treatment based on parent-child interaction with the virtual education method on the executive functions of students with hyperactivity and attention deficit disorder.

### Method

The research method was quasi-experimental, with a pre-test and post-test design with a control group. The statistical population of the study was all children aged 10 to 12 years in the 19th district of Tehran in 2021 who were suffering from hyperactivity and attention deficit. The sample size of 30 people was determined by the purposeful sampling method, this number of people was divided into two groups by matching method, and the number of each group was determined to be 15 people. The experimental group received treatment based on parent-child interaction through offline and online training, and the control group did not receive any treatment program. The criteria for entering this research for the sample groups were: Being at least 10-12 years old, not

suffering from learning disorders and mental retardation. Also, the exclusion criteria were that if the experimental groups were absent from one session during the implementation of the research, they were eligible to withdraw from the research. Finally, after scoring the questionnaire, the data was entered into SPSS 25 statistical software and the research objectives were evaluated using the multivariate covariance analysis method.

### Materials

**1. Gerrard et al.'s Executive Functions Questionnaire (2010):** This questionnaire was created by Gerard et al. in 2010. This questionnaire has 86 questions. In which, according to the conditions of occurrence of the situation for the child, it is scored as "never" and "sometimes" and "always" respectively from 1 to 3 by the parents. It examines the child's behavior at school or at home and is designed to interpret the executive performance of children aged 5 to 18 (Guy et al., 2000). The dimensions of this questionnaire are: inhibition, attention transfer, emotional regulation, active memory, planning, control, initiation and organization. The completion time of this form is between 10 and 15 minutes. This questionnaire is scored with a Likert scale. Each of the questions is related to one of the subsets of the questionnaire, and these subsets are divided into two main parts: behavior regulation skills and metacognitive skills, which are as follows: a) Behavior regulation skills: inhibition, transmission, emotion control, b) Metacognitive skills: planning, organizing materials, monitoring, working memory, initiation. In the present study, the parent form was used. This test has high internal consistency ranging from 80 to 98 Cronbach's alphas in 1951 for both parent and teacher forms. The evaluation of the internal consistency of the parent form of this questionnaire is 0.82 to 0.98 and the test-retest reliability of this form is reported as 0.72 to 0.84. The validity of each of the subscales in the parent form: control (0.76); organization (0.79); planning (0.85); active memory (0.85); initiation (0.80); emotional control (0.79); attention transfer (0.79); Inhibition (0.84) (Nodei et al., 2016). Cronbach's alpha coefficient was used by Majidi in 2011 to check the internal consistency of the Persian version of the Executive Functions Questionnaire. Cronbach's alpha coefficient was determined as 0.86 for the entire test. Cronbach's alpha coefficient was obtained by Guy in 2011 for this questionnaire as 0.88, which is the optimal value and the BRIEF questionnaire has good validity and reliability.

**2. Parent-child interaction therapy:** Parent-child interaction therapy was provided in 14 weekly one-hour sessions to guide parent-child interaction.

Table 1. Eyeberg (2005) parent-child interaction therapy protocol

Session	Content
1	Initial assessment and determination of treatment direction was established in the form of interviews. The input elements in the plan were checked during the game.
2	In this meeting, the parents were told that the most basic rule of child-supervisor interaction is to allow the child to direct the activity, and considering that one of the important principles of this stage is the parents following the child, the parents were asked to refrain from asking questions, giving orders, and criticizing. and refrain from blaming.
3	Strengthening the therapeutic relationship is one of the goals of this session and is dedicated to guiding child-centered skills in the form of games.
4	Strengthening the therapeutic relationship and providing support are the goals of this meeting. At the end of the work, more emphasis is placed on the parents' strengths and they are asked to try harder to reduce the number of questions and increase the feedback in homework.
5	This session was conducted with the aim of strengthening the therapeutic relationship and increasing the independence of children and is dedicated to guiding child-centered skills in the form of games appropriate to the developmental level.
6	In this meeting, it was emphasized the importance of talking about emotions and strategies for regulating them by parents, as well as the role of parents in leading children's emotions. These strategies were clearly and directly taught to children and their use was strengthened.
7	Teaching the nature of anxiety for parents. Parents were taught that they should encourage their children to face their fears and support them during the confrontation and reward their success; Emphasis was also placed on using (avoidance) and (doing) skills in anxiety-provoking situations.
8	In this session, the importance of confrontation was explained to the child in age-appropriate language. Children were encouraged to cooperate in building the ladder of courage and assigning rewards for practicing the ladder of courage; Also, child-centered interaction skills were used by parents during Steps of Courage.
9	Parents were taught a set of social skills appropriate to the level of development that the child cannot do continuously; Such as greeting others, joining a group, using brave words, being a good host or guest, and creating social opportunities and practice in the real world.
10	The purpose of this session is to strengthen skills including the ability to express needs and defend personal rights in front of other people and support and defend oneself in a way that leads to positive results and practice in the real world.
11	Teaching how to give orders to the child was done to deal with the child's disobedience to the orders and emphasis on not using parent-centered interaction during anxiety-provoking situations.
12	Teaching how to give orders to the child and expressing skills to deal with the child's disobedience to the orders, such as the deprivation method and continuing to face the hierarchy of anxiety-provoking situations in the child, were done.

13	The importance of applying and generalizing the mentioned skills in all situations of daily life and removing possible weaknesses in the field of learned skills was expressed.
14	In this meeting, the repetition of the acceptance criteria and the evaluation of the criteria for the completion of the training were carried out along with the introduction of other behavior management techniques. Planning for a support session that was held three months after the end of the treatment.

### Implementation

After obtaining permission from the university and coordination with counseling centers and psychological services and identifying qualified people and obtaining the consent of the children's parents, the subjects were divided into two research groups in terms of demographic characteristics and the level of attention deficit hyperactivity disorder. In the pre-test stage, the executive functions questionnaire of Gerard et al. (2010) was completed by the students. Then, the parent-child interaction therapy intervention program was implemented in a non-attendance manner. In this way, the parents were asked in the virtual space where the educational programs are pre-recorded and the necessary videos and files are saved in the relevant channel and it is possible for the parents to access it through the Internet. Educational sessions were conducted online and parents' points and doubts were resolved through voice and video calls. In the parent-child interaction treatment program, two categories of skills were considered for treatment. In the child-centered

interaction phase, parents received the use of usual play therapy skills in order to improve the parent-child relationship by the therapist in the form of group and individual training. All the intervention programs of this stage are in the form of non-attendance meetings that include the use of information brochures, audio and video files, podcasts, telephone counseling and messengers. In the parent-centered interaction phase, parents were taught the necessary skills to increase obedience and reduce child disruptive behaviors. Among the skills of this stage are giving orders, praising, being obedient, using exclusion techniques for disobedience, and establishing house rules. All these skills were done through visual, written, listening and speaking tools mentioned above.

### Results

The mean (standard deviation) age of the participants in the experimental group was 11.2 (1.1) and the control group was 11.7 (1.5). The minimum and maximum ages of both experimental and control groups were 10 and 12 years.

**Table 2. Mean and standard deviation of executive function variable and its sub-components in two groups**

Group	Variable	Stage	Mean	SD	N
Exp.	Inhibition	Pre-test	27.27	1.624	15
		Post-test	28.67	2.380	15
	Attention transfer	Pre-test	26.20	1.612	15
		Post-test	27.27	2.604	15
	Emotion Regulation	Pre-test	35.00	1.648	15
		Post-test	35.60	2.197	15
	active memory	Pre-test	25.93	1.280	15
		Post-test	26.47	2.503	15
	Planning	Pre-test	26.13	1.885	15
		Post-test	27.87	1.807	15
	Control	Pre-test	22.93	1.751	15
		Post-test	24.27	2.052	15
	initiation	Pre-test	12.13	1.767	15
		Post-test	13.00	1.732	15
organize	Pre-test	16.93	1.751	15	
	Post-test	18.20	1.935	15	

	Executive function	Pre-test	191.33	5.525	15
		Post-test	201.27	8.242	15
<b>Control</b>	Inhibition	Pre-test	26.67	1.799	15
		Post-test	26.73	1.907	15
	Attention transfer	Pre-test	25.73	1.534	15
		Post-test	26.20	1.521	15
	Emotion Regulation	Pre-test	35.13	2.066	15
		Post-test	35.73	1.981	15
	active memory	Pre-test	26.00	1.890	15
		Post-test	23.87	2.295	15
	Planning	Pre-test	25.80	1.740	15
		Post-test	26.33	1.543	15
	Control	Pre-test	22.73	2.154	15
		Post-test	22.60	1.844	15
	initiation	Pre-test	12.40	1.765	15
		Post-test	12.60	1.844	15
	organize	Pre-test	17.47	1.767	15
		Post-test	17.60	1.844	15
	Executive function	Pre-test	191.93	5.637	15
		Post-test	191.67	4.593	15

As can be seen in Table 2, the mean scores of the executive functions and its sub-components in the control group in the post-test stage compared to the pre-test did not show much difference in the average scores, but in the virtual training group, a small difference was observed in the post-test stage compared to the pre-test. Considering that the value of Shapiro and Kolmogrof-Smirnov test in the scores of executive functions and its sub-components in three groups is between +1.96 and -1.96 and the

statistic was not significant. Therefore, with a confidence factor of 95%, we can accept the assumption of normal distribution of the statistical population. It should be noted that one of the assumptions of using the analysis of variance statistical test is the assumption of homogeneity of variances. Levene’s test is used to check this assumption. If this test is not statistically significant, the assumption of homogeneity of variances has been fulfilled.

**Table 3. The results of Levene’s test, the assumption of homogeneity of variable variance of executive functions and its sub-components**

Variable	Levene	Df1	Df2	Sig
<b>Inhibition</b>	0.761	2	28	0.473
<b>Attention transfer</b>	0.041	2	28	0.960
<b>Emotion Regulation</b>	0.553	2	28	0.580
<b>active memory</b>	0.770	2	28	0.469
<b>planning</b>	0.280	2	28	0.757
<b>Control</b>	3.016	2	28	0.060
<b>initiation</b>	0.478	2	28	0.623
<b>organize</b>	0.980	2	28	0.384
<b>Executive function</b>	1.684	2	28	0.198

According to the findings of Table 3 and according to the amount of F obtained from Levene's test, no significant difference is observed at the level of  $\alpha=0.05$ , so the null hypothesis, that is, the assumption of homogeneity of variances, is accepted. In

addition, the F value of independent variable and covariance is 1.405, which is not significant. ( $P>0.05$ ) Therefore, it can be concluded that the assumption of homogeneity of the regression slope has been met.

**Table 4. The main output of the covariance analysis and the effect of the intervention program on the executive function in the groups**

Source	SS	df	MS	F	sig	Effect size
Pre-test	104.099	1	104.099	2.461	0.128	0.084
Group	719.144	1	719.144	17.000	0.000	0.386
Error	1142.168	27	42.303			

According to Table 4, it can be seen that the F value of the table (17.00) is significant according to the observed significance level of 0.001 because its error probability is smaller than the significance level of 0.01. There is a significant difference between the averages of the two

groups after removing the covariate effects. Therefore, the treatment based on parent-child interaction with the virtual education method is effective on the executive functions of students with hyperactivity and attention deficit with an effect rate of 38%, which is relatively acceptable.

**Table 5. The results of Wilks's lambda test of sub-component scores of executive functions in the group**

Test	Value	F	Sig	Eta square
Pillai's trace	0.564	2.099	0.113	0.564
Wilks' Lambda	0.436	2.099	0.113	0.564
Hotteling's trace	1.292	2.099	0.113	0.564
Roy's largest root	1.292	2.099	0.113	0.564

As can be seen in Table 5, the effect of the group on the composition of the studied components is significant. Based on this, the eta square shows that the difference between the two groups is significant with respect to the components of the

dependent variable. The amount of this difference is 0.43 for inhibition, attention transfer, emotional regulation, planning, control, initiation and organization as a group composition, based on the Wilkes' lambda test.

**Table 6. The results of the covariance analysis of the post-test scores of the control and experimental groups in the components of executive functions.**

Source	Dependent variable	SS	df	MS	F	Sig	Effect size
Group	Inhibition	7.610	1	7.610	4.600	0.044	0.187
	Attention transfer	3.140	1	3.140	2.662	0.118	0.117
	Emotion Regulation	.308	1	0.308	.248	0.624	0.012
	Active memory	19.668	1	19.668	4.904	0.039	0.197
	Planning	11.998	1	11.998	12.134	0.002	0.378
	Control	16.552	1	16.552	8.095	0.010	0.288
	Initiation	2.881	1	2.881	3.525	0.075	0.150
	Organize	5.686	1	5.686	5.132	0.035	0.204
Error	Inhibition	33.086	20	1.654			



Attention transfer	23.589	20	1.179
Emotion Regulation	24.848	20	1.242
Active memory planning	80.206	20	4.010
Control	19.775	20	0.989
Initiation	40.893	20	2.045
Organize	16.347	20	0.817
	22.161	20	1.108

According to the results of Table 6, there is a significant difference between the experimental group and the control group in inhibition, active memory, planning, control, initiation and organization at the confidence level of 0.05. However, no significant difference was observed in the components of attention transfer and emotional regulation.

Attachment style (avoidant, ambivalent or anxious, secure), media literacy, locus of control and Internet addiction, R2 index shows the amount of explained variance of endogenous latent variables. The coefficient of determination of attachment style variable (avoidant, ambivalent or anxious, secure) is 0.56. It shows that all independent and mediating variables, i.e. attachment style (avoidant, ambivalent or anxious, secure), can predict 56% of the changes in nomophobia symptoms, which is a strong amount. It can be seen that the coefficient of determination of media literacy variable is 36% and the variable of control source is 42%, on average, the coefficient of determination of Internet addiction variable is 46% on average. According to the estimated indicators, it is suitable to develop a model of symptoms of nomophobia in students based on attachment style, media literacy and locus of control with the mediation of Internet addiction.

### Conclusion

The present study was conducted with the aim of the effectiveness of parent-child interaction therapy with virtual education method on the executive functions of students with hyperactivity and attention deficit disorder. The findings of the present study showed that there is a significant difference between the experimental and control groups in the post-test stage in executive functions. Thus, it can be said that the treatment based on parent-child interaction with the virtual education method is effective on the executive functions of students with

hyperactivity and attention deficit. This finding is in line with the research results of Rahmati Qajari et al. (2021), Ghasemi et al. (2020), Akbarizadeh and Hassanzadeh (2020), Al-Sehi et al. (2021) and Mikami and Lerner (2015). In the explanation, it can be said that having a child with hyperactivity and attention deficit creates special problems for parents. It reduces their abilities; It limits their parental role. It causes anxiety, feelings of inadequacy in education and weak parent-child emotional attachment. It increases stress and dissatisfaction and disrupts family relationships. Therapy based on virtual parent-child interaction has the ability to strengthen the level of executive functions in children with attention deficit and hyperactivity disorder. Moreover, due to the reduction of psychological pressures and proper interaction between parents and children, it provides a peaceful family atmosphere, which directly affects the behavior of parents. In addition, it increases their acceptance and empathy and reduces their interpersonal problems. In this way, parents can play their role effectively and the abilities of the family can be improved in all fields. The treatment protocol based on virtual parent-child interaction emphasizes the influence of parents on their children in a completely virtual environment without the presence of unrelated persons. It addresses parents' concerns about their children, their behavior with children with ADHD, and the child's behavior with them, and provides enough information to improve parents' understanding of their children. A treatment program based on parent-child interaction includes a clear framework for guiding the process of cultural adjustment. The purpose of this educational program is to encourage parents to actively participate in an intervention that improves executive functions; Correct methods of communicating and correct understanding of children's problems and needs

expand, regulate emotions and develop emotional status (Akbarizadeh & Hassanzadeh, 2020). Parents, as the closest people to their children, have the greatest contribution to their children's education and learning. Therefore, the correct behavior of parents improves the relationship of parents, helps them to better understand their children's needs and actively and effectively reduces their and their children's problems. To our knowledge, this is the first case report of a child with attention deficit hyperactivity disorder associated with neurobehavioral symptoms and externalizing problems, for whom parent-child interaction therapy with virtual learning method was an effective treatment. There are several case studies of children with medical conditions in which externalizing behavior problems improved with standardized, personalized parent-child interaction therapy. Due to the epidemic of COVID-19, treatment based on parent-child interaction with the virtual education method has received more attention, and this method has been tried to be used to provide behavioral training for individual and group caregivers and to treat destructive behaviors and related disorders in children during the Corona period. Parent-child interaction therapy with virtual training teaches parents to pay attention to their children and interact with them to improve their relationships (Mikami & Lerner, 2015). In this therapy, parents gain skills to build safe relationships that help children develop. Parents learn to become closer to their children, use better communication methods that are more compatible with their children's needs, pay more attention to their children's adjusted behaviors and pay less attention to their maladaptive behaviors. Moreover, children learn to respond better to these interactions. The aim of this treatment is to improve the quality of the parent-child relationship by reducing parental stress, improving communication skills, shaping the parents' view of children's maladaptive behaviors, and increasing attention and intimacy in parent-child interaction, thereby improving the management of children. Based on recent developments in cognitive psychology, various theoretical models of executive functions have been presented. There are two main models: a simple model, which claims that executive functions are simple functions, and a complex

model, where executive functions are divided into multiple elements. According to the latter model, based on the results of a series of cognitive tasks, Dacourt et al. (2018) reported that the three critical components of executive functions are "inhibition", "attention shifting" and "updating (working memory)".

Piaget (1954) describes that inflexibility occurs in young children when: At the age of eight to ten months, the child can successfully remember the object in the location (a); Then, when they hide it secretly in place (B), the child, even though he saw it in place B, still searches in the same place A. Piaget considers this error to be caused by insufficient development in the understanding of the concept of the object. However, a novel interpretation of this error is that children have difficulty in mentally representing the location of the object to ignore the frequent response. By using exercises based on parent-child interaction, the focus is on eliminating the defects in the child's mental representation. Exercises allow the parent to give the child the strength and ability to overcome this violation through practice and repetition by being present and interacting. Among the limitations of the present study was the lack of prevention course and self-reporting as a research tool, because there was a possibility of individual biases in answering the questions with people's wrong perceptions of them. It is suggested to consider variables such as children's IQ as a control variable and try to choose children who are at the same level in terms of intelligence. It is suggested to the therapists to use play therapy, doll therapy, and storytelling during the implementation of the treatment program. Finally, it is suggested that the therapists tell the correct methods to the mothers in a complete and accurate way so that they can follow the training course at home and not just focus on the time of attending the treatment clinics.

#### Conflict of Interest

According to the authors, this article has no financial sponsor or conflict of interest.

#### References

- Akbarzadeh, A., & Hassanzadeh, S. (2020). The effectiveness of the combined training of face-to-face-virtual parent-child interaction therapy based on the Ayberg approach on the relationship between mother and child with behavioral disorders, *Applied Psychological Research Quarterly*, 11(1), 1-14.
- Al Sehli, S., Helou, M., Sultan, M. (2021). The Efficacy of Parent-Child Interaction Therapy

- (PCIT) in Children with Attention Problems, Hyperactivity, and Impulsivity in Dubai. *Case Rep Psychiatry*. 4:5588612.
- Alizadeh, H. (2016). The relationship between neuro-cognitive executive functions and developmental disorders. *Cognitive science updates*. 8 (4): 57-70.
- Andrews, K., Dunn, J., Prime, H., Duku, E., Atkinson, L., Tiwari, A., Gonzalez, A. (2021). Effects of household chaos and parental responsiveness on child executive functions: a novel, multi-method approach. *BMC Psychol*. 22;9(1):147.
- Boris, C., Bernhardt, F., Min, L., et al. (2019). Frontal Lobe Functions in Children with Newly Diagnosed Temporal Lobe Epilepsy: Functional Magnetic Resonance Imaging (P3.287). *American Academy of Neurology*, 13(5): 90-74.
- Çetin, F. H., Uçaryılmaz, H., Uçar, H. N., Artaç, H., Güler, H. A., Duran, S. A., Kılınç, K., & Türkoğlu, S. (2022). Regulatory T cells in children with attention deficit hyperactivity disorder: A case-control study. *Journal of neuroimmunology*, 367, 577848.
- Costa, D., Paula, J. J., Alvim-Soares Júnior, A. M., Diniz, B. S., Romano-Silva, M. A., Malloy-Diniz, L. F., & Miranda, D. M. (2014). ADHD inattentive symptoms mediate the relationship between intelligence and academic performance in children aged 6-14. *Revista brasileira de psiquiatria (Sao Paulo, Brazil: 1999)*, 36(4), 313–321.
- Daucourt, M., Schatschneider, C., Connor, CM., Al Otaiba, S., Hart, S. (2018) Inhibition, Updating Working Memory, and Shifting Predict Reading Disability Symptoms in a Hybrid Model: Project KIDS. *Front. Psychol*. 9:238.
- Davidson, M., Amso, D. (2012). Development of cognitive control and executive functioning from 4 to 13 years: Evidence from manipulations of memory, inhibition and task switching. *Neuropsychologia*, 44(11): 2037-78.
- DuPaul, G. J., Kern, L., Belk, G., Custer, B., Daffner, M., Hatfield, A., & Peek, D. (2018). Face-to-Face Versus Online Behavioral Parent Training for Young Children at Risk for ADHD: Treatment Engagement and Outcomes. *Journal of clinical child and adolescent psychology: the official journal for the Society of Clinical Child and Adolescent Psychology*, American Psychological Association, Division 53, 47(sup1), S369–S383.
- Egger, H., Angold, A. (2016). Common emotional and behavioral disorder in preschool children. *Child Psychol Psychiatry*. 47: 313-337.
- Fawns, T. (2021). Attention Deficit and Hyperactivity Disorder. *Primary care*, 48(3), 475–491.
- Gerard, A., Gioia, D., Peter, K., Isquith, B., Kenworthy, L., Richard, M. (2010). Barton: Profile of Everyday Executive Function in Acquired and Developmental Disorder: *Journal of Child Neuropsychology*: 2010. <http://dx.doi.org/10.1076/chin.8.2.121.8727>
- Ghamari Givi, H. (2019). Comparison of executive functions in children with attention deficit hyperactivity disorder, learning disability and normal children. *Journal of Principles of Mental Health*. 11(44), 322-33.
- Ghanilu, M. R., Sharifi, M., Karami, H. (2016). Investigating the impact of attention deficit disorder (hyperactivity) on students' academic performance, the first international conference on management, accounting, educational sciences and resistance economics; Action and action, Sari.
- Ghasemi, E., Amiri, M., Elahi, T. (2020). The effectiveness of treatment based on parent-child interaction on overprotectiveness, anxiety symptoms of mothers and reduction of separation anxiety symptoms in their children. *Quarterly journal of research in psychological health*. 14 (3): 18-37
- Hosogane, N., Kodaira, M., Kihara, N. et al. (2018). Parent–Child Interaction Therapy (PCIT) for young children with Attention-Deficit Hyperactivity Disorder (ADHD) in Japan. *Ann Gen Psychiatry* 17, (9), 101-125.
- Lambert, E., Wahler, R., Andrade, A., Bickman, L. (2010). Looking for the disorder in conduct disorder. *J Abnorm Psychol*. 110: 110–123.
- Meynen, M., Colonnese, C., Abrahamse, M., Hein, I., Stams, G., Lindauer, R. (2022). A Cohort Study on the Effect of Parental Mind-Mindedness in Parent-Child Interaction Therapy. *Int J Environ Res Public Health*. 9;19(8):4533.
- Mikami, A., Lerner, M. (2015). Parental Influence on Children with Attention-Deficit/Hyperactivity Disorder: II. Results of a Pilot Intervention Training Parents as Friendship Coaches for Children, *J Abnorm Child Psychol*. 38(6): 737–749.
- Nodehee, Kh., Sarami, Gh., & Keramati, H. (2016). The relationship between executive functions and working memory capacity with students' reading performance: the role of age, gender

- and intelligence. *Cognitive Psychology Quarterly*, 4 (3), 11-20
- Rahmati Ghajari, F., Fakhri, M. K., & Mirzaian, B. (2022). The effectiveness of parent-child interaction therapy (PCIT) on adaptation skills and emotional regulation of children with oppositional defiant disorder. *Razi Journal of Medical Sciences*, 4(29), 0-0
- Robinson, T., Tripp, G. (2017). Neuropsychological functioning in children with ADHD: Symptom persistence is linked to poorer performance on measures of executive and nonexecutive function. *Japanese Psychological Research*, 55(2): 154- 67.
- Shirzadi, P., Amini Shirazi, N., & Asgharpour Leshkani, Z. (2020). The relationship between Corona anxiety in mothers and parent-child interaction and children's aggression during quarantine. *Family research*, 16(2), 139-154.
- Sonuga Bark, E. (2013). The dual pathway model of ADHD. *Neurosci Biobehav Rev*; 27: 593-604.
- Soto, E. F., Kofler, M. J., Singh, L. J., Wells, E. L., Irwin, L. N., Groves, N. B., & Miller, C. E. (2020). Executive functioning rating scales: Ecologically valid or construct invalid?. *Neuropsychology*, 34(6), 605–619.
- Tehrani Dost, M., & Radgudarzi, R. (2013). Deficits of executive functions in children with attention deficit hyperactivity disorder, *Cognitive Science News*, 5(11), 58-50.
- Urquiza, A., Timmer, S. (2012). Parent-child interaction therapy: Enhancing parent child relationships. *Psychosoc Interv*. 2012; 21(2):145-156.
- Wafa, D., Hamzam S. (2020). A comparative study of executive functions among children with attention deficit and hyperactivity disorder and those with learning disabilities, *Middle East Current Psychiatry*, 27(10): 102-125.
- Zoghi Paydar, M., Yaghoubi, A., & Nabizadeh, S. (2015). Prediction of academic performance of students with attention deficit hyperactivity disorder based on stress and parents' behavior, *Psychology Quarterly of Exceptional People*, 5(19): 140-155.