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ORIGINAL RESEARCH

Associations between Computer Game Addiction and Attention Deficit and Hyperactivity Disorder - An Emprical Study

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Main Points

- Children with ADHD have a significantly higher computer game addiction than healthy children.
- It has been found that computer game addiction levels are higher for children who play action, shooter and racing games than those who do not.
- It has also been found that playing online games has a significant impact on the level of computer game addiction.
- ADHD is a risk factor for computer game addiction.

Abstract

The aim of this study is to compare the video game addiction levels and habit of playing computer games between children with attention deficit hyperactivity disorder (ADHD) and healthy children. The study group consisted of 100 children aged between 10 and 13 years who were diagnosed with ADHD and who applied to the psychiatry clinic in the province of Istanbul. The control group consisted of 100 healthy children between the ages of 10 and 13 years with no psychiatric diagnoses and were matched with the study group in terms of sociodemographic characteristics. The Personal Information Questionnaire and the Computer Game Addiction Scale for Children (CGASC) were applied to the participants. Children with ADHD had significantly higher levels of video game addiction than healthy children. Video game addiction levels were found to be higher in children who play action, shooter, and racing games than those who did not play them. Furthermore, online gaming has been found to have a significant effect on the level of video game addiction.
Keywords: Attention deficit hyperactivity disorder, video game addiction, game genre

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Introduction

Internet gaming disorder (IGD) is a result of excessive and prolonged internet gaming with negative consequences such as impaired real-life relationships or academic performance (Kuss, 2013). The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) proposed the diagnostic criteria of IGD to define addiction to internet gaming. It is classified under the conditions for further study of Section III, and it is suggested that more evidence is necessary before it is included as a standard disorder in the DSM system (APA, 2013).

Playing a computer game helps a person to cope with negative emotions such as frustration, stress, and fear (Weinstein & Weizman, 2012). It is also one of the preferred activities of leisure. Playing computer games improves visual-spatial skills and attention. Educational games increase the interest of the students in the lessons and are known to improve the ability to grasp a concept and the rate of

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retention (Granic et al., 2014). However, some researchers have reported issues due to computer games. The inability to control the desire to play the game leads to unsuccessful attempts to control the behavior, and changes in emotions, thoughts and social life result; the problem or the dependence of the problem is diagnosed (Griffiths & Davies, 2005; Young, 2009).

Impulsivity, defined by the neurobiological basis of computer addiction, and acting without considering the consequences of actions, similarly forms the basis of gambling and substance addictions (Choi et al., 2014). At the same time, gambling, playing a computer game, and using certain substances are associated with the dopaminergic system in the brain and stimulates the brain's reward mechanism (Blum et al., 2000). Based on these similarities, risk factors for gambling and drug addiction could pose a risk for computer gaming addiction. According to previous studies, prognosis for IGD is associated with the presence of underlying disorders such as attention-deficit hyperactivity disorder (ADHD) and major depressive disorder (MDD) (Forrest et al., 2017; Han et al., 2012). Baseline depression and ADHD symptoms are also inversely related to long-term IGD recovery (Han et al., 2018). As suggested in the literature, these comorbid conditions may be predisposing factors for the development and maintenance of IGD (Brand et al., 2016). In the light of increasing evidence, it can be said that there is a strong relationship between ADHD and IGD (Kim et al., 2017; Yen et al., 2017). Nevertheless, it needs to be emphasized that IGD is conceptually different from internet addiction. The criteria for IGD proposed in the DSM-5 classification include nine items: preoccupation, withdrawal, tolerance, unsuccessful attempts to control, loss of interest, continued excessive use despite psychosocial problems, deceit, escape, and functional impairment (APA, 2013). Several scales have been developed in order to evaluate computer game addiction such as the short form of Young's Internet Addiction Test (YIAT-SF) (Young, 2004) and the Digital Game Addiction Scale (DGAS-7) (Lemmens et al., 2009). Given that ADHD is a risk factor for IGD, it is important to determine and deal with computer game addiction levels of children diagnosed with ADHD.

In our study, we investigated whether there is a significant difference between the levels of computer game addiction in children with and without the diagnosis of ADHD. We hypothesized that children with ADHD have significantly higher levels of video game addiction than healthy children.

Methods

Participants and Procedures

The sample for the study group consisted of 100 children aged between 10 and 13 years who were admitted to the child and adolescent psychiatry clinic in İstanbul and were diagnosed with ADHD. The control group of the study consisted of 100 secondary school students aged between 10 and 13 years who did not have any psychiatric diagnosis and who were matched with the study group in terms of age, gender, and socioeconomic characteristics. The children selected for the study group and the control group were chosen using the purposive sampling technique. The study was carried out with children who were examined at five different child psychiatry clinics in İstanbul.

Procedures for Data Collection

The Personal Information Questionnaire and Computer Game Addiction Scale for Children (CGASC) were applied to the participants. For the control group data, permits were obtained from the principals of two secondary schools. Children and their families were informed that they had the right to withdraw from the study if they wanted to do so. The scale was applied to a total of 247 people, but the data of 29 participants were not included in the evaluation due to incomplete information on the form, and 18 participants were excluded from the study because they had excessive extremes and disrupted normal distribution. In total, the data of 200 participants were evaluated.

Instruments

Personal Information Questionnaire: The Personal Information Form prepared by the researchers is an interview form which includes the gender, age, the place where the child plays computer games, how many years the child has played computer games, and the type of games that they play.

CGASC: In order to measure the levels of computer game addiction of the children participating in the study, the CGASC developed by Horzum, Ayas and Balta (2008) was used. This 5-point Likert-type scale consists of 21 items and has a four-factor structure such as "failure to quit playing a computer game," associating the game with life," "the disrupting of tasks due to game playing," and preferring game playing to other activities." Each item on the scale scores between 1 and 5, the lowest possible score is 21, and the highest possible score is 105. The increase in the total score indicates that the child's level of computer addiction is high. Exploratory factor analysis was used to examine the construct validity of the scale. In order to measure the reliability of the scale, Cronbach's internal consistency coefficient was used. Accordingly, the internal consistency coefficient of the sub-factor of the failure to quit playing a computer game was 0.83, the internal consistency coefficient of the sub-factor of the association of computer game with real life was 0.60, the internal consistency coefficient of the sub-factor of the disruption to tasks due to game playing was 0.50, and the internal consistency coefficient of the sub-factor of preferring game playing to other activities was found to be 0.50.

Statistical Analysis

Data were analyzed using the the Statistical Package for Social Sciences version 25.0 (IBM SPSS Corp.; Armonk, NY, USA) program. The significance level was selected as $p<0.05$ in hypothesis testing. As the data obtained were normal distribution, parametric analysis methods were used. According to the parametric test assumptions, independent samples t-test analysis was used for comparison of the binary groups from continuous data, and categorical variables were compared with Chi-squared test. Bi-directional or multivariate analysis of variance was used to examine the effect of two or more independent variables on multiple dependent variables.

Results

The frequency and percentage distributions of the sociodemographic information of 200 participants that are the sample of the study are given in Table 1. Eighteen (18%) female and 82 (82%) male children diagnosed with ADHD were included in the study, and the mean age was 11.53 ± 1.03 years. The control group included 40 (40%) girls and 60 (60%) boys who were not

diagnosed with ADHD, and the mean age was 11.83±0.98 years. Twenty eight (28%) of the children with ADHD had been playing computer games for less than one year, 21 (21%) had been playing computer games for 1-2 years, and 51 (51%) had been playing computer games for more than 2 years. While families of 67 children set a time limit for computer games, 33 children had no time limit. At the same time, 26 children were playing less than 1 hour per day, 37 children were playing 1-2 hours per day, 16 children were playing 2-3 hours per day, and 21 children (21%) played more than 3 hours per day. In addition, 70 children were playing online games, and 30 children were not (Table 1).

Table 1.
Sociodemographic Characteristics of the Sample

	Children with ADHD		**Children without ADHD**	
	M	**SD**	**M**	**SD**
Age	11.53	1.03	11.83	0.98
	N	%	N	%
Gender				
Girls	18	18	40	40
Boys	82	82	60	60
Age				
10	19	19	8	8
11	30	30	33	33
12	30	30	27	27
13	21	21	32	32
Grade				
5.grade	37	37	27	27
6.grade	33	33	41	41
7.grade	30	30	32	32
Period of playing time				
Less than 1 year	28	28	25	25
1-2 years	21	21	25	25
More than 2 years	51	51	50	50
Family's limiting of time				
Yes	67	67	82	82
No	33	33	18	18
Frequency of game playing				
1 time	76	76	82	82
2 times	13	13	13	13
3 times or more	11	11	5	5
Daily total playing time				
Less than 1 hour	26	26	29	29
1-2 hours	37	37	49	49
2-3 hours	16	16	12	12
More than 3 hours	21	21	10	10
Online game playing				
Yes	70	70	74	74
No	30	30	26	26
Using credit card for game				
Yes	22	22	17	17
No	78	78	83	83

M: mean; SD: standard deviation

Table 2 shows the results of the analysis of the CGASC and the subscale mean scores of children with and without ADHD. According to the results of independent samples t-test analysis, the total CGASC mean scores of children with and without ADHD was found to be statistically significantly different ($t(198)=5.652$, $p<0.001$, $d=0.799$). The mean scores of the subscales of the inability to stop playing computer games, associating the game with life, and the disrupting tasks due to the game were also found to be significantly different between children with and without ADHD (Table 2).

As the result of a multivariate analysis of variance, as shown in Table 3, according to the age of the children ($\chi=0.99$, $F=0.161$, $p>0.05$, $\eta^2=0.003$) and group x age interaction ($\chi=0.95$, $F=0.901$, $p>0.05$, $\eta^2=0.019$), the mean score of CGASC and their subscales do not differ significantly. Table 4 shows that, as a result of a multivariate analysis of variance, the CGASC and subscale scores differ statistically according to the online game-playing variable ($\chi=0.93$, $F=3.749$, $p<0.01$, $\eta^2=0.072$) while the scale mean scores do not have a statistically significant difference according to the group x online game play interaction ($p>0.05$). In the advanced analysis to determine the dependent variables upon which online game playing is effective, there was a significant difference between children playing online and children not playing online in terms of the inability to stop playing the computer game, associating the game with life, disrupting tasks due to the game subscales mean scores, and the total CGASC mean scores; this difference was in favor of children playing online games.

Independent samples t-test analysis was performed in order to test whether the mean scores of the total CGASC and the subscales differ significantly according to the type of games played by children with ADHD. The results of the analysis are given in Table 5. Children with ADHD who prefer action-type games have significantly higher scores on the inability to stop playing the computer game and associating the game with life subscales of the CGASC than those of children who did not play action-type games, and their total score of CGASC is also higher than for children who did not prefer action type games (Table 5).

Children with ADHD who preferred shooter type games had significantly higher mean scores on the subscales of inability to stop playing the computer game, associating the game with life, and preferring game playing to other activities, according to the results of the independent samples t-test analysis (Table 5). Total score of the CGASC was also higher than for children who did not prefer shooter type games (Table 5). In addition to these results, although children with ADHD who prefer simulation type games had significantly higher mean scores on the subscale of associating the game with life, children who did not play training type games had higher mean scores on the subscale of the disruption to tasks due to game playing (Table 5). The children with ADHD who preferred racing type games also had significantly higher mean scores on the subscales of inability to stop playing the computer game, disruption of tasks due to game playing, and preferring game playing to other activities and the total score of the CGASC (Table 5).

Table 2.
Independent Samples t-test Analysis of CGASC and Subscale Mean Scores of Children with and without ADHD

	Children with ADHD		Children without ADHD				
	M	**SD**	**M**	**SD**	**t**	**p**	**Cohen's d**
Inability to stop playing computer games	28.65	9.19	20.94	7.37	6.546	0.000	0.926
Associating the game with life	8.59	3.73	7.05	2.98	3.225	0.001	0.456
Disruption of tasks due to game playing	6.00	2.56	4.60	1.72	4.539	0.000	0.642
Preferring game playing to other activities	8.75	3.76	7.84	3.57	1.755	0.081	0.248
Total	51.99	15.85	40.43	12.93	5.652	0.000	0.799

M: mean; SD: standard deviation

Table 3.
Results of a Multivariate Analysis of Variance According to Age of the Children and Group x Age Interaction

Effect	**Wilks' Lambda Value**	**F**	**df**	**Error df**	**p**	**η^2**
Age	0.99	0.161	12	500	0.999	0.003
Group x age	0.95	0.901	12	500	0.546	0.019

Table 4.
Results of a Multivariate Analysis of Variance According to the Age of the Children and Group x Age Interaction

Effect	**Wilks' Lambda Value**	**F**	**df**	**Error df**	**p**	**η^2**
Playing online games	0.93	3.749	4	193	0.006	0.072
Group x playing online games	0.97	1.735	4	193	0.144	0.035

Discussion

Familiarity with computer games provides an opportunity to identify its negative effects and risk factors. Determining the susceptibility to addiction is necessary in order to take precautions and prescribe treatment. In this study, we found that children with ADHD had higher levels of computer game addiction than healthy children. In the literature, it has been reported that the scores of children diagnosed with ADHD on the problematic video game play scale are significantly higher than those of the children who had not been diagnosed (Bae et al., 2016; Bioulac et al., 2007). Hyun et al. (2015) found that ADHD symptoms were more common in computer game addicts compared to healthy controls (Hyun et al., 2015). In another study, when the clinical sample and healthy sample of problematic computer game players were compared, it was found that the rate of ADHD was 42.3% in the clinical sample and 21.3% in the healthy sample, and the difference was reported to be significant (Vadlin et al., 2016). As the results of our study and the studies in the literature, it can be stated that since an ADHD diagnosis provides a predisposition to addiction, it may also be a predisposition to gaming addiction. Follow-up studies with children with ADHD indicate that smoking, alcohol dependence, and behavioral addictions are more likely to be observed in these children (Kieling & Rohde, 2011; Madsen, 2014).

Studies showed that adolescents with IGD have higher scores on the Barratt Impulsivity Scale (Ding et al. 2014) and young adults with IGD had similar results regarding self-reported impulsivity (Ko et al., 2015). Based on these findings, it can be argued that the association between impulsivity and IGD could make individuals yield to the rewarding effects of gaming and contribute to a vulnerability to IGD (Yen et al., 2016). It is possible that the need for reward in a child with ADHD who gradually loses his/her confidence due to constant difficulties in school and at home is resolved in this way. In this study, it was concluded that the mean scores of children from the CGASC total and all other sub-dimensions did not show a significant difference according to the age variable.

This study is partially compatible with Horzum's study (2011) that compared the grade level and computer gaming addiction of third, fourth, and fifth grade students (Horzum, 2011). In addition, in our study, the CGASC total and all subscale scores of online game players were found to be significantly higher than of those who played offline. Müller et al. (2015) stated that, in a study of 12,938 adolescents aged 14-17 years from European countries, among the types of games that were a risk factor for computer game addiction, online games were the strongest predictor (Müller et al., 2015). Similarly, another study that examined the effect of adult gaming preferences on computer gaming addiction has shown that online game players are more likely to meet the criteria for computer gaming addiction compared to offline game players (Na et al., 2017).

In the literature, there are no studies investigating the computer game preferences of children with ADHD. In our study, when we compared the types of computer games that children with ADHD and without ADHD were playing, we found that there was no significant difference between the levels of playing games such as ac-

Table 5.
Independent Samples t-test Analysis of the Mean Scores of Total CGASC and Subscales According to the Type of Games Played by Children with ADHD

		Yes		No				
		M	**SD**	**M**	**SD**	***t***	**p**	**Cohen's d**
Action	Inability to stop playing computer games	31.38	8.60	24.88	8.72	3.710	0.000	-0.751
	Associating the game with life	9.53	3.91	7.29	3.05	3.104	0.002	-0.641
	Disruption of tasks due to game playing	6.41	2.72	5.43	2.22	1.927	0.057	-0.397
	Preferring game playing to other activities	9.31	3.97	7.98	3.35	1.769	0.080	-0.363
	Total	56.64	15.47	45.57	14.18	3.656	0.000	-0.746
Adventure	Inability to stop playing computer games	29.40	8.98	27.81	9.44	0.861	0.391	-0.172
	Associating the game with life	9.15	3.86	7.96	3.51	1.610	0.111	-0.324
	Disruption of tasks due to game playing	5.96	2.58	6.04	2.56	0.156	0.876	0.031
	Preferring game playing to other activities	8.89	3.88	8.60	3.66	0.385	0.701	-0.077
	Total	53.40	15.41	50.40	16.34	0.349	0.349	-0.188
Strategy	Inability to stop playing computer games	28.47	9.16	28.80	9.29	0.180	0.858	0.036
	Associating the game with life	8.87	3.97	8.36	3.53	0.669	0.505	-0.134
	Disruption of tasks due to game playing	5.73	2.67	6.22	2.47	0.942	0.348	0.189
	Preferring game playing to other activities	8.36	3.16	9.07	4.19	0.975	0.332	0.193
	Total	51.42	15.56	52.45	16.21	0.323	0.748	0.065
Shooter	Inability to stop playing computer games	31.46	8.82	27.00	9.06	2.399	0.018	-0.499
	Associating the game with life	9.97	3.93	7.78	3.38	2.951	0.004	-0.599
	Disruption of tasks due to game playing	6.57	2.95	5.67	2.26	1.717	0.089	-0.343
	Preferring game playing to other activities	9.92	3.64	8.06	3.69	2.440	0.016	-0.506
	Total	57.92	15.42	48.51	15.15	2.979	0.004	-0.616
Simulation	Inability to stop playing computer games	30.28	9.49	27.73	8.95	1.334	0.185	-0.276
	Associating the game with life	9.92	3.97	7.84	3.39	2.756	0.007	-0.561
	Disruption of tasks due to game playing	6.08	2.87	5.95	2.39	0.243	0.808	-0.049
	Preferring game playing to other activities	9.56	3.78	8.30	3.70	1.619	0.109	-0.336
	Total	55.83	16.63	49.83	15.09	1.841	0.069	-0.378
Racing	Inability to stop playing computer games	32.07	8.38	26.17	9.01	3.327	0.001	-0.678
	Associating the game with life	9.17	4.11	8.17	3.40	1.321	0.190	-0.264
	Disruption of tasks due to game playing	6.67	2.75	5.52	2.32	2.263	0.026	-0.452
	Preferring game playing to other activities	9.93	3.83	7.90	3.50	2.753	0.007	-0.554
	Total	57.83	15.05	47.76	15.16	3.290	0.001	-0.667

M: mean; SD: standard deviation

tion, adventure, strategy, gunner, simulation, sports, racing, puzzle, and role-playing. In addition, we observed that children without ADHD played more educational games than those with ADHD.

Considering the types of games, those that are fast-moving, similar to real life, competitive, and aggressive are attractive not only for the children with ADHD who lack rewards in other areas of life but also for healthy children. It was observed that children who play action games have significantly higher mean scores on the subscales of "inability to stop playing the computer game" and "associating the game with life" subscales and total CGASC mean scores. This result is similar to some studies in the literature; the findings of a study conducted with young adults show that action type games are among the most frequently played games by problematic computer game players (Elliott et al., 2012). The reasons that action-type games are preferred by children with ADHD who need stimulus and reward include the fact that they are rich in audio-visual stimulation, the action provides constant change, and a prize is won as a result of struggle. Children with ADHD who prefer shooter-type games have significantly higher mean scores on the subscales of inability to stop playing the computer game, associating the game with life, and preferring game to other activities. The total mean score of CGASC is also higher than for children with ADHD who do not prefer shooter type games. Shooter games are computer games where participants aim to kill or injure each other. Similar studies can be found in the literature. In a study conducted by Ream, Elliott, & Dunlap (2014), shooters games were mentioned as one of the most preferred game played by problematic computer game

player adults between the ages of 18 and 29 (Ream et al., 2014). Another study with adolescents shows that one of the most powerful game types predicting computer game addiction are shooter games (Müller et al. 2015). In addition to these results, children with ADHD who prefer simulation type games have significantly higher mean scores on the subscale of associating the game with life. The content of these simulation games enables children to use life-like elements in the game or experience similar things in the game**.** The fact that children play this game as one person, that the game does not contain much movement and change, and the game progresses uniformly can be shown to be non-addictive features of the game. As we have seen in our study, the children with ADHD who prefer racing type games have also significantly higher mean scores on the subscales of the inability to stop playing the computer game, experience disruption of tasks due to game playing, and prefer game playing to other activities and the total score of CGASC. Racing games played with a computer or person are based on competition and are ranked by success. It is thought that being first is the biggest motivation in this game as it is in the category of games containing other competitive elements, so it is difficult for children to give up the game.

Another observation was that children who did not play training type games had higher mean scores on the subscale of disruption of tasks due to the game play. Educational games are based on thinking, strategy development, and problem solving that aim to teach the player different concepts. When the literature related to computer gaming addiction was examined, there were no studies examining the relationship of education with games. Because educational games are intended for a specific teaching purpose, they may seem boring to young children and could serve as reminders of school assignments.

Limitations and Suggestions for Future Research

A limitation of the study is that it was conducted only in Istanbul and with a narrow age group. It is believed that studies carried out in different provinces with larger sample sizes and wider age groups with parental participation will shed further light on this area.

In this study, it was found that children with ADHD had higher levels of computer game addiction than healthy children. ADHD is the most common neurodevelopmental disorder, and there are a limited number of studies conducted in our country on how ADHD affects computer gaming addiction. Our study is important in terms of showing that an ADHD diagnosis and some playing habits are risk factors for computer game addiction.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Hasan Kalyoncu University (Approval no: 2017/34 - Date: 27.10.2017).

Informed Consent: Written informed consent was obtained from the parents' of the participants.

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