

ORIGINAL RESEARCH

The Association of Probable ADHD with the Increase in Video Gaming and the Disordered Gaming Symptom Severity During COVID-19 Pandemic in Turkey

Cuneyt Evren¹ , Bilge Evren² , Ercan Dalbudak³ , Merve Topcu⁴ , Nilay Kutlu⁵ 

¹ Research, Treatment, and Training Center for Alcohol and Substance Dependence AMATEM, Bakirkoy Training and Research Hospital for Psychiatry Neurology and Neurosurgery, Istanbul, Turkey

² Department of Psychiatry, Baltalimani State Hospital for Muskuloskeletal Disorders, Istanbul, Turkey

³ Department of Psychiatry, Yüksek İhtisas University Faculty of Medicine, Ankara, Turkey

⁴ Cankaya University Department of Psychology, Ankara, Turkey

⁵ Department of Psychiatry, Baltalimani State Hospital for Muskuloskeletal Disorders, Istanbul, Turkey

Abstract

Objective: The objective of the study is to examine the association of probable attention deficit hyperactivity disorder (ADHD) with the increase in video gaming and the severity of disordered gaming symptoms among young adults during the COVID-19 pandemic restrictions. The second objective was to examine the mediating role of COVID-19 related dysfunctional anxiety and current age.

Methods: The Adult ADHD Self-Report Scale (ASRS-v1.1), the nine-item Internet Gaming Disorder Scale- Short Form (IGDS9-SF), and the Coronavirus Anxiety Scale (CAS) were used to evaluate university students.

Results: Participants with probable ADHD (n=117, 21.2%) did not differ in terms of age, gender, romantic relationship, and employment status when compared with participants without probable ADHD (n=441, 79.0%). However, they had higher scale scores (IGDS9-SF and CAS). In the hierarchical logistic regression analysis, probable ADHD predicted the increase in video gaming during the pandemic, but when the current age and the dysfunctional anxiety related with COVID-19 were included in the analysis, they were significant predictors, whereas probable ADHD was no more a predictor. While probable ADHD was associated with the symptom severity of disordered gaming in ANCOVA, COVID-19 related dysfunctional anxiety was a significant covariate.

Conclusion: Findings of the current study may suggest that the relationship between probable ADHD and the increase in video gaming during the pandemic was mediated by lower age and COVID-19 related dysfunctional anxiety among young adults. Additionally, while COVID-19 related dysfunctional anxiety was a significant covariate for the severity of disordered gaming symptoms, probable ADHD was independently associated with the symptom severity of disordered gaming.

Keywords: ADHD, Anxiety, COVID-19, Internet Gaming Disorder

INTRODUCTION

The new coronavirus (COVID-19) pandemic has become a global public health concern across the globe since March 11, 2020 (1). Besides the strategies such as wearing the mask, social distancing, and hand hygiene (1), inevitably, in many countries across the globe, so as in Turkey, stay-at-home restrictions implemented (2). Unfortunately, the pandemic caused deaths, job losses, social isolation (3), symptoms of psychological

problems (4,5), and widespread fear and anxiety (3,6). Studies conducted during the pandemic suggest that experiencing these negative effects related to the pandemic may trigger problematic video gaming as a coping mechanism to deal with stress and negative feelings (7-12).

While the popularity of video gaming, particularly online gaming, as a leisure activity is gradually increasing (13), excessive gaming eventually may lead to social, professional, family, school, and psychologic functional impairment (14-16), and finally disordered gaming (17,18) in some gamers. Nevertheless, the previous researches also suggest that excessive video gaming is not necessarily problematic (19,20). Indeed, video gaming might reduce isolation and loneliness (21), and may even be an adaptive way of coping (22), particularly compared to more harmful ways of coping with stress like substance use (23,24). Consistent with these, the

Corresponding Author: Cuneyt Evren

Research, Treatment, and Training Center for Alcohol and Substance Dependence AMATEM, Bakirkoy Training and Research Hospital for Psychiatry Neurology and Neurosurgery, Istanbul, Turkey.

E-mail: dusunenadameditor@gmail.com

Citation: Evren C, Evren B, Dalbudak E, Topcu M, Kutlu N. The Association of probable ADHD with the Increase in Video Gaming and the Disordered Gaming Symptom Severity During COVID-19 Pandemic in Turkey. Psychiatry and Behavioral Sciences 2021;11(3):200-208.

Doi: 10.5455/PBS.20210522020838

Received: May 24, 2021

Accepted: Aug 16, 2021

World Health Organization (WHO) launched the “Play Apart Together” campaign on March 28, 2020, and recommended video gaming as a safe social practice to deal with the pandemic and related restrictions (10,24,25). Indeed video gaming may be an adaptive strategy to cope with stress on the short term (26). However, if other healthy coping strategies are not used and video gaming becomes permanent coping mechanism, it may become maladaptive for some players, which may increase the risk of disordered gaming and related problems (26). Thus, it is not clear whether this campaign affected the time spent on gaming or increased the rate of disordered gaming as a consequence, particularly among young adults. Also, this kind of campaign can also create or encourage vulnerabilities that can be abused by companies looking for new ways to promote their products (24). Consistent with this, online gaming and related activities such as esports watching and videogame streaming has increased as a result of “stay at home” restrictions during the pandemic (24,27).

Young adults are vulnerable to disordered gaming and they experienced school suspensions and online learning as a consequence of spatial-distancing policies and practices (9,25). In Turkey, university students left the campuses by March 2020, and are still off-campus. Therefore, particularly young individuals may have taken solace in video gaming, particularly online, as an indoor activity, which has the elements of social community and competition (8). Parallel with this, recent studies conducted among adolescents (25) and college students (11,28) found that both video gaming and disordered gaming increased during the pandemic.

As a reinforcing behavior, video gaming is often used to reduce stress and anxiety, to alleviate depressed mood, and/or avoid from the situations that causes them (29). Consistent with this, the escape and coping motives were found to be important factors for the excessive usage of video games and have been found to be related with disordered gaming (28,30,31). One of the nine criteria of Internet Gaming Disorder in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) (32) is “the use of gaming to relieve negative moods, such as guilt or hopelessness”. Thus, video gaming may be an attempt to reduce or avoid negative feelings during “stay at home” period. Anxiety experienced during the pandemic seems to be an important factor that affects the frequency of video gaming and the severity of disordered gaming (25). Belief that video gaming helps to cope with stress is related with video gaming

during “stay at home” period in university students (28). Perceived COVID-19 impacts were a mediator between anxiety symptoms and disordered gaming (25). Parallel with this, health anxiety was found to be associated with anxiety and fear due to COVID-19 and the gaming disorder severity (33). Anxiety has also a strong mediator effect on the relationship between disordered gaming and variables such as insomnia and quality of life (8).

The association between attention-deficit/hyperactivity disorder (ADHD) and disordered gaming is an important topic that has gained increasing attention in the literature over the last decade (34). According to the recent reviews, a robust relationship between ADHD and disordered gaming is suggested (35,36). Although the direction of this relationship is unclear (35), there is an agreement that the symptoms of ADHD should be screened when evaluating the disordered gaming and that disordered gaming should be evaluated in the presence of ADHD (35-38). Finally, it was even suggested that those with ADHD and disordered gaming comorbidity may be considered as a specific sub-class of ADHD by DSM criteria in the future (39). Thus, special attention must be given to excessive video gaming among at-risk people, such as young adults with ADHD during the pandemic restrictions (26).

The pandemic restrictions may have deteriorated effects on individuals with ADHD. The restrictions could induce psychological distress particularly among those who adapted well at work/school but struggled at home prior to the pandemic (40). Thus, the well known association between ADHD and disordered gaming might even be stronger during the COVID-19 pandemic because “stay at home” may limit physical activity and engagement in video gaming may increase as a rewarding activity (12). Video games may also offer instant and constant rewards, which people with ADHD may favor because they prefer smaller immediate rewards to bigger delayed rewards, according to the “delay aversion theory” (38,41). A recent research conducted in Wuhan, China, where the pandemic has started, reported that university students with ADHD symptoms had 2.3 times the risk for problematic internet use (12). Similarly, study conducted in Australia found that gaming increased twice as much in 5-17 years old children with ADHD during “stay at home” due to COVID-19 restrictions (42).

Although the relationship of ADHD with video gaming in children (42) was evaluated during the pandemic restrictions, as to our knowledge, this relationship has not been evaluated among young adults yet. It was also wanted to explore how this association may

be influenced by the age and COVID-19 associated dysfunctional anxiety. Therefore, the first aim of the current study is to evaluate the relationships of ADHD with the increase in video gaming and the severity of disordered gaming symptoms among young adults during the COVID-19 pandemic restrictions. The second objective was to evaluate the mediating effects of COVID-19 related dysfunctional anxiety and current age on these relationships. For the purposes above, a cross-sectional study was conducted with a sample of university students after 5 months school closure. The hypothesis of the current study is that probable ADHD may be associated with both the increase in video gaming and severity of disordered gaming symptoms. Also, COVID-19 related dysfunctional anxiety and lower age may both have partial mediator effect on these relationships.

METHODS

Participants and Procedure

A cross-sectional online study was designed and conducted among university students. We used voluntary response sampling method in the present study. This study's data were collected mainly from Turkish-speaking university students. Also, an online survey link on the Qualtrics program was exported, and the survey link was distributed across gaming forums in Turkish. Reporting not playing any games was an exclusion criterion for this study.

The Ethical Committee of Cankaya University (Ankara, Turkey) approved the protocol of the study. Involvement in the study was anonymous and confidential. The Plain Language Information Statement was given to the participants, and informed consent was registered online. The data collected via Qualtrics. No penalty was given for nonparticipants, attrition, or dropouts. Cankaya University students were rewarded with bonus credit added to their overall score in exchange for participation.

The data collection was spanned from 6 June to 1 November 2021. We used Qualtrics to determine the sample size, which offers a calculator online (<https://www.qualtrics.com/blog/calculating-sample-size/>). Taking the confidence level as 95%, population size as 34,000,000 (approximate number of gamers in Turkey) and margin of error as 5% we found the ideal sample size as 385. Total of 1042 students initiated the online survey, among which 558 were included in the study

because the rest of the students marked the option of "I never play video games".

MEASURES

Gaming time: Weekly gaming time ranges were as follows: (1) "less than seven hours weekly (less than one hour a day)", (2) "7-14 hours weekly (1-2 hours per day)", (3) "15-28 hours weekly (2-4 hours per day)", (4) "29-42 hours weekly (4-6 hours per day)", and (5) "more than 42 hours weekly (more than 6 hours per day)".

Internet Gaming Disorder Scale–Short-Form (IGDS9-SF): The IGDS9-SF measures the symptom severity of disordered gaming and its negative consequences by evaluating gaming behaviors during last 12 months (43). The IGDS9-SF contains 9 items that reflect the 9 criteria of the DSM-5. It is a 5-point Likert scale (ranging from "never" as 1 point to "very often" as 5 point) and higher scores on the IGDS9-SF correlate with higher severity of disordered gaming. The IGDS9-SF was validated for Turkish language, which had high Cronbach's α (0.89) (44).

Adult ADHD Self-Report Scale (ASRS-v1.1) Screening Version: Six-item Screening Version of the ASRS-V1.1 was developed for community-based studies to measure ADHD symptoms (45-48). The ASRS-v1.1 is a five-point Likert scale ranging from "never" (0) to "very often" (4). Answers were given as "2" or more (sometimes or greater) to items 1–3 is equal to 1 point, whereas responses are given as "3" or more (often or greater) to items 4–6 resulted in a point. If the total score is 4 or higher than it is considered as probable ADHD, which are highly likely ADHD cases. The Turkish version was validated in university students (49).

The Coronavirus Anxiety Scale (CAS): The CAS is a 5-item self-report measure that aims to assess dysfunctional anxiety specific to the COVID-19 pandemic (3). The CAS has strong reliability ($\alpha=0.93$) and validity (3). The scale was also validated for Turkish language (50).

Statistical Analysis

The IBM SPSS Statistics Version 20 was used for the statistical analyses. The data were cleaned before the analyses. The data with substantial missing values across the measures were excluded. When comparing categorical variables, the χ^2 statistics were used. We run the χ^2 statistics to identify the differences between those with probable ADHD and those without. To evaluate the risk of increase in video gaming among those with probable ADHD the odds ratio together

with 95% confidence interval were used. The Student's t-test was used to compare the group means on the continuous variables. We run the Student's t-test to identify the differences between those with probable ADHD and those without. Correlation between the severity of IGD symptoms and COVID-19 related dysfunctional anxiety was evaluated with Pearson correlation. Taking the increase in video gaming as a dependent variable and probable ADHD, COVID-19 related dysfunctional anxiety, and age as independent variables logistic regression analysis was conducted. An analysis of covariance (ANCOVA) was used to evaluate predictors of the severity of disordered gaming symptoms. In this analysis probable ADHD was a fixed independent factor, and the dysfunctional anxiety related to COVID-19 and current age were covariates. After evaluation of the data, it was found that the data do not meet the basic assumptions of ANCOVA. Thus, nonparametric ANCOVA methodology (Quade's) known as ranked ANCOVA method was used. In this study, p values were accepted as two-tailed, and the relationships were accepted to be significant at $p < 0.05$ for all the statistical analyses.

RESULTS

Characteristics of the Sample

The sample's mean age was 25.52 years (SD = 8.52). The sample included 298 males (53.4%) and 260 females (46.6%). Among total sample, 258 (46.2%) had a romantic relationship, 139 (24.9%) reported that they were working in a regular job, 10 (1.8%) were a part-time worker, 333 (59.7%) were a student, 47 (8.4%) were unemployed and 29 (5.2%) reported as "other" for their employment status.

Sociodemographic and Clinical Variables According to the Presence of Probable ADHD

Participants with probable ADHD (n=117, 21.2%) and without probable ADHD (n=441, 79.0%) did not differ when considered the current age, gender, romantic relationship and employment status, whereas they had higher scale scores (IGDS9-SF and CAS) (Table 1).

Correlation between IGDS9-SF and CAS

The relationship between the severity of disordered gaming and the severity of dysfunctional anxiety related with COVID-19 was assessed. The IGDS9-SF showed mild but significant correlation with the CAS ($r=0.25$, $p < 0.001$, $n=558$).

Age Difference According to Increase in Video Gaming

The mean age of those who reported that there was an increase in their video gaming during the pandemic (n=426, 76.3%, 24.61 ± 7.65) was lower than those who reported no increase (n=132, 27.17 ± 10.68) in their video gaming ($t=2.564$, $p=0.011$).

Table 1. Comparing sociodemographic and clinical variables according to the presence of probable ADHD

	Probable ADHD				c2	p
	Present n=117, 21.0%		Absent n=441, 79.0%			
	n	%	n	%		
Age (Mean±SD)	24.25	6.65	25.47	8.94	t=-1.637	0.103
Gender					1.307	0.253
Male	57	48.7	412	68.4		
Female	60	51.3	190	31.6		
Romantic relationship	56	47.9	202	45.8	0.158	0.691
Employment					5.098	0.277
Working	26	22.2	113	25.6		
Part-time worker	1	0.9	9	2.0		
Unemployed	8	6.8	39	8.8		
Student	79	67.5	254	57.6		
Other	3	2.6	26	5.9		
Increase in gaming ^{a*}	98	83.8	328	74.4	4.509	0.034
IGDS9-SF (Mean±SD)	22.31	8.56	17.09	6.37	t=6.162	<0.001
CAS (Mean±SD)	2.30	3.31	1.21	2.16	t=3.374	0.001

*Non-business / non-academic gaming during the pandemic period (last 5 months)

Odds Ratio (95% C.I.)= ^a 1.598 (1.018-2.509), ADHD: Attention deficit hyperactivity disorder, IGDS9-SF: Internet Gaming Disorder Scale- Short Form. CAS: Coronavirus Anxiety Scale

Predictors of Increase in Video Gaming

In the hierarchical logistic regression analysis, probable ADHD predicted the increase in video gaming during the pandemic, but when the current age and the anxiety

related with COVID-19 were included in the analysis as independent variables, probable ADHD was no more a predictor, whereas age and anxiety related to COVID-19 were (Table 2).

Table 2. Predictors of increase in video gaming during pandemic in logistic regression analysis

		B	S.E.	Wald	df	p	Odds Ratio	95% C.I.		Nagelkerke R ²
								Lower	Upper	
Step 1	Probable ADHD	0.575	0.273	4.423	1	0.035	1.777	1.040	3.037	0.013
Step 2	Probable ADHD	-0.536	0.275	3.808	1	0.051	0.585	0.341	1.002	0.033
	Age	-0.030	0.011	7.891	1	0.005	0.970	0.950	0.991	
Step 3	Probable ADHD	-0.380	0.280	1.842	1	0.175	0.684	0.395	1.184	0.072
	Age	-0.029	0.011	7.129	1	0.008	0.972	0.951	0.992	
	CAS	0.220	0.067	10.853	1	0.001	1.246	1.093	1.420	

ADHD: Attention deficit hyperactivity disorder, CAS: Coronavirus Anxiety Scale

Predictors of Symptom Severity of Disordered Gaming

In the ANCOVA analysis, both probable ADHD and dysfunctional anxiety related to COVID-19 were significantly related to the symptom severity of disordered gaming (Table 3). Since the data did not meet the basic assumptions of ANCOVA we also used nonparametric ANCOVA methodology (Quade's)

known as ranked ANCOVA method (Type III Sum of Squares=719812,170, df= 1, 556, F=30,250, p<0.001, Partial Eta Squared=0.052, R² = 0.052, Adjusted R² = 0.050). To test the null hypothesis that the error variance of the dependent variable is equal across groups, Levene's Test of Equality of Error Variances was used (F=0.446, df1=1, df2=556, p=0.505).

Table 3. Predictors of disordered gaming symptom severity in ANCOVA analysis, where presence of probable ADHD is a fixed factor and age and severity of anxiety related to COVID-19 are covariates.

Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta Squared
<i>Covariates</i>						
Age	114.517	1	114.517	2.530	0.112	0.005
CAS	1107.421	1	1107.421	24.470	<0.001	0.042
<i>Fixed factor</i>						
Probable ADHD	1830.372	1	1830.372	40.444	<0.001	0.068

a. R² = 0.131 (Adjusted R² = 0.126), CAS: Coronavirus Anxiety Scale, ADHD: Attention deficit hyperactivity disorder

DISCUSSION

The major result of this research was that the association between probable ADHD and the increase in video gaming during the pandemic is mediated by lower age and dysfunctional anxiety related to COVID-19 among young adults. This may suggest that younger individuals with probable ADHD might have increased their use of video games to manage this dysfunctional anxiety, as a coping effort, during the "stay at home" restrictions related to pandemic regulations. This is consistent

with a recent finding concluded that anxiety regarding COVID-19 is related to the severity of gaming disorder (33). Also, consistent with the hypothesis, while anxiety related to COVID-19 was a significant covariate for the severity of disordered gaming symptoms, probable ADHD was independently related with the symptom severity of disordered gaming. These findings may suggest that although probable ADHD is indirectly associated with an increase in video gaming, it is related to the severity of disordered gaming symptoms both directly and indirectly via COVID-19 related dysfunctional anxiety.

This is consistent with the recent studies that showed ADHD to increase the use of video games (42) and the risk of problematic internet use (12) during the stay at home period. As far as we know, there is no research that examined the relationship of disordered gaming symptom severity with both ADHD and dysfunctional anxiety related with COVID-19 altogether. Video gaming as a reinforcing behavior may relieve stress and anxiety (51,52). As a result, the ADHD symptoms' relationship with the increase of video gaming may be part of a coping mechanism for dealing with the stress of the COVID-19 pandemic, as well as the anxiety (53,54). People with probable ADHD who are bored with delayed rewards combined with diminished working memory may be satisfied from online video games and find the online gaming atmosphere appealing because they provide a constant stream of stimuli and immediate rewards (55,56). Thus, they may become more susceptible to excessive use of video games and higher severity of disordered gaming (57). Excessive video gaming, on the other hand, has been associated with the higher risk of ADHD symptoms at follow-up (58). Also, symptoms of anxiety in prepandemic period is associated with excessive video gaming and severity of disordered gaming during the pandemic period (25). Individuals with ADHD symptoms have other psychiatric comorbidities including anxiety (59), which is consistent with the finding of the present study that the risk of having a diagnosis of anxiety disorder before the COVID-19 pandemic was 2.2 times higher in the group with probable ADHD. Using video games as a coping mechanism for life stressors and feelings of anxiety may result with unpleasant experiences in gamers' lives (60). This subgroup of gamers with probable ADHD and anxiety disorder diagnosis may even have higher difficulties during the COVID-19 pandemic. Thus, bidirectional and complex associations between the key structures of interest are possible. Unfortunately, since the present study is cross-sectional, definitive inferences regarding the temporal order of the key structures of concern were not possible.

ADHD seems to be related with the loss of self-control, which is related to excessive online video gaming; this can disturb the daily life of an individual (61,62) and make them even more vulnerable to disordered gaming. Results of the current study may suggest that video gaming may provide immediate pleasure to young adults particularly those with probable ADHD, which may satisfy the needs of coping with or escape from the COVID-19 pandemic dysfunctional anxiety and may contribute

to the loss of self-control in gamers with probable ADHD. This may be similar to the self-medication theory suggested in substance use disorders (63). Thus, playing with video games maybe is to compensate for the consequences of underlying problems that have not been properly treated, such as ADHD symptoms and dysfunctional anxiety related to COVID-19 they are experiencing. If gaming activity to cope causes excessive gaming and becomes disordered gaming, problems such as diminished academic performance and/or increase in anxiety levels may occur (64), which may result in gaming becoming a maladaptive coping, making a vicious circle.

There are some limitations that have to be considered for the present study. First of all, it was a non-clinical sample evaluated with self-rating scales. Unfortunately, self-rating scales may only show elevated risk of ADHD or disordered gaming rather than making the the clinical diagnosis of these disorders. Also we used voluntary response sampling method in the present study, which may have a higher risk of sampling bias. These may limit the generalizability of these findings. Also, severe symptoms of ADHD may be related to weaker cognitive function, lowering the reliability of these results as self-rated scales were used in this study. Secondly, video gaming motives, particularly coping/escape motives, and symptoms of anxiety and depression were not evaluated, which can be considered as a limitation. Finally, it is impossible to comment on the casual associations between the primary constructs of interest, since our study was cross-sectionally designed. As a result, the findings of the present study should be confirmed in future prospective studies in latter period of pandemic using structured interviews.

Despite these limitations, the obtained results highlight the association between the severity of disordered gaming symptoms with the presence of probable ADHD, as well as dysfunctional anxiety related with COVID-19 in young adults. ADHD and disordered gaming may have bidirectional longitudinal associations, in which they may reinforce and increase the risk of each other (38), but dysfunctional anxiety related to COVID-19 during pandemic restrictions seems to worsen and complicate this situation further. Parents or other family members of those with probable ADHD need to pay special attention to these young adults if there is an increase usage of video games and if video gaming is a coping mechanism for them to deal with dysfunctional anxiety during the current COVID-19 pandemic (8). Type of the game that is preferred to use is also important. While disordered gaming is more likely to occur in mainstream

video games, which are complicated, endless, socially-driven games (31), there are also so-called educational video games (26) or “serious games”, which are found to be useful and effective tools and therapeutic interventions discriminating ADHD cases from controls and in enhancing cognitive functions and reducing ADHD symptoms (65). Also, effective and accessible guidelines should be prepared to reduce excessive video gaming and to prevent disordered gaming, particularly for young adults with probable ADHD (10). For these aims, regular exercise should be recommended (12), which can be performed with exergames (active video games), a tool to help coping with the COVID-19 related dysfunctional anxiety (26,66).

REFERENCES

- [1] World Health Organization. WHO Director-General’s opening remarks at the media briefing on COVID-19 – 11 March 2020. <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-themedia-briefing-on-covid-19-11-march-2020>.
- [2] Lewnard JA, Lo N. Scientific and ethical basis for social-distancing interventions against COVID-19. *Lancet: Infect Dis* 2020;20(6):631–633.
- [3] Lee SA. Coronavirus Anxiety Scale: A brief mental health screener for COVID-19 related anxiety. *Death Studies* 2020;44(7):393–401.
- [4] Tian F, Li H, Tian S, Yang J, Shao J, Tian C. Psychological symptoms of ordinary Chinese citizens based on SCL-90 during the level I emergency response to COVID-19. *Psychiatry Res* 2020;288:112992.
- [5] Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health* 2020;17(5):1729.
- [6] Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD, Pakpour AH. The fear of COVID-19 scale: Development and initial validation. *Int J Ment Health Addict* 2020;27:1–9. doi: 10.1007/s11469-020-00270-8.
- [7] Chen CY, Chen IH, Hou WL, Potenza MN, O’Brien KS, Lin CY, Latner JD. The relationship between children’s problematic internet-related behaviors and psychological distress during the onset of the COVID-19 pandemic: A longitudinal study. *J Addict Med* 2021 doi: 10.1097/ADM.0000000000000845.
- [8] Fazeli S, Mohammadi Zeidi I, Lin CY, Namdar P, Griffiths MD, Ahorsu DK, et al. Depression, anxiety, and stress mediate the associations between internet gaming disorder, insomnia, and quality of life during the COVID-19 outbreak. *Addict Behav Rep* 2020;12:100307.
- [9] Islam MS, Sujan MSH, Tasnim R, Ferdous MZ, Masud JHB, Kundu S, et al. Problematic internet use among young and adult population in Bangladesh: Correlates with lifestyle and online activities during the COVID-19 pandemic. *Addict Behav Rep*. 2020;12:100311.
- [10] Masaeli N, Farhadi H. Prevalence of Internet-based addictive behaviors during COVID-19 pandemic: a systematic review. *J Addict Dis* 2021; 1-27. doi: 10.1080/10550887.2021.1895962.
- [11] Shrestha MV, Shrestha N, Sharma SC, Joshi SK. Gaming disorder among medical college students during COVID-19 pandemic lockdown. *Kathmandu Univ Med J (KUMJ)* 2020 COVID-19 SPECIAL ISSUE;18(70):48-52.
- [12] Zhao Y, Jiang Z, Guo S, Wu P, Lu Q, Xu Y, et al. Association of symptoms of attention deficit and hyperactivity with problematic internet use among university students in Wuhan, China during the COVID-19 pandemic. *J Affect Disord* 2021;286:220-227.
- [13] López-Fernández FJ, Mezquita L, Griffiths MD, Ortet G, Ibáñez MI. The role of personality on disordered gaming and game genre preferences in adolescence: gender differences and person-environment transactions. *Adicciones* 2020; 1370. doi: 10.20882/adicciones.1370.
- [14] Griffiths MA. A “components” model of addiction within a biopsychosocial framework. *J Subst Use* 2005;10:191-197.
- [15] Lemmens JS, Valkenburg P, Peter J. Development and validation of a game addiction scale for adolescents. *Media Psychol* 2009;12:77-95.
- [16] Gentile DA, Choo H, Liau A, Sim T, Li D, Fung D, et al. Pathological video game use among youth: A two-year longitudinal study. *Pediatrics* 2011;127:319-329.
- [17] Zanetta Dauriat F, Zermatten A, Billieux J, Thorens G, Bondolfi G, Zullino D, et al. Motivations to play specifically predict excessive involvement in massively multiplayer online role-playing games: evidence from an online survey. *Eur Addict Res* 2011;17:185-189.
- [18] Aggarwal S, Saluja S, Gambhir V, Gupta S, Satia SPS. Predicting the likelihood of psychological disorders in PlayerUnknown’s Battlegrounds (PUBG) players from Asian countries using supervised machine learning. *Addict Behav* 2020;101:106132.
- [19] Király O, Toth D, Urban R, Demetrovics Z, Maraz A. Intense video gaming is not essentially problematic. *Psychol Addict Behav* 2017;31(7):807–817.
- [20] Van Rooij AJ, Schoenmakers TM, Vermulst AA, Van Den Eijnden RJJM, Van De Mheen D. Online video game addiction: identification of addicted adolescent gamers. *Addiction* 2011;106:205e21.
- [21] Carras MC, Van Rooij AJ, Van de Mheen D, Musci R, Xue Q-L, Mendelson T. Video gaming in a hyperconnected world: a cross-sectional study of heavy gaming, problematic gaming symptoms, and online socializing in adolescents. *Comput Human Behav* 2017;68:472–479.
- [22] Billieux J, Flayelle M, Rumpf H-J, Stein DJ. High involvement versus pathological involvement in video games: a crucial distinction for ensuring the validity and utility of gaming disorder. *Curr Addict Rep* 2019;6(3):323–330.
- [23] Corbin WR, Farmer NM, Nolen-Hoekesma S. Relations among stress, coping strategies, coping motives, alcohol consumption and related problems: a mediated moderation model. *Addict Behav* 2013; 38(4):1912–1919.
- [24] King DL, Delfabbro PH, Billieux J, Potenza MN. Problematic online gaming and the COVID-19 pandemic. *J Behav Addict* 2020;9(2):184-186.
- [25] Teng Z, Pontes HM, Nie Q, Griffiths MD, Guo C. Depression and

- anxiety symptoms associated with internet gaming disorder before and during the COVID-19 pandemic: A longitudinal study. *J Behav Addict* 2021; doi: 10.1556/2006.2021.00016.
- [26] Ko CH, Yen JY. Impact of COVID-19 on gaming disorder: Monitoring and prevention. *J Behav Addict* 2020;9(2):187-189.
- [27] Amin KP, Griffiths MD, Dsouza DD. Online gaming during the COVID-19 pandemic in India: Strategies for work-life balance. *Int J Ment Health Addict* 2020;1-7. doi: 10.1007/s11469-020-00358-1.
- [28] Balhara YPS, Kattula D, Singh S, Chukkali S, Bhargava R. Impact of lockdown following COVID-19 on the gaming behavior of college students. *Indian J Public Health* 2020;64(Supplement):S172-S176.
- [29] Király O, Potenza MN, Stein DJ, King DL, Hodgins DC, Saunders JB, et al. Preventing problematic internet use during the COVID-19 pandemic: Consensus guidance. *Compr Psychiatry* 2020;100:152180.
- [30] Demetrovics Z, Urbán R, Nagygyörgy K, Farkas J, Zilahy D, Mervó B, et al. Why do you play? The development of the motives for online gaming questionnaire (MOGQ). *Behav Res Methods* 2011;43:814-825.
- [31] King DL, Delfabbro PH, Perales JC, Deleuze J, et al. Maladaptive player-game relationships in problematic gaming and gaming disorder: A systematic review. *Clin Psychol Rev* 2019;73:101777.
- [32] American Psychiatric Association (2013) *Diagnostic and Statistical Manual of Mental Disorders (5th ed.)*. Arlington, VA: American Psychiatric Association.
- [33] Elhai JD, McKay D, Yang H, Minaya C, Montag C, Asmundson GJG. Health anxiety related to problematic smartphone use and gaming disorder severity during COVID-19: Fear of missing out as a mediator. *Hum Behav Emerg Technol* 2020;10.1002/hbe2.227.
- [34] Evren B, Evren C, Dalbudak E, Topcu M, Kutlu N. Neuroticism and introversion mediates the relationship between probable ADHD and symptoms of Internet gaming disorder: results of an online survey. *Psychiatry Clin Psychopharmacol* 2019; 29:90-96.
- [35] Dullur P, Krishnan V, Diaz AM. A systematic review on the intersection of attention-deficit hyperactivity disorder and gaming disorder. *J Psychiatr Res* 2021;133:212-222.
- [36] González-Bueso V, Santamaría JJ, Fernández D, Merino L, Montero E, Ribas J. Association between Internet gaming disorder or pathological video-game use and comorbid psychopathology: a comprehensive review. *Int J Environ Res Public Health* 2018;15(4):688.
- [37] Evren C, Evren B, Dalbudak E, Topcu M, Kutlu N. Relationships of Internet addiction and Internet gaming disorder symptom severities with probable attention deficit/hyperactivity disorder, aggression and negative affect among university students. *Atten Defic Hyperact Disord* 2019;11(4):413-421.
- [38] Marmet S, Studer J, Grazioli VS, Gmel G. Bidirectional associations between self-reported gaming disorder and adult attention deficit hyperactivity disorder: evidence from a sample of young Swiss men. *Front Psychiatry* 2018;9:649.
- [39] Chang CH, Chang YC, Cheng H, Tzang RF. Treatment efficacy of Internet gaming disorder with attention deficit hyperactivity disorder and emotional dysregulation. *Int J Neuropsychopharmacol* 2020; 23(6):349-355.
- [40] Ando M, Takeda T, Kumagai K. A qualitative study of impacts of the COVID-19 pandemic on lives in adults with attention deficit hyperactive disorder in Japan. *Int J Environ Res Public Health* 2021;18(4):2090.
- [41] Paulus FW, Sinzig J, Mayer H, Weber M, von Gontard A. Computer gaming disorder and ADHD in young children—a population-based study. *Int J Ment Health Addict* 2017;16:1193-1207.
- [42] Sciberras E, Patel P, Stokes MA, Coghill D, Middeldorp CM, Bellgrove MA, et al. Physical health, media use, and mental health in children and adolescents with ADHD during the COVID-19 pandemic in Australia. *J Atten Disord* 2020; doi: 10.1177/1087054720978549.
- [43] Pontes HM, Griffiths MD. Measuring DSM-5 Internet gaming disorder: Development and validation of a short psychometric scale. *Comput Human Behav* 2015;45:137-143.
- [44] Evren C, Dalbudak E, Topcu M, Kutlu N, Evren B, Pontes HM. Psychometric validation of the Turkish nine-item Internet Gaming Disorder Scale-Short Form (IGDS9-SF). *Psychiatry Res* 2018;265:349-354.
- [45] Chamberlain SR, Ioannidis K, Leppink EW, Niaz F, Redden SA, Grant JE. ADHD symptoms in non-treatment seeking young adults: relationship with other forms of impulsivity. *CNS Spectr* 2016; 22:22-30.
- [46] Kessler RC, Adler L, Ames M, Demler O, Faraone S, Hiripi E, Howes MJ, Jin R, Secnik K, Spencer T, Ustun TB, Walters EE. The World Health Organization adult ADHD self-report scale (ASRS): a short screening scale for use in the general population. *Psychol Med* 2005; 35:245-256.
- [47] Kessler RC, Chiu WT, Demler O, Merikangas KR, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry* 2005;62:617-627.
- [48] Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, Faraone SV, Greenhill LL, Howes MJ, Secnik K, Spencer T, Ustun TB, Walters EE, Zaslavsky AM. The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *Am J Psychiatry* 2006;163:716-723.
- [49] Dogan S, Oncu B, Varol-Saracoglu G, Kucukgoncu S. Validity and reliability of the Turkish version of the Adult ADHD Self-Report Scale (ASRS-v1.1). *Anadolu Psikiyatri Derg* 2009;10:77-87.
- [50] Evren C, Evren B, Dalbudak E, Topcu M, Kutlu N. Measuring anxiety related to COVID-19: A Turkish validation study of the Coronavirus Anxiety Scale. *Death Studies* 2020; 1-7. doi: 10.1080/07481187.2020.1774969.
- [51] Blasi MD, Giardina A, Giordano C, Coco GL, Tosto C, Billieux J, et al. Problematic video game use as an emotional coping strategy: Evidence from a sample of MMORPG gamers. *J Behav Addict* 2019;8:25-34.
- [52] Király O, Urbán R, Griffiths MD, Ágoston C, Nagygyörgy K, Kökönyei G, Demetrovics Z. The mediating effect of gaming motivation between psychiatric symptoms and problematic online gaming: an online survey. *J Med Internet Res* 2015;17(4):e88.
- [53] Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *Lancet Psychiatry* 2020;7(10):883-892.

- [54] Shi L, Lu ZA, Que JY, Huang XL, Liu L, Ran MS, et al. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. *JAMA Netw Open* 2020;3(7):e2014053.
- [55] Castellanos FX, Tannock R. Neuroscience of attention-deficit/hyperactivity disorder: The search for endophenotypes. *Nat Rev Neurosci* 2002;3:617–628.
- [56] Diamond A. Attention-deficit disorder (attention-deficit/hyperactivity disorder without hyperactivity): a neurobiologically and behaviorally distinct disorder from attention-deficit/hyperactivity disorder (with hyperactivity). *Dev Psychopathol* 2005;17:807–825.
- [57] Evren C, Evren B, Dalbudak E, Topcu M, Kutlu N, Elhai JD. Relationship between internet gaming disorder symptoms with attention deficit hyperactivity disorder and alexithymia symptoms among university students. *Addicta: The Turkish Journal on Addictions* 2020;7: 1-9.
- [58] Ra CK, Cho J, Stone MD, De La Cerda J, Goldenson NI, Moroney E, et al. Association of Digital Media Use With Subsequent Symptoms of Attention-Deficit/Hyperactivity Disorder Among Adolescents. *JAMA* 2018;320(3):255-263. doi: 10.1001/jama.2018.8931.
- [59] Katzman MA, Bilkey TS, Chokka PR, Fallu A, Klassen LJ. Adult ADHD and comorbid disorders: clinical implications of a dimensional approach. *BMC Psychiatry* 2017;17(1):302.
- [60] Shi J, Renwick R, Turner NE, Kirsh B. Understanding the lives of problem gamers: The meaning, purpose, and influences of video gaming. *Comput Human Behav* 2019; 97:291-303.
- [61] Bioulac S, Arf L, Bouvard MP. Attention deficit/hyperactivity disorder and video games: a comparative study of hyperactive and control children. *Eur Psychiat* 2008;23:134–141.
- [62] Weinstein A, Weizman A. Emerging association between addictive gaming and attention-deficit/hyperactivity disorder. *Curr Psychiatry Rep* 2012;14(5):590-597.
- [63] Khantzian EJ. Addiction as a self-regulation disorder and the role of self-medication. *Addiction* 2013;108:668–669.
- [64] Kuss DJ, Griffiths MD. Online gaming addiction in children and adolescents: a review of empirical research. *J Behav Addict* 2012;1: 3e22.
- [65] Peñuelas-Calvo I, Jiang-Lin LK, Girela-Serrano B, Delgado-Gomez D, Navarro-Jimenez R, Baca-Garcia E, et al. Video games for the assessment and treatment of attention-deficit/hyperactivity disorder: a systematic review. *Eur Child Adolesc Psychiatry* 2020; doi: 10.1007/s00787-020-01557-w.
- [66] Viana RB, Vancini RL, Silva WF, Morais NS, de Oliveira VN, Andrade MS, et al. Comment on: Problematic online gaming and the COVID-19 pandemic - The role of exergames. *J Behav Addict* 2021 Mar 4. doi: 10.1556/2006.2021.00014.