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Effects of digital game addiction on cardiovascular health behavior on secondary school students during the COVID-19 pandemic

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ABSTRACT

Purpose: This study aimed to investigate factors affecting digital game addiction in secondary school students during the COVID-19 pandemic and the effects of digital game addiction on cardiovascular health behavior.
Design and methods: This descriptive, correlational, and cross-sectional study was conducted with 619 secondary school students aged 10–14 years. Study data were analyzed using World Health Organization AnthroPlus and SPSS programs. Simple linear regression and multiple linear regression methods were used in the analysis process.
Results: Findings showed that 43.6% of the students played digital games for more than two hours a day. Descriptive characteristics (gender, age, basal metabolic rate, educational status of parent, income status, etc.) and digital gaming habits of the students accounted for 37.0% of the variance in digital game addiction. Digital game addiction adversely affected cardiovascular health behavior and all its sub-dimensions.
Conclusion: The first factor that predicted digital game addiction, in order of significance, was daily digital game playing time. Digital game addiction negatively affected the sedentary lifestyle sub-dimension of cardiovascular health behavior most. Digital game addiction may trigger an increase in the incidence of diseases such as diabetes, cancer, and especially cardiovascular diseases, at later ages.
Practice implications: Nurses, schools, and parents have critical responsibilities in preventing digital game addiction. Results of this research will make a remarkable contribution to the development of preventive services by revealing risk factors for digital game addiction and the effects of digital game addiction on cardiovascular health behavior.

Introduction

The first case of COVID-19 occurred in Turkey on March 11, 2020 (Genç, 2021). To keep the spread of COVID-19 under control, face-to-face education was suspended in schools on March 12, 2020, and the distance learning process was launched. On April 3, 2020, lockdown restrictions were mandated for people under 20 years of age (Öğütlü, 2020). These situations caused students to spend increased time at home (Duran & Ömeroğlu, 2022; Ozturk Eyimaya & Yalçin Irmak, 2021).

The COVID-19 pandemic has had a profound effect on students' physical activity and screen time. Lockdown measures led to an increase in students' daily screen time (Nagata et al., 2020). This, in turn, led to reduced levels of physical activity. Compared to the pre-pandemic period, rates of students who met World Health Organization (WHO) physical activity guidelines decreased, overall sports activities decreased, and recreational screen time increased partially because team sports and organized activity classes were canceled (World Health Organization (WHO), 2020; Schmidt et al., 2020; Dunton et al., 2020; Zhang et al., 2020; López-Gil et al., 2021).

Screen time increased because educational activities and social support were only available online and digital games were one of the few acceptable means of social interaction during the COVID-19 lockdown (Nagata et al., 2020). Digital games are a component of screen time used for recreation and are described as any game played on a digital device. During the COVID-19 pandemic, digital game playtimes and downloads increased by record levels in the United States of America and Europe. These situations increased the risk of digital game addiction (DGA), which is described as continuing to play games despite their usage adversely affecting daily life (Fazeli et al., 2020; Ko & Yen, 2020). Since excessive screen time increases sedentary time, it is also associated with an increase in cardiovascular disease (CVD) risk factors such as obesity, high blood pressure, and insulin resistance (Lissak, 2018). Studies have revealed that excessive screen time results in unhealthy weight gain and an increased risk of CVD (McDool et al., 2020; Wang et al., 2020).

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Cardiovascular disease, which is a chronic non-communicable disease, ranks first among the causes of death worldwide and in Turkey (Republic of Turkey Ministry of Health, 2017; World Health Organization (WHO), 2021). Moreover, in the Global Burden of Disease Study, it ranks first among the main disease groups that create disease burdens in both the 50–74 and 75 and over age groups (Vos et al., 2020). In addition, CVD also increased the severity of other diseases and the risk of death from these other diseases during the COVID-19 pandemic (Nishiga et al., 2020).

As a lingering effect of the COVID-19 pandemic, the habits of increasing DGA and lack of physical activity in students might be maintained in later ages. This situation, in turn, may cause an increase in the incidence of CVD, specifically in older ages. Hence, this might negatively impact individuals and countries regarding both early deaths and disease burden. Thus, it is crucial to investigate the factors impacting students' DGA and the effects of DGA on cardiovascular health behavior during the COVID-19 pandemic. To our knowledge, there are no similar studies in the literature. The results of this study will contribute to the prevention of DGA, which is a preventable risk factor for CVD.

Methods

Design

This research was a descriptive, correlational, and cross-sectional study conducted with secondary school students between November 2020 and June 2021 in Türkiye.

Participants

The sample population was 1463 students studying in two secondary schools selected by the simple random sampling method among secondary schools of the provincial Directorate of National Education in western Turkey. Inclusion criteria were being between the ages of 10 and 14, participating in this study voluntarily, having parental consent, having internet access, and being able to fill out the online data collection form sent using WhatsApp. Exclusion criteria were having a chronic disease and not actively continuing (freezing registration etc.) their education during lockdown. At least 10 participants per predictor variable are appropriate for regression equations involving six or more predictors and 30 participants per variable are recommended to detect a small effect size (VanVoorhis & Morgan, 2007). The sample size of the study was calculated as 600 individuals assuming 40 subjects per variable for regression analysis (40×15 (number of variables) $= 600$). Given the possibility of data loss, 700 students from two secondary schools were included using the stratified random sampling method (Polit & Beck, 2017). An online data collection form was sent to the registered phone numbers of the parents of these students. At the end of the data collection process, 619 students who voluntarily participated in the present study, had parental consent, met the inclusion criteria, and filled out the data collection forms fully/appropriately constituted the final study sample.

Procedure

The study process was conducted in accordance with the Human Rights Declaration of Helsinki. Ethical approval was obtained for this study from the Non-Interventional Research Ethics Committee (Ethics Approval Number: 2020/14–05, Date: June 22, 2020). Institutional permission (Number: 12018877–604.01.02-E.13574882) was obtained from the Provincial Directorate of National Education to which the schools were affiliated.

During data collection, between November 2020 and June 2021, students continued to have distance learning at home and data were collected through an online-based survey (Google form) in cooperation with school administrators. Students were informed that to fill out the data collection form, he or she must have parental consent, want to participate in this study voluntarily, and meet the inclusion criteria. They were told that the data collected would be used for research purposes only and that participants could withdraw from the study at any time. The contact information of the researchers and an authorized person from the school administration were included at the bottom of the form so that the participants were able to send their questions, views, and suggestions about this research. The online data collection form was completed only by students whose informed consent form was approved by their parents and who voluntarily agreed to participate in this study.

Measures

A descriptive information form, digital gaming habits information form, the Digital Game Addiction Scale for Children, and Cardiovascular Health Behavior Scale for Children were used to collect the data in this study (Celik & Bektas, 2020; Hazar & Hazar, 2017). Permission was granted from the developers of the Digital Game Addiction Scale for Children and the Cardiovascular Health Behavior Scale for Children for their use.

Descriptive information form

The form, created by the researchers, included questions about the student's gender, age, height, weight, parental education, income, and family history of CVD.

Digital gaming habits information form

The form was generated by the researchers in line with the literature to identify students' digital game playing habits (Donati et al., 2021; Drummond & Sauer, 2020; Işıkoğlu et al., 2021; Knell et al., 2019; Lissak, 2018; Nagata et al., 2020; Park et al., 2020; Van Den Eijnden et al., 2018). The Davis technique was used to evaluate the content validity of the form (Davis, 1992). Expert opinions received from five academics in nursing evaluated the content validity of the digital gaming habits information form. The content validity index of the form was 0.94. The form included questions about the age at which digital gaming was started, the duration of digital gaming, the preferred type of digital game, the presence of other family members playing digital games, and the change in digital gaming time during the COVID-19 pandemic.

Digital Game Addiction Scale for Children

The Digital Game Addiction Scale for Children, developed by Hazar and Hazar (2017), was used to measure the DGA levels of students (Hazar & Hazar, 2017). The scale measures digital game usage related to situations, such as insisting on playing digital games, constantly wanting to play digital games for longer, and not being able to fulfill responsibilities (such as homework) due to digital gaming. The scale includes 24 questions, each of which is scored using a 5-point Likert-type scale ranging from 1 (absolutely disagree) to 5 (completely agree). The lowest score obtainable is 24 and the highest score is 120. The higher the score on the scale, the higher the level of DGA. The developers determined the scale's Cronbach's α coefficient is 0.90.

Cardiovascular Health Behavior Scale for Children

To measure students' cardiovascular health behavior levels, the Cardiovascular Health Behavior Scale for Children developed by Çelik & Bektaş was used (Celik & Bektas, 2020). This scale consists of subdimensions of nutrition, exercise, sedentary lifestyle, smoking, self-love, and stress. It measures the level of cardiovascular health behavior with items such as, "I drink cola, orange soda, or soft drinks every day," "I watch TV for >2 h every day," "I feel disturbed when someone smokes

around me," and "I think everything will go wrong" in its sub-dimensions. The scale includes 28 questions scored on a 4-point Likert scale, each ranging from 1 (always) to 4 (never). When scoring the scale, 15 items (1–7, 13–16, and 25–28) are reversed. The scores range from 28 to 112. Higher scores indicate higher levels of negative cardiovascular health behaviors. Scale developers found Cronbach's α coefficient values are 0.83 for the whole scale, 0.76 for the nutrition sub-dimension, 0.79 for the exercise sub-dimension, 0.72 for the sedentary lifestyle sub-dimension, 0.75 for the smoking sub-dimension, 0.70 for the self-love sub-dimension, and 0.74 for the stress sub-dimension.

Data analysis

Research data were analyzed using SPSS Statistics 25.0 (IBM Corp., Armonk, NY). Mean, standard deviation, and percentile values were calculated for descriptive statistics. Body mass index (BMI) z-scores adjusted for age and gender were calculated using WHO AnthroPlus software developed to monitor the growth of children and adolescents aged 5–19 years (World Health Organization (WHO), 2007a). The BMI groups of the students were determined by comparing the data obtained as a result of the calculation with the growth reference values published by WHO in 2007 (World Health Organization (WHO), 2007b). Whether the data fit a normal distribution was analyzed by calculating the kurtosis and skewness coefficients. Cronbach's α coefficient was calculated to determine the internal consistency of the scales used in this study. Multiple regression analysis was performed (forward method) to investigate the effects of students' descriptive characteristics and digital gaming habits on their DGA levels. Multicollinearity and independence of residuals were tested in the regression model. The independence of factors was determined (none of the correlation coefficients between variables that influenced DGA was above 0.80). After verifying the error term's basic assumptions, the Durbin-Watson test statistic (1.970) showed no autocorrelation. The tolerance limit of multicollinearities was ≥0.1, with tolerance values of 0.91–0.98. The variance inflation factor was <10. The conditions for the error terms' normality and homoscedasticity were satisfied. A simple linear regression analysis was performed to investigate the effects of students' DGA on cardiovascular health behavior and its sub-dimensions. The level of acceptable significance was set at $p < 0.05$.

Results

In this study, 52.8% of the students were female and their mean age was 12.29 (±1.10). Of the students, 24.4% were overweight, 12.6% were obese, 36.8% had mothers who were high school graduates, 38.0% had fathers who were high school graduates, and 56.5% had families where their income was equal to their expenses. The rate of people receiving blood pressure medication in the family or close relatives of the students was 78.5%, while the rate of relatives who had a heart attack was 44.7% (Table 1).

The age at which the students started playing digital games was 7.51 (±1.88). Of the students, 43.6% played digital games for more than two hours a day, 68.5% played digital games mostly on weekends, and 56.5% preferred to play digital games with a smartphone. Of the students, 69.3% preferred online digital games, 70.1% had another person playing digital games in their family, and 57.5% stated that they played digital games always with parental guidance. Furthermore, 32.8% of the students stated that digital games adversely affected their academic course success and 61.7% stated that their playing time increased during the COVID-19 pandemic (Table 2).

The students' Digital Game Addiction Scale mean score was 48.62 ± 22.51 and Cardiovascular Health Behavior Scale for Children mean score was 56.60 ± 11.03. The mean scores of the Cardiovascular Health Behavior Scale for Children sub-dimensions of the students were 13.76 ± 3.28 for nutrition, 11.30 ± 3.96 for exercise, 9.51 ± 2.99 for sedentary lifestyle, 5.05 ± 2.13 for smoking, 7.24 ± 2.63 for self-love, and 9.71 ± 3.00 for stress (Table 3).

The Cronbach's α value for the Digital Game Addiction Scale was 0.953 and for the Cardiovascular Health Behavior Scale for Children was 0.842. The Cardiovascular Health Behavior Scale for Children scale sub-dimensions Cronbach's α values ranged from 0.708 to 0.820. The kurtosis and skewness coefficient values were calculated to check

Table 1
Descriptive characteristics of the students ($n = 619$).

Descriptive Characteristic	X ± SD	Min.	Max.
Age	12.29 ± 1.10	11.00	14.00
Height	153.10 ± 10.91	122	200
Weight	47.58 ± 12.62	25	90
		n	%
Gender	Female	327	52.8
	Male	292	47.2
School year	First year	200	32.3
	Second year	150	24.2
	Third year	154	24.9
	Fourth year	115	18.6
BMI	Underweight	37	6.0
	Normal	353	57.0
	Overweight	151	24.4
	Obese	78	12.6
Educational Status of Mother	Primary school graduate	165	26.7
	Secondary school graduate	127	20.5
	High school graduate	228	36.8
	University graduate	99	16.0
Educational Status of Father	Primary school graduate	139	22.5
	Secondary school graduate	108	17.4
	High school graduate	235	38.0
	University graduate	137	22.1
Income status	Income less than Expenses	147	23.7
	Income equal to Expenses	350	56.6
	Income more than Expenses	122	19.7
Presence of Person Receiving Blood Pressure Medicine in the Family	Yes	486	78.5
	No	133	21.5
Presence of a person who has had a heart attack in the family	Yes	277	44.7
	No	342	55.3

Table 2
Students' digital game playing habits (n = 619).

Digital game playing habit	$\bar{X}$±SD	Min.	Max.
Age started playing digital games	7.51 ± 1.88	3	10
		n	%
Daily time playing digital games	Fewer than two hours	349	56.4
	two hours or more	270	43.6
Day most digital games were played	Weekday	195	31.5
	Weekend	424	68.5
Device of choice for digital games	Computer	136	22.0
	Phone	350	56.5
	Tablet	111	17.9
	Other (e.g., game console)	22	3.6
Preferred digital game type	Online	429	69.3
	Off-line	190	30.7
Presence of another person playing digital games in the family (mother, father, or sibling)	Yes	434	70.1
	No	185	29.9
Status of parental guidance	Never controls	35	5.7
	Controls occasionally	228	36.8
	Always controls	356	57.5
Effects of digital games on course success	Adverse effect	203	32.8
	No effect	348	56.2
	Positive effect	68	11.0
Time playing digital games during COVID-19 pandemic	Increased	382	61.7
	No change	157	25.4
	Decreased	80	12.9

Table 3
Mean Scores of Students' Digital Game Addiction Scale, Cardiovascular Health Behavior Scale, and Sub-dimensions of Cardiovascular Health Behavior Scale.

	n	Mean	±SD	Min.	Max.
Digital Game Addiction Scale for Children	619	48.62	22.51	24.00	118.00
Cardiovascular Health Behavior Scale for Children	619	56.60	11.03	30.00	97.00
Cardiovascular Health Behavior Scale for Children Sub-dimensions					
Nutrition	619	13.76	3.28	7.00	28.00
Exercise	619	11.30	3.96	5.00	20.00
Sedentary lifestyle	619	9.51	2.99	4.00	16.00
Smoking	619	5.05	2.13	4.00	16.00
Self-love	619	7.24	2.63	4.00	16.00
Stress	619	9.71	3.00	4.00	16.00

whether the scales and the sub-dimension scores fit a normal distribution and they ranged from +2 to −2 for the DGA scale, cardiovascular health behavior scale, and the cardiovascular health behavior sub-dimensions.

The factors predicting DGA, in order of significance, were daily digital game playing time ($\beta = 0.325, p < 0.001$), the day most digital games were played ($\beta = 0.191, p < 0.001$), age starting digital game play ($\beta = -0.144, p < 0.001$), change in digital game playing duration during the COVID-19 pandemic (decreased; $\beta = -0.120, p = 0.001$, unchanged; $\beta = -0.092, p = 0.011$), gender ($\beta = 0.115, p = 0.001$), and preferred digital game type ($\beta = 0.076, p = 0.025$). The explanatory power of the model was 37.0% ($F = 53.586, p < 0.001$) (Table 4).

The increase in DGA resulted in the worsening of cardiovascular health behavior and all sub-dimensions. Digital game addiction predicted 23% of negative cardiovascular health behaviors ($\beta = 0.482, F = 78.078, p < 0.001$). Digital game addiction accounted for 11.1% of the variance in the sedentary lifestyle sub-dimension ($\beta = 0.619, F = 382.651, p < 0.001$), 11.1% of the variance in the nutrition sub-dimension ($\beta = 0.335, F = 186.956, p < 0.001$), 7.7% of the variance in the exercise sub-dimension ($\beta = 0.281, F = 52.781, p < 0.001$), 5.1% of the variance in the self-love sub-dimension ($\beta = 0.229, F = 34.235, p < 0.001$), 2.9% of the variance in the smoking sub-dimension ($\beta = 0.174, F = 19.323, p < 0.001$), and 0.07% of the variance in the stress sub-dimension ($\beta = 0.092, F = 5.304, p = 0.022$) (Table 5).

Fig. 1 summarizes the groups at risk for DGA and the negative effect of DGA on cardiovascular health behaviors.

Discussion

This study investigated the factors affecting students' DGA and the effects of DGA on cardiovascular health behavior during the COVID-19 pandemic.

The pandemic began in December 2019 and spread rapidly worldwide (Huang et al., 2020). Studies conducted during the COVID-19 pandemic show that children's screen time increased, and physical activity time decreased (Dunton et al., 2020; López-Gil et al., 2021; Moore et al., 2020; Nagata et al., 2020; Ozturk Eyimaya & Yalçin Irmak, 2021; Schmidt et al., 2020; Zhang et al., 2020). The results of these studies are consistent with the findings presented here. If measures are not taken, the increase in digital game playing time during the pandemic will be maintained as a habit as the children age (Wang et al., 2020). It is essential to identify the risk factors to take effective measures against DGA. This study first analyzed these risk factors.

Daily digital gaming time

Based on the results of the multiple linear regression analysis, the first factor that predicted DGA, in order of significance, was daily digital game playing time. During the pandemic, the DGA levels of students who played digital games for more than two hours a day were higher than the DGA levels of students who played digital games for fewer than two hours. World Health Organization and the American Academy of Pediatrics (AAP) do not recommend screen time for children up to 24 months. They also recommend that children between the ages of two and five should not exceed one hour of screen time per day. For older children, it is recommended that recreational screen time not exceed two hours a day (Knell et al., 2019; Pappas, 2022). A child who plays digital games for more than two hours a day can watch videos and spend time on social media in addition to the game time. The total daily recreational screen time may exceed four hours. In studies conducted during the pandemic, children's recreational screen time reached 6–7 h a day (López-Gil et al., 2021; Ten Velde et al., 2021). Behavioral changes similar to substance addiction occur in children who exceed the recommended time, notably during digital game playing. This situation, in turn, increases the risk of DGA (Lissak, 2018). It is vital to follow the recommendations of WHO and AAP in cooperation with parents and children to prevent DGA. Nurses who meet the child and their parents, especially school nurses, can undertake critical tasks in informing children and parents about these recommendations. Nurses may ask how many hours children play digital games

Table 4
Factors affecting digital game addiction (n = 619).

Independent Variable	Unstandardized Coefficients		Standardized Coefficients	t	p	95.0% CI
	B	SE	β			
(Constant)	49.450	3.494		14.15	<0.001	42.58 to 56.31
Gender (R: Female)						
Male	5.181	1.509	0.115	3.43	0.001	2.21 to 8.14
Age started playing digital games	−1.722	0.389	−0.144	−4.42	<0.001	−2.48 to −0.95
Daily digital gaming time (R: fewer than two hours)						
Over two hours	14.747	1.735	0.325	8.50	<0.001	11.34 to 18.15
Preferred digital game type (R: Off-line)						
Online	3.703	1.651	0.076	2.24	0.025	0.46 to 6.94
Day most digital games were played (R: weekend)						
Weekday	9.275	1.656	0.191	5.60	<0.001	6.02 to 12.52
Change in digital game playing time during the pandemic (R: increased)						
No change	−4.763	1.873	−0.092	−2.54	0.011	−8.44 to −1.08
Decreased	−8.056	2.432	−0.120	−3.31	0.001	−12.83 to −3.28

Notes: Durbin-Watson = 1.970; $F = 53.586, p < 0.001$; $R = 0.617$; $R^2 = 0.380$; Adjusted $R^2 = 0.370$.
Abbreviations: CI, confidence interval; SE, standard error; β, standardized regression coefficient.
*Significance level was accepted as $p < 0.05$. *Dependent variable = Digital game addiction.

Table 5
Effects of students' digital game addiction on cardiovascular health behavior and its sub-dimensions (n = 619).

Independent Variable	Cardiovascular health scale	Nutrition	Physical activity-exercise	Sedentary life	Smoking	Self-love	Stress
B	0.482*	0.335*	0.281*	0.619*	0.174*	0.229*	0.092*
R	0.482	0.335	0.281	0.335	0.174	0.229	0.092
R^2	0.233	0.112	0.079	0.112	0.030	0.053	0.009
Adjusted R^2	0.231	0.111	0.077	0.111	0.029	0.051	0.007
F	186.956	78.078	52.781	382.651	19.323	34.235	5.304
P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.022
Durbin-Watson	1.949	1.855	1.991	2.074	2.030	1.897	1.780

Abbreviations: β, standardized regression coefficient. *Significance level was accepted as $p < 0.05$.

per day. They can inform parents and children about WHO and AAP recommendations. They can refer children who play digital games for too long to relevant specialists. Parents can be informed about these recommendations by the schools at regular intervals. Students who are reported to play digital games more than two hours a day can be followed regularly by school counselors and informed about the harms of digital games.

Day most digital games were played

The second factor that predicted DGA in order of significance was the day most digital games were played. The DGA levels of the students who played digital games more on weekdays were higher than the levels of the students who played digital games mostly on weekends. The closure of schools and lockdown measures during the pandemic caused students to spend time at home during the week. Students played digital games late on weekdays since they did not have to go to school the next day. This situation, in turn, increased their DGA levels (Ko & Yen, 2020). Students are expected to fulfill their school-related responsibilities during the week. During the pandemic, in many countries, education was continued with distance learning opportunities on weekdays. This indicates that students continued to have school-related responsibilities during the pandemic period. However, school-related responsibilities are disrupted, and academic performance is adversely affected when students play excessive digital games on weekdays (Islam et al., 2020). Neglecting responsibilities due to playing digital games is one of the symptoms of DGA. Playing digital games on the weekends, when there are fewer school-related responsibilities and more time for social activities, has a more favorable impact on academic performance than playing digital games on weekdays (Hartanto et al., 2018; Van Den Eijnden et al., 2018). Child and parent cooperation is of considerable importance in restricting digital game playing times on weekdays. Parents should talk to their children about the negative effects of playing digital games on weekdays and plan activities, such as studying together, reading a book, or playing chess. All nurses working with children, notably school nurses, can inform parents about these activities, which can enhance the awareness of parents and children about the adverse effects of playing digital games for a long time on weekdays. It is crucial for schools to inform and support both parents and students in this process.

Age started to play digital games

The third factor that predicted DGA in order of significance was the age the participants started to play digital games. Students who started playing digital games at a younger age had higher DGA levels than students who started playing digital games at an older age. In this study, the DGA level decreased as the age of starting to play digital games increased. Starting to play digital games at an early age is among the factors that lead to DGA (Işıloğlu et al., 2021). World Health Organization and AAP, which emphasize in detail the harms of screen exposure at an early age in the guidelines they published, do not recommend screen time for children up to 24 months (Koell et al., 2019; Pappas, 2022). Parents have key responsibilities in preventing digital gaming at an early age. Parents should be regularly informed by nurses of the potential risks of starting to play digital games at an early age. Furthermore, other people who take care of the child should also have a high awareness of the potential risks of starting to play digital games at an early age.

Change in digital gaming time during the COVID-19 pandemic

The fourth factor, in order of significance, that predicted DGA was the change in digital game playing duration during the COVID-19 pandemic. The DGA level of the students who stated that their digital game playing time increased during the COVID-19 pandemic was higher than the students who stated that their playing time did not change or decreased. During the COVID-19 pandemic, the closure of schools and the cancellation of group and outdoor activities caused students to spend more time playing digital games (Ko & Yen, 2020). One of the domains most affected by the pandemic was organized sports activities. These activities were vital for students to spend their recreational time physically active. The cancellation of organized sports activities increased the time students spent playing digital games (Schmidt et al., 2020). Studies conducted in many countries reveal that students' physical activity levels decreased and their recreational screen time, including playing digital games, increased during the pandemic (Carroll et al., 2020; Dunton et al., 2020; Moore et al., 2020; Ozturk Eyimaya & Yalçin Irmak, 2021; Ten Velde et al., 2021). The rise in digital game playing time has also increased the risk of DGA, which has been a growing trend in recent years (Irmak & Erdoğan, 2019). This study also showed students whose digital game playing time increased during the pandemic were at a greater risk of DGA. The increase in digital game playing time may continue even after the pandemic is over. Students whose organized sports activities were interrupted during the pandemic may not return to these activities. Notably, school nurses and all nurses who meet with the child and their parents can undertake key roles in identifying the students whose digital game duration increased and who left sports activities irreversibly, especially during the pandemic. Parents can plan encouraging activities for their children to reduce digital game playing time and urge them to engage in sports activities. Schools can create special activity groups for these students. Nurses, meanwhile, may question the recreational screen time during the pandemic in health screenings and inform both parents and students about this issue.

Gender

The fifth factor that predicted DGA in order of significance was gender. Digital game addiction levels of male students were higher than the DGA levels of female students. Given that the first digital games were designed by males for males, digital games are often violent and the leading game characters are usually males, which caused males to be more interested in these games than females (Leonhardt & Overå, 2021). This initially led males to spend more time with digital games than females, and DGA symptoms were more common among males (Donati et al., 2021; Lissak, 2018). To protect male students from DGA, it is of great importance to analyze the games they usually play and

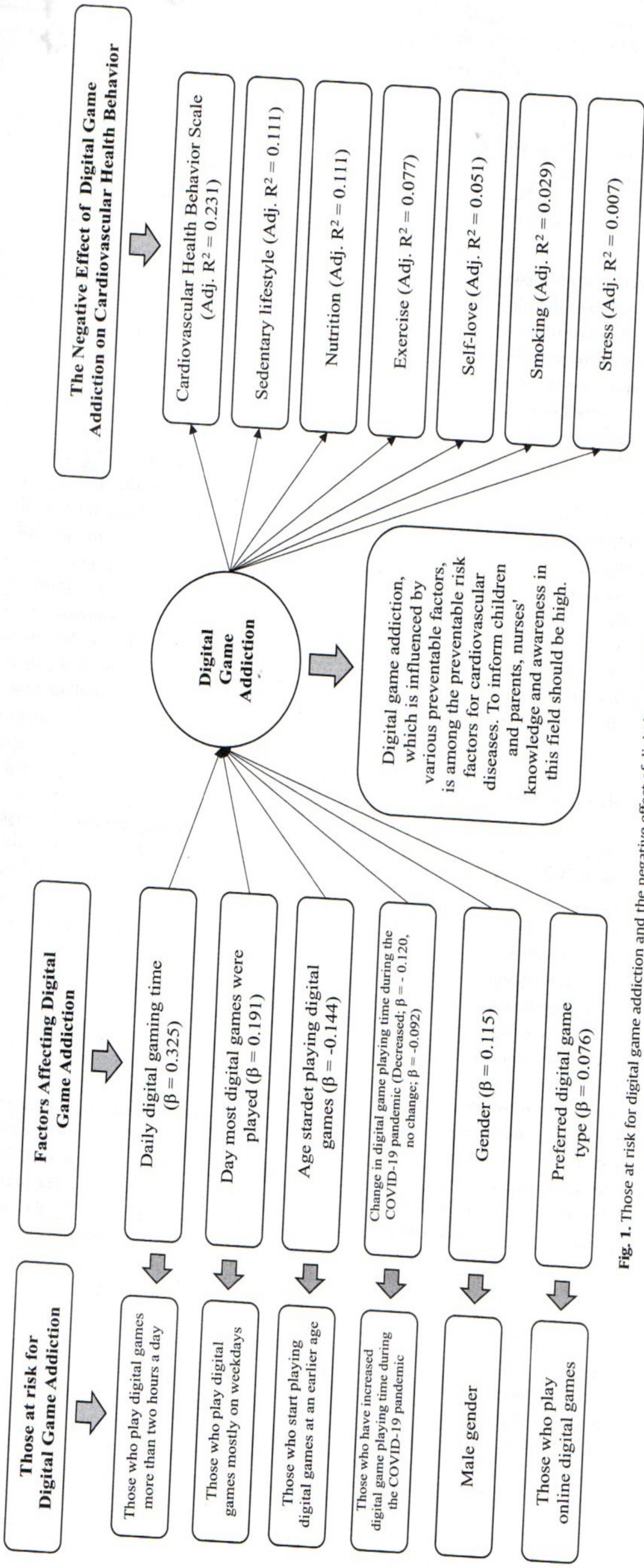

Fig. 1. Those at risk for digital game addiction and the negative effect of digital game addiction on cardiovascular health behavior.

playing time accurately. Parents should keep track of what kind of games their boy plays and at what time intervals. They should make decisions in cooperation with their children on issues such as game selection and duration. To promote this cooperation, they can also play digital games with their children occasionally. Increased cooperation can enable easier implementation of the decisions made. All nurses who meet with the child and their parents, especially school nurses, can undertake key roles in identifying male students with DGA symptoms and informing them about the harms of DGA.

Preferred digital game type

The sixth factor that predicted DGA in order of significance was the preferred digital game type. The DGA levels of the students who preferred to play online digital games were higher than the DGA levels of the students who preferred non-online digital games. Participation in online games has substantially increased during the pandemic (King et al., 2020; Ozturk Eyimaya & Yalçin Irmak, 2021). Playing online games increases addiction levels. Excessive online gaming may cause addictive behaviors similar to substance addiction (Hahn et al., 2014; Kim et al., 2022; Lissak, 2018). Research suggests that online gaming is one of the most likely reasons for problematic internet use. Time spent playing online games shows stronger correlations with internet gaming disorder than time spent playing offline games. Online gaming addicts spend more time preparing, organizing, and playing games (Stetina et al., 2011; Kuss & Griffiths, 2012; Lemmens & Hendriks, 2016). Parents should regularly check their children's online gaming habits. To perform this control effectively, parents should have high awareness and knowledge about online games. In particular, school nurses and healthcare professionals should inform parents about the risks of online games.

Effects of digital game addiction on cardiovascular health behavior

Effective measures must be taken to prevent DGA, which causes unhealthy weight gain and increased risk of CVD (Kracht et al., 2020). If these measures are not taken, the rise in DGA may adversely affect long-term cardiovascular health. In this study, an increase in DGA resulted in the worsening of cardiovascular health behavior and all sub-dimensions. Since excessive screen time, including digital game playing time, increases sedentary time and unhealthy snack consumption, it is associated with CVD risk factors such as obesity, high blood pressure, and insulin resistance (Lissak, 2018; McDool et al., 2020; Wang et al., 2020).

In this study, DGA had the greatest negative impact on the sedentary lifestyle sub-dimension of cardiovascular health behavior and the third highest on the exercise sub-dimension. A sedentary lifestyle, defined as behavior spent in sitting, reclining, and lying positions while awake, increases the risk of diabetes mellitus, hypertension, cancer, and CVD (Park et al., 2020; Tremblay et al., 2017). Digital game addiction, which has an adverse effect on physical activity, increased this adverse impact during the pandemic. The lockdown situation decreased the duration of physical activity and increased sedentary time (Caner & Evgin, 2021; Namli & Demir, 2020; Wunsch et al., 2021). The main danger is that students who turned to digital games more during the pandemic will carry their sedentary lifestyle and physical activity habits during the pandemic into the future. Nurses should be aware of the negative effects of DGA on a sedentary lifestyle and physical activity and should inform children and parents about this.

In this study, the second highest sub-dimension affected by DGA was nutrition. Digital game addiction is one of the key determinants of emotional eating, which is termed binge eating, as a psychological reaction to negative emotions. Digital game addiction increases the consumption of unhealthy snacks. There has been an increase in processed food consumption during the pandemic (Caner & Evgin, 2021; Lissak, 2018; Ruíz-Roso et al., 2020). Binge eating as well as consumption of unhealthy snacks and processed foods increase obesity and CVD risk factors (Singh et al., 2021). Parents and children should be informed about the negative effects of DGA on a diet. They should be warned that unhealthy eating habits may cause various chronic diseases, especially CVD, at later ages. The negative effects of DGA on nutrition should be included in the content prepared to prevent DGA.

DGA negatively affected self-love fourth, smoking fifth, and stress sixth. Digital game addiction may cause a decrease in self-esteem and an escalation in emotional problems (McDool et al., 2020; Toker & Baturay, 2016). Digital game addiction may lead to neglect of other duties and responsibilities related to home, school, and daily life. Such neglect may lead to student-parent conflict and increased stress. In particular, neglecting school-related responsibilities may result in academic failure. Academic failure, in turn, may trigger a decrease in self-esteem and stress (Männikkö et al., 2020). Especially in violent digital games, there is also content that abets smoking. Moreover, such content carries the risk of enticing students to smoke. Nurses should also have information related to the effects of DGA on self-love, smoking, and stress. They should inform children and parents about these issues. The effects of DGA on these sub-dimensions should also be contained in the curriculum prepared to prevent DGA.

This research shows that DGA has negative effects, specifically on the sedentary lifestyle, nutrition, and exercise sub-dimensions. The effect in other sub-dimensions was more limited. In particular, the sub-dimensions of self-love, smoking, and stress, which had limited effects, may be affected differently by diverse digital game types. Particularly, digital games containing content such as violence, aggression, crime, and substance use may affect these sub-dimensions considerably. Thus, parents' knowing and controlling the content of the games their children play can limit such harmful effects.

Limitations

These research findings should be interpreted with caution in light of the following limitations. First, since distance learning continued due to the pandemic, the data were collected using an online data collection form, so the possibility of bias cannot be excluded. Generalizability to other regions may be limited as all participating students were from the province of Izmir. It is recommended to conduct further studies that span diverse regions.

Conclusion

These findings revealed that during the COVID-19 pandemic, students' time playing digital games increased, with roughly half of them playing digital games for more than two hours a day. Playing digital games more than two hours a day, playing digital games more on weekdays, starting digital game play at a younger age, an increase in digital game playing time during the pandemic, male gender, and playing online digital games caused an increase in DGA. Digital game addiction, meanwhile, negatively affected cardiovascular health behavior and its sedentary lifestyle, nutrition, exercise, self-love, smoking, and stress sub-dimensions. The main danger is that students who turn to more digital games due to the effects of the pandemic might carry these habits into the next period of the pandemic. Students whose organized sports activities were interrupted during the pandemic may not be able to return to these activities. They may continue to spend more time using digital games. This, in turn, may cause a lack of physical activity, a sedentary lifestyle, and unhealthy eating habits. The prevalence of these habits may trigger an increase in the incidence of diseases such as diabetes, cancer, and especially CVD at later ages. To eliminate these negative effects, all nurses who meet with the child and parent, especially school nurses, can incorporate important educational content about DGA into these meetings.

Practical implications

It is crucial to effectively inform children and parents about the risk factors of DGA and its effects on cardiovascular health. Hence, all nurses who meet/work with children and families, notably school nurses, need to have high knowledge and awareness about DGA and its effects. Issues related to DGA should be included in in-service training in nursing schools and institutions. Nurses should evaluate the children they encounter in their work environment regarding DGA. They should gather information about digital game playing habits from parents and children. In risky situations, parents and children should be informed about the necessary measures to be taken. In the post-pandemic period, parents and children should be urged to spend more time outdoors. Nurses have a substantial influence on preventive health care. The results of this research will make a remarkable contribution to the development of these preventive services by revealing the risk factors for DGA and the effects of DGA on cardiovascular health behaviors.

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Authorship contributions

I.C. and M.B. contributed to the conception and design of this study. I.C. carried out the data collection process. I.C. and M.B. performed the statistical analysis and drafted this manuscript. M.B. critically reviewed the manuscript and supervised the whole study process. Both authors read and approved the final version of this manuscript.

Ethical approval

The study process was conducted in accordance with the Human Rights Declaration of Helsinki. Ethical approval was obtained for this study from the Dokuz Eylul University Non-Interventional Research Ethics Committee (Ethics Approval Number: 2020/14-05, Date: June 22nd, 2020). Institutional permission with the number 12018877-604.01.02-E.13574882 was obtained from the Izmir Provincial Directorate of National Education, to which the schools are affiliated. The permission to use the scales utilized in this research was obtained from the developers of the scales using e-mail. For the data collection form to be viewed, we have attached the informed consent form, which must be read and approved by the parent first. The online data collection form was completed only by students whose informed consent form was approved by their parents and who voluntarily agreed to participate in this study.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Competing Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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