Impact of the coronavirus disease 2019 pandemic on obesity, internet addiction, and sleep quality in adolescents

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ABSTRACT

Purpose: This descriptive cross-sectional study aimed to examine the effects of the coronavirus disease-19 (COVID-19) pandemic on obesity, Internet addiction, and sleep quality in adolescents.
Methods: In this study, data were collected from 395 healthy adolescents using a sociodemographic form, an Internet addiction scale, and a sleep quality scale. Descriptive statistics were analyzed as numbers, percentages, and mean values. The Wilcoxon test was performed to compare the mean body mass index (BMI), Internet addiction, and sleep quality scores of the participants before and after the COVID-19 pandemic. The differences were significant at a p value of <0.05.
Results: The mean age of the participants was 15.04 ± 1.81 years, and 53% of them were female. The difference between the mean BMI scores of adolescents before and after the COVID-19 pandemic was significant ($p < 0.01$). The difference between the mean Internet addiction scale scores of the participants before and after the COVID-19 pandemic was significant ($p < 0.01$). The difference between the mean sleep quality scale scores before and after the COVID-19 pandemic was also significant ($p < 0.01$). Approximately 27.1% and 34.9% of the participants were obese before and after COVID-19, respectively.
Conclusion: The obesity rate, BMI, and Internet addiction levels of children increased, whereas their sleep quality decreased after the COVID-19 pandemic.
Practical implications: During the pandemic period, online trainings for parents should be organized on planning physical activities during closure periods, regulating the adolescents' sleep and eating habits.

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Introduction

Coronavirus disease (COVID-19), which emerged in December 2019 in the Wuhan Province of China, was declared a pandemic by the World Health Organization in March 2020. This epidemic caused mental stress among individuals of all age groups (Tamiolaki & Kalaitzaki, 2020; WHO, 2020). To prevent the spread of the disease, workplaces and schools were closed, and home quarantine policies were implemented for children and adults. This caused a substantial loss of employment or income in various families, and children were unable to perform developmental tasks freely (Republic of Turkey Ministry of Health, 2020). The children were provided with distance education without any orientation and were unable to adapt to this process without support (Balhara et al., 2020; Çaykuş & Çaykuş, 2020).

The COVID-19 pandemic adversely affected the health, healthcare systems, and the economy, causing significant morbidity and mortality. It is an urgent public health problem, causing global mental, social, and economic difficulties. During the COVID-19 pandemic, 860 million children and young people were quarantined worldwide (Munro & Faust, 2020). Several researchers have stated that children whose lives have been profoundly affected by the COVID-19 pandemic have the greatest risk of deterioration of their health (Golberstein et al., 2020; Munro & Faust, 2020). The COVID-19 pandemic has caused and continues to cause increased stress and health problems among adolescents for a variety of reasons, including getting sick, fear of death, losing loved ones, home quarantine, and economic problems (Golberstein et al., 2020; UNICEF, 2020).

The implementation of social distancing and home quarantine policies significantly reduced the physical activity of the adolescents. Isolation promoted a sedentary lifestyle and increased the food consumption in children; increased food consumption, in turn, reportedly caused weight gain and obesity (Golberstein et al., 2020; Rundle et al., 2020).

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The prevalence of a sedentary lifestyle and physical inactivity led to a significant increase in the body mass index (BMI; 21–70%) of children after the pandemic compared with that in the pre-pandemic period (Dutta, 2020; Honce & Schultz-Cherry, 2019; Pujia et al., 2021; Xie et al., 2020; Workman, 2020). The adolescents had a difficult time coping with the sudden changes that occurred during the pandemic, with some of them experiencing social isolation, anxiety, and sleep and nutrition problems (Çaykuş & Çaykuş, 2020; Ünver et al., 2020; Xiang et al., 2020).

Hence, the adolescents had the tendency to engage in unhealthy behaviors such as the excessive use of the Internet to cope with these problems (Király et al., 2020). The Turkish Statistical Institute (2020) found that the Internet usage rate of individuals aged between 16 and 24 years relatively increased (84.3%) in Türkiye. When the literature was analyzed, the time spent using the Internet and watching television increased during the period of the pandemic, and the prevalence of Internet addiction increased by 24.4% (Király et al., 2020; Lin et al., 2020; Medrano et al., 2021; Oflu et al., 2021). Similarly, during the quarantine period, the adolescents tended to spend more time using the Internet and watching television (Nagata et al., 2020). The adolescents often ate their meals in front of the screen during the pandemic. This practice can delay satiety and cause excessive consumption of food. Excessive consumption of food has led to an increased risk of obesity (Chang et al., 2021; Khan et al., 2019; Mulugeta & Hoque, 2021; Ten Velde et al., 2021).

Besides obesity and Internet addiction, the pandemic adversely affected the sleep habits and quality in children (Burkart et al., 2022; Çaykuş & Çaykuş, 2020; Fidancı et al., 2021; Ünver et al., 2020; Yurteri & Sarigedik, 2021). The results of the study revealed that during the pandemic, children delayed their sleeping and waking up times, their sleep habits changed, and their sleep quality decreased by 20%–28% (Bruni et al., 2022; Burkart et al., 2022; Yurteri & Sarigedik, 2021). Since the schools were closed during the pandemic, the children tended to spend more time in front of the screen, eat more, sleep less, and perform less physical activity. These factors may have led to an increase in the risk of obesity during the pandemic (Burkart et al., 2022; Bruni et al., 2022; Çakır et al., 2019; Király et al., 2020; Lin et al., 2018; Wang et al., 2020).

Previous studies examined the effect of obesity, Internet addiction, or sleep problems, either as a single variable or a combination of any two variables. However, studies examining the effects of these three variables on each other could not be found (Bruni et al., 2022; Burkart et al., 2022; Çakır, 2019; Király et al., 2020; Lin et al., 2018; Medrano et al., 2021; Nagata et al., 2020; Oflu et al., 2021; Ünver et al., 2020; Workman, 2020; Xie et al., 2020; Yurteri & Sarigedik, 2021). Therefore, this study aimed to examine the impact of the COVID-19 pandemic on obesity, Internet addiction, and sleep quality in adolescents.

Methods

Aim and design

This descriptive, comparative, correlational, and cross-sectional study was conducted to examine the impact of the COVID-19 pandemic on obesity, Internet addiction, and sleep quality in adolescents.

Participants

The participants included healthy adolescents who were brought to the general pediatric outpatient clinics of the Pediatrics and Surgery Training and Research Hospital in the western region of Turkiye, which has a bed capacity of 320, an average of 800 outpatient visits per day, and an average of 450 emergency service applications.

The number of participants required for the study was determined to be 395 adolescents who were admitted in the hospital based on a significance level of 0.05, a statistical power of 80%, and a low effect size, which were evaluated using the GPOWER statistical analysis program. The study was conducted between May and September 2021. A total of 401 parents were interviewed at the outpatient clinic, and the parents of 395 adolescents agreed to include their children in the study. The study was conducted after receiving consent from their parents, and the response rate was 98.7%.

Data collection tools

Data were collected using the Informed Voluntary Consent Forms, Sociodemographic Data Collection Form, Internet Addiction Scale for Adolescents, and Sleep Quality Scale and Sleep Variables Questionnaire.

Data were collected in the outpatient clinic or electronically, depending on the participants' preference. The data collection forms were filled within 15–20 min. The information was gathered in an outpatient setting following the COVID-19 prevention protocols. The questions included in all questionnaires were related to the information on the pre-COVID and post-COVID periods.

Sociodemographic data collection form

This form consists of questions related to the parents' age, job, and education status; parents' economic status; number of children, age, and sex; the type of house they lived in; and the height and weight of the children before and after the pandemic. The following formula was used to calculate the BMI: weight (kilograms)/height (meters^2). BMI classification was determined according to the World Health Organization's BMI Z value for male and female adolescents (WHO, 2022). These data were compared with the hospital data.

Sleep quality scale and sleep variables questionnaire

The Sleep Quality Scale and Sleep Variables Questionnaire (SQS-SVQ) were developed by Meijer and Van den Wittenboer (2004). The SQS-SVQ measures sleep quality, parental control, total sleep time, sleep efficiency, and the corrected mid-point of sleep on free days (MSFsc). The Cronbach's alpha internal consistency coefficient of the scale was 0.67 for the parameters measuring sleep quality. Önder et al. (2016) conducted a validity and reliability study in Türkiye. As in the original scale, the SQS-SVQ consists of seven scale items and eight questionnaire items for measuring sleep quality in the Turkish sample. The internal consistency coefficient of the SQS was 0.72, whereas the test-retest correlations of the SQS-SVQ ranged from 0.67 to 0.88. The minimum and maximum obtainable scores on the scale were 7 and 21 points, respectively. The higher the score obtained from the scale, the lower the quality of sleep.

Internet addiction scale for adolescents

Taş (2019) developed an Internet addiction scale for adolescents based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, for online gaming addiction. The questions were answered using the following response opinions: "Never," "Rarely," "Sometimes," "Often," and "Always." The single-factor structure explains approximately 40% of the variance of the scale. The factor loads ranged between 0.548 and 0.707. Results of the confirmatory factor analysis showed that the fit indices were sufficient, and the scale could be used to determine the presence and severity of Internet addiction. The item-total score correlation was 0.427–0.587. The test-retest correlation coefficient calculated was $r = 0.72$, whereas the Cronbach's alpha internal consistency coefficient was 0.81. Higher scale scores indicated a higher level of Internet addiction. The total score ranged from 5 to 45 points. Participants who obtained a score of 30 points or more were considered to have Internet addiction.

Statistical analysis

The SPSS 25.0 statistical package program was used to analyze the data. Descriptive statistical methods (percentage, mean, and standard deviation) were used for evaluating the data. The normality of continuous data was evaluated based on the Gaussian curve, mean score, minimum and maximum ranges of the scores, and results of the Kolmogorov-Smirnov test. As the mean BMI, the mean Internet addiction scale score, and the mean sleep scale score in this study were not normally distributed, non-parametric tests were used for evaluation. The Wilcoxon test was conducted to compare the pre-COVID-19 and post-COVID-19 BMI averages, the mean Internet addiction score, and the mean sleep quality score of the participants. The McNemar's test was performed to compare the pre-COVID-19 and post-COVID-19 pandemic obesity status. The relationship among COVID-19, sleep, Internet addiction, and BMI was examined using the structural equation model (SEM), which was used to determine the mean BMI attributable to the COVID-19 pandemic. The differences between the study groups were significant at $p < 0.05$.

Ethical considerations

This study was approved by the ethics committee and the relevant institution. The information was gathered in the outpatient clinic or, if the participants preferred, via the Internet by e-mailing them a Google Form. The permission to use the measurement tools for the study was obtained from the scale owners via e-mails. The researchers obtained permission from the Ministry of Health before the study was conducted during the COVID-19 pandemic.

Results

The mean age of the participants was 15.04 ± 1.81 years, and 53% of them were female. The participants' mothers were mostly primary school graduates (28.9%), whereas their fathers were mainly high school graduates (31.1%). Half of the participants (51.1%) had sufficient income to sustain their needs. (See Table 1)

The mean body mass index (BMI) values of the children before and after the pandemic were 22.82 ± 3.87 kg/m^2 and 24.38 ± 4.24 kg/m^2, respectively, and the BMI increased significantly after the pandemic ($p < 0.01$). (See Table 2)

Approximately 27.1% of the participants ($n = 107$) were obese before the pandemic, whereas 34.9% of them ($n = 120$) were obese after the pandemic. The percentage of obese participants was significantly higher after the pandemic (p < 0.01). (See Table 3)

Table 1
Distribution of the descriptive characteristics of all participants.

Variables	Categories	n	% / Mean ± SD
Age		395	15.04 ± 1.81
Gender	Female	210	53
	Male	185	47
Mother's education	Illiterate	12	3
	Literate	27	6.8
	Primary school	114	28.9
	Middle school	82	20.8
	High school	84	21.3
	University and higher education	76	19.2
Father's education	Illiterate	3	0.8
	Literate	2	0.5
	Primary school	68	17.2
	Middle school	90	22.8
	High school	123	31.1
	University and higher education	108	27.6
Income status	Income is less than expenditures	87	22
	Income is equal to expenditures	202	51.1
	Income is greater than expenditures	106	26.8

SD = Standard Deviation.

Table 2
Pre-COVID-19 and post-COVID-19 body mass index values.

	BMI values (kg/m^2)		z	p
	M	SD		
Pre-COVID-19	22.82	3.87	13.539	< 0.01
Post-COVID-19	24.38	4.24		

BMI = Bady Mass Index, M = Mean, SD = Standard Deviation.

The mean Internet addiction scale scores of the participants before and after the COVID-19 pandemic were 18.68 ± 6.19 and 24.71 ± 7.42, respectively. The Internet addiction levels of children increased significantly after the COVID-19 pandemic ($p < 0.01$). (See Table 4)

The mean sleep quality scale scores before and after the pandemic were 16.09 ± 1.84 and 13.74 ± 2.49, respectively. The sleep quality of the children decreased significantly after the COVID-19 pandemic ($p < 0.01$). (See Table 5)

A moderate negative relationship was found between COVID-19 and sleep quality ($r = -0.40$), whereas a moderate positive relationship was found between Internet addiction ($r = 0.42$) and BMI ($r = 0.30$). A low level of significant relationship was observed between sleep quality and BMI ($r = 0.04$) and between Internet addiction and BMI ($r = 0.07$). The COVID-19 pandemic, changes in sleep quality, and Internet addiction contributed to 10% of the changes in the BMI ($r^2 = 0.10$). In addition, the change created by the COVID-19 pandemic contributed to 25% of the change in sleep quality ($r^2 = 0.25$) and 16% of the change in Internet addiction rate ($r^2 = 0.16$). All fit indices were above 0.90. (See Fig. 1)

Discussion

In this study, the effects of the COVID-19 pandemic on obesity levels, Internet addiction, and sleep quality in adolescents were investigated.

Results showed that the post-COVID-19 BMI of adolescents was significantly higher than the pre-COVID-19 BMI. The obesity status of the adolescent in this study increased by approximately 7% after the COVID-19 pandemic. Similar studies found that unhealthy weight gain associated with pediatric BMI changes occurred in children who were already vulnerable during the pandemic (Chang et al., 2021; Dutta, 2020; Eskici, 2020; Mulugeta & Hoque, 2021; Naja & Hamadeh, 2020; Storz, 2020; Ten Velde et al., 2021; Workman, 2020). During the pandemic, schools were closed, and social restrictions were imposed to stop the spread of COVID-19. Social restrictions led to a decrease in physical activity, decrease in sleep quality, increase in the consumption of snacks and emotional eating to cope with stress, and increase in screen time in adolescents. These increasing unhealthy behaviors have led to an increase in the incidence of obesity (Di Pietro et al., 2020; Dunton et al., 2020; Dutta, 2020; Eskici, 2020; Naja & Hamadeh, 2020; Rundle et al., 2020; Storz, 2020; Workman, 2020). In the literature, it is emphasized that providing adequate opportunities for adolescents to do physical activity during the period of social restrictions, increasing their social interactions, and providing healthy nutrition reduces the risk of obesity during the pandemic (Chang et al., 2021; Dutta, 2020;

Table 3
Obesity status of the participants before and after the COVID-19 pandemic.

Pre-COVID-19		Post-COVID-19				Total	
		Non-obese		Obese		n	%
		n	%	n	%		
Non-obese		254	88.2	34	11.8	288	72.9
Obese		3	2.8	104	97.2	107	27.1
Total		257	65.1	138	34.9	395	100.0
Mc Neamer	X^2	24.324					
	p	<0.001					

Table 4

Pre-COVID-19 and post-COVID-19 Internet addiction scale scores.

	Internet Addiction Scale Scores		z	p
	M	SD		
Pre-COVID-19	18.68	6.19	15.032	< 0.01
Post-COVID-19	24.71	7.42		

M = Mean, SD = Standard Deviation.

Table 5

Sleep quality scale scores before and after the COVID-19 pandemic.

	Sleep Quality Scale Scores		z	p
	M	SD		
Pre-COVID-19	16.09	1.84	13.490	< 0.01
Post-COVID-19	13.74	2.49		

M = Mean, SD = Standard Deviation.

Eskici, 2020; Mulugeta & Hoque, 2021; Naja & Hamadeh, 2020; Storz, 2020; Ten Velde et al., 2021; Workman, 2020).

Our results showed that the Internet addiction levels of adolescents increased during the pandemic period. Moreover, 50.8% of adolescents spent >10 h a day playing digital games online and using the social media. The literature shows that during the pandemic period, social isolation limited the adolescents' time with their friends, reduced their recreational activities, and they experienced higher levels of boredom owing to the limited activities that they could perform at home (Chang et al., 2021; Dunton et al., 2020; Király et al., 2020; Mulugeta & Hoque, 2021; Xiang et al., 2020). Adolescents showed higher Internet usage rate during the pandemic to reduce their boredom and increase their sociability (Balhara et al., 2020; Tsenoli et al., 2021; Zhang & Liu, 2020). In this study, we attributed the increase in Internet addiction levels to the fact that children use the Internet more often to socialize, reduce their boredom, enjoy, and cope with their emotional problems.

Our findings showed a significant decrease in the sleep quality of adolescents. The literature shows that especially during the pandemic period, longer screen time, staying up late at night, and getting up late in the morning disrupted the sleep patterns and decreased the sleep quality in children (Bruni et al., 2022; Cellini et al., 2021; Tetik & Şen, 2021; Ünver et al., 2020; Xie et al., 2020; Yurteri & Sarigedik, 2021). The severity of daytime sleepiness of children increased during the pandemic period, and adolescents slept more during the day in order to overcome both daytime sleepiness and boredom (Bruni et al., 2022; Cellini et al., 2021; Tetik & Şen, 2021; Ünver et al., 2020; Xie et al., 2020; Yurteri &

Sarigedik, 2021). This disruption in the adolescents' sleep habits led to the decrease in their physical activity levels, increase in screen time, and excessive intake of energy, thus increasing the risk of obesity. For this reason, it is important to re-establish the sleep routines of adolescents to the pre-pandemic time, reduce their screen time by providing appropriate activities, and design a suitable nutrition program to maintain their health during the pandemic period.

We found a significant relationship among Internet addiction, BMI, and sleep quality. Internet addiction and sleep quality were responsible for 10% of the change in BMI during the pandemic period. In particular, longer screen time resulted in the reduction of physical activity levels, changes in sleep hours, and an increase in the consumption of junk food. Both decreased activity and increased energy intake increase the risk of obesity (Bruni et al., 2022; Cellini et al., 2021; Chang et al., 2021; Dunton et al., 2020; Király et al., 2020; Mulugeta & Hoque, 2021; Ten Velde et al., 2021; Xiang et al., 2020; Yurteri & Sarigedik, 2021). In this study, increased Internet addiction and decreased sleep quality were associated with an increase in BMI. The results of this study are consistent with previous findings (Bruni et al., 2022; Cellini et al., 2021; Dunton et al., 2020; Király et al., 2020; Xiang et al., 2020; Yurteri & Sarigedik, 2021).

Practice implications

During the pandemic period, online trainings for parents should be organized on planning physical activities during closure periods, regulating the adolescents' sleep habits, and managing negative habits of children to managing problematic behaviors such as consuming junk food and emotional eating.

Adolescents should be taught to cope with the stress that results in emotional eating, urged to be physically active after appropriate physical activity programs are implemented when the restrictions are finally removed, and encouraged to foster and maintain relations with friends following the pandemic prevention protocols. It is necessary to create online physical activity groups for adolescents during the closure periods, to increase their physical activity levels and cope with stress.

Sleep patterns should be enforced by the parents, with bedtimes and wake-up times planned in consultation with the adolescents, and the screen time should be determined according to the periods recommended in the literature.

Limitations

This study has several limitations. First, a convenience sampling was performed. The convenience sampling may affect the generalizability of
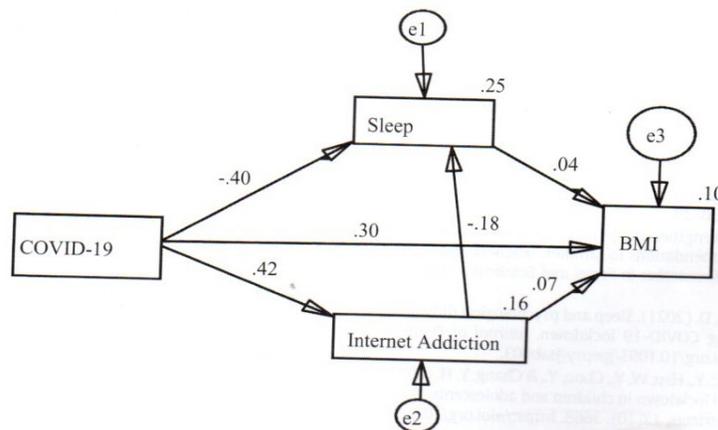
Fig. 1. Relationship among the variables.

the study results. However, it is thought that the large sample size and the inclusion of children from various provinces in the study may reduce the limitations.

However, the fewer follow-ups of healthy children during the pandemic and the fact that the children were only referred to the hospital during emergency situations and during follow-up might have affected the study results.

Conclusion

This study determined that the BMI and Internet addiction levels of adolescents increased, whereas their sleep quality decreased during the pandemic period. Moreover, increased Internet addiction decreased the sleep quality, and increased Internet usage time and decreased sleep quality were associated with the changes in BMI. Internet addiction and sleep quality were determined to be important factors underlying the changes in BMI.

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Ethical statement

Non-Interventional Clinical Research Ethics Committee (IRB no:2021/15–05).

Authors' contributions

FD, DO, MB and BÖ conceptualized and designed the study, acquired, analyzed and interpreted the data, and drafted the manuscript. All authors designed the study, search literature and revised the manuscript. All authors read and approved the final manuscript.

Declaration of Competing Interest

The authors declare that they have no conflicts of interest.

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