

# The effects of COVID-19 pandemic and lockdown on internet, smartphone use and emotional-behavioral problems in adolescents: A longitudinal study

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## SUMMARY

**Objective:** Young people had adverse emotional and behavioral effects due to the pandemic and restricted measures, which caused social isolation, spending more time online with smartphones, tablets, and computers. We aimed to investigate adolescents' emotional/behavioral problems and internet/smartphone usage features during this pandemic and to compare the findings with the pre-pandemic features.

**Method:** The sample consisted of 57 adolescents (27 males, 30 females). Data were collected at two-time intervals: before the COVID-19 pandemic [T1] and during the COVID-19 pandemic [T2]. All participants fulfilled the Strengths and Difficulties Questionnaire (SDQ), The Young's Internet Addiction Test (IAT), Smartphone Addiction Scale-Short Version (SAS-SV).

**Results:** The results indicated that both internet and smartphone use duration significantly increased at T2 ( $P < 0.001$ ). With regards to SDQ, emotional symptoms, hyperactivity problems, prosocial behaviors, and total difficulties subscales were significantly worse at T2 than T1 ( $P < 0.05$ ). Additionally, significant correlations were found between IAT and SAS scores and SDQ behavioral problems, hyperactivity-inattention subscores, and total difficulties scores ( $P < 0.001$ ). Finally, according to regression analysis hyperactivity-inattention problems increased the risk of problematic internet use ( $P < 0.05$ ).

**Discussion:** We objectively observed internet and smartphone use increase and relations with emotional and behavioral problems among adolescents during the outbreak of Covid-19. Therefore, these results should be carefully kept in mind while developing health policies for the long-term effects of the pandemic, whose duration is not yet known.

**Key Words:** Pandemic, internet addiction, smartphone addiction, emotional problems, behavioral problems

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## INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has brought some challenges and difficulties to the lives of people around the world, including children and adolescents. The World Health Organization (WHO) declared the disease a pandemic on 11 March 2020. As a response to the pandemic, most countries immediately implemented

some measures such as home quarantines, social restrictions, and school closures to slow down to spread of the infection. The mandated lockdowns keeping the social distance abruptly changed people's social lives and daily routines, along with the escalating use of digital gadgets and the internet (1). Although youngsters are less vulnerable to COVID-19, children and adolescents may experience more short and long-term side effects of the

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pandemic and measures, including lockdowns and school closures (2-4).

In recent years, the usage of technological communication devices (e.g., smartphones, tablets) has rapidly increased worldwide. With the restriction of outdoor activities due to lockdowns and school closures, participation in other activities (e.g., internet or smartphone use, exercise, watching television) may increase or decrease during the COVID-19 outbreak period. The pandemic induced an increase in internet usage, which may increase the risk of developing addictive behaviors in adolescents that persist throughout their lifespan (5). Furthermore, overuse of these devices and spending more time on the internet may lead to physical or mental problems (6-8). Previous researches have emphasized that in addition to excessive fear of being infected, social isolation and increasing digital consumption are also related to many mental health problems ranging from sleeping problems to emotional and behavioral problems among adolescents (9-12). Duan et al. (2020) has figured out the higher prevalence of anxiety and depression in adolescence during this global crisis, and it has been highlighted the positive correlation between internet/smartphone addiction and anxiety/depression levels (13).

During the pandemic, some children and adolescents may not be completely isolated due to their parents being at home. However, keeping in mind that social interaction with peers is a crucial part of psychosocial development, the social distance may force many adolescents to experience more loneliness (11). Additionally, previous studies have reported the impacts on mental and physical health during the pandemic (14). Since children and adolescents are more vulnerable to any type of addiction than adults, disasters such as epidemics and terrorist attacks may have increased addictive behaviors including smoking, excessive alcohol consumption, and internet addiction (15-17). In this case, children and adolescents may have increased spending more time on social media and the internet as a strategy to keep themselves busy and to cope with the feeling of loneliness, anxiety and depression (15,18,19). In the light of knowledge that adolescence involves immature coping strategies and resilience, it is not surprising that all the consequences of the pandemic could have a

more compelling impact on adolescents' mental health.

Given the scope of the COVID-19 pandemic, it is essential to better understand impacts on the mental health of adolescents and behavioral changes. In this case, if related risk factors, mental health problems, and related factors are known, intervention methods can be developed accordingly during or after the pandemic. Based on current knowledge, we can guess that social isolation may increase screen time and internet use, but, in the literature, studies comparing the pre and during pandemic features of mental health, screen and internet usage have been limited. Because many previous studies have focused on the impacts of the pandemic on mental health, screen and internet usage time during this process comparing with the prepandemic data, which was obtained by asking in the same time with pandemic data. So that, the aims of this present study were 1) to investigate the emotional/behavioral problems and internet/smartphone usage features of adolescents during this pandemic and 2) to compare the findings with the pre-pandemic features.

## **METHODS**

### **Participants and Study Design**

Our study was first designed to investigate the smartphone and internet usage characteristics of adolescents who applied to Child and Adolescent Psychiatry outpatient unit due to any problem and their relationship with emotional/behavioral problems before the pandemic. Therefore, the first data of the study were collected between March and December 2019, Time 1 (T1). 126 adolescents (63 females, 63 males) aged 12-18 years participated in the first part of the study. Psychopathologies evaluated by clinical interviews and researchers collected data of participants via sociodemographic form including smartphone and internet usage time, online occupation areas (e.g. video gaming, social media, chat). All participants fulfilled the Strengths and Difficulties Questionnaire (SDQ), The Young's Internet Addiction Test (IAT), Smartphone Addiction Scale-Short Version (SAS-SV).

After March 2020, when the first COVID 19 case was diagnosed in our country, mandatory measures were started to be implemented in Turkey. As a result, school closures and lockdowns were imposed for a long time, as in many countries. Adolescents who participated in the first part were invited to the second part of study to fill out the questionnaires again in order to investigate the characteristics of the pandemic process. Fifty-seven adolescents (27 males, 30 females) of all participated in the second part of this study. The second data collection period was between September and December 2020, Time 2 (T2), a period that the schoolchildren in Turkey were not allowed to attend school. At T1, participants completed the study survey in the classroom setting, while at T2, students completed an online survey from home due to the COVID-19 restrictions.

## Measures

### The Socio-Demographic Measures

Gender, age, school grade, school achievement (self-perception), parental education statuses, family income, internet and smartphone usage areas (e.g., social media, video gaming, communication) were assessed.

*Strengths and Difficulties Questionnaire (SDQ)*: SDQ has been developed by Goodman in 1997 to diagnose psychological problems in children and adolescents (20). The SDQ consists of 25 items, and responses are on a Likert-type scale of 0 to 2 (based on the following replies: “Not true”, “Somewhat true”, “Certainly true”). It has five subscales: conduct problems, hyperactivity-inattention, peer problems and prosocial behaviors, and emotional symptoms. All these scales, except prosocial behaviors, are added together to generate a total difficulty score. The total difficulty score ranges from 0 to 40; it can also be categorized as a total score 0–14 indicates normal, a total score of 16–19 indicates borderline, and 20–40 indicates an abnormal score (21). Turkish version of the scale was adapted and observed to be consistent and reliable, with the Cronbach’s  $\alpha$ : 0.70 (22).

*The Young’s Internet Addiction Test (IAT)*: Turkish version of The Young’s Internet Addiction Test was

used to assess internet addiction symptoms (23). It is a self-rated test with 20 items, and each item is scored on a scale of 1-5. According to Young et al.’s criteria (24), participants whose IAT total scores 70 or above were classified as addictive internet users (AIU). Participants with an IAT total score of 40-69 were classified as problematic internet users (PIU) who had encountered general life problems due to Internet use. Participants with an IAT score of 39 or below were classified as normal Internet users (NIU), who only had some or no problems controlling Internet use. Coefficient Alpha for the Turkish version of IAT equals 0.895 (23).

*Smartphone Addiction Scale-Short Version (SAS-SV)*: SAS-SV was developed by Kwon et al. (2013) to measure the risk of smartphone addiction (25). Participants expressed their opinion for each item over a 6-point scale, ranging from 1 (strongly disagree) to 6 (strongly agree), with higher scores indicating a high risk of addiction. References to the previous studies, the cut-off value of this scale was defined by sex, precisely 31 for female and 33 for male, respectively (25). The internal consistency of the test was verified with a Cronbach’s  $\alpha$  of 0.90 in adolescents in Turkey (26).

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Eskisehir Osmangazi University of Medicine School. (ethical approval references: Study One: 2018-231 Study Two: 2020-436). All participants provided written informed consent prior to completing the survey (computer-based, e.g., by clicking “yes”).

### Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 23.00 was used to analyze the data. Simple descriptive statistics were expressed as frequency and percentage for categorical variables, mean and standard deviation (SD) for continuous variables. The comparisons of the normal distribution of numeric variables were evaluated using Paired-samples t-test, and non-normally distributed numeric variables were evaluated using the Wilcoxon test in the study population before and during the COVID-19 lockdown. The McNemar test was used to compare the categorical before and

during the COVID-19 lockdown. A p-value lower than 0.05 was considered statistically significant.

## RESULTS

### Sociodemographic characteristics

Of the 126 study participants (T1), 57 were included because they completed both times (T1 and T2) questionnaires. The mean age of adolescents was  $15.1 \pm 1.8$  at baseline (T1). All participants were 5th grade to 12th-grade students at T1. At T2, 6 were university students, 9 were currently not attending school, and the rest were 6th to 12th-grade students. Table 1 shows the sociodemographic and additional data of participants during lockdowns.

Moreover, their time spent on smartphones at T2 (mean  $6.4 \pm 4.7$  h daily) was significantly longer than their time spent on smartphones at T1 (mean  $3.9 \pm 2.7$  h daily) ( $P < 0.001$ ); time spent on the internet at T2 (mean  $7.7 \pm 5$  h daily) was significantly longer than their time spent on the internet at T1 (mean  $4.5 \pm 3$  h daily) ( $P < 0.001$ ). With regards to SDQ, emotional symptoms, hyperactivity prob-

**Table 1:** Sociodemographic characteristics of the study population and frequency of Lock-Down-Related Ratings

	N (%)
Gender	
Female	30 (52.7%)
Male	27 (47.3%)
Marital status	
Married parents	45 (78.9%)
Divorced parents	9 (15.8%)
Widow parents	3 (5.3%)
Parents' educational level	
Mother	
Primary school	28 (49.1%)
High School	15 (26.3%)
Graduation	14 (24.5%)
Father	
Primary school	18 (31.6%)
High School	21 (36.8%)
Graduation	18 (31.6%)
Psychiatric disorder at T1	
Depressive Disorders	9 (15%)
ADHD	9 (15%)
Anxiety Disorders	8 (14%)
Conduct Disorders	5 (8.8%)
Oppositional Defiant Disorder	1 (1.8%)
OCD	1 (1.8%)
Enuresis Nocturna	1 (1.8%)
None	23 (40.4%)
School attendance	
Online	32 (56.1%)
Online and in-person	17 (29.8%)
Not attending	8 (14%)
Meeting with friends	
No	22 (38.6%)
1-2 times a week	35 (61.4%)
Smartphone usage areas	
Social media	48 (84.2%)
Game	28 (49.1%)
Communication	47 (82.5%)
Other	15 (26.3%)
Academical performance	
Good	26 (45.6%)
Moderate-bad	31 (54.4%)

ADHD: Attention Deficiency Hyperactivity Disorder, OCD: Obsessive-Compulsive Disorder

**Table 2:** Comparisons of daily hours and scale scores

	Time 1 Mean (95% CI)	Time 2 Mean (95% CI)	P-value
Internet use (hours/daily)	4.5-3	7.7-5	< 0.001
Smartphone use (hours/daily)	3.9-2.7	6.4-4.7	< 0.001
SDQ-Emotional problems	3.3-2.1	4.3-2.5	0.004
SDQ-Behavioral problems	2.7-1.4	2.6-1.8	0.571
SDQ-Hyperactivity-inattention	4.8-2.1	5.5-2.0	0.035
SDQ-Peers problems	3.2-2.0	3.3-1.8	0.788
SDQ-Prosocial behaviors	8.2-1.9	7.5-2.1	0.015
SDQ-Total difficulty	14.1-4.8	15.9-5.0	0.031
IAT <sup>b</sup>	43.7-15.6	44.1-15.4	1.000
SAS-SV <sup>c</sup>	29.6-12.3	28.1-12.6	0.367

a: Strengths and Difficulties Questionnaire(SDQ) b: The Young's Internet Addiction Test (IAT), c: Smartphone Addiction Scale-Short Version (SAS-SV)

lems, prosocial behaviors, and total difficulties subscales were significantly worse at T2 than T1 ( $P < 0.05$ ). In addition, when we evaluated the IAT and SAS scores, no difference was found between the scores in the two time periods (Table 2).

Problematic internet users (PIU) were diagnosed based on the total score of the IAT. Participants who scored higher than 40 and more on the IAT were considered PIU. Table 3 reveals that PIU had poor behavioral problems, hyperactivity subscales and total scores of SDQ during lockdowns.

In addition, Table 4 shows the bivariate correlations of study variables. Statistically significant correlations were found between IAT and SAS scores and SDQ behavioral problems, hyperactivity-inattention subscores, and total difficulties scores.

According to the results of the regression analysis in Table 5, a 1-unit increase in hyperactivity-inattention subscores of SDQ led to increase the risk of problematic internet using (OR: 1.749, ( $P < 0.05$ )).

## DISCUSSION

To the best of our knowledge, although research on internet and smartphone use has increased recently, studies comparing pre-pandemic data with data during the pandemic are still limited. This study provides evidence of the adverse effects of the COVID-19 pandemic on internet and smartphone use and related risk factors. According to our findings, total daily time spent on the internet and

**Table 3:** Comparisons of SDQ scores between normal and problematic internet users

	PIU (n:31) mean-SD	Normal internet users (n:26) mean-SD	p
SDQ-Emotional problems	4.8-2.6	3.8-2.3	.117
SDQ-Behavioral problems	3.1-2	2.0-1.4	0.045
SDQ-Hyperactivity-inattention	6.4-1.8	4.5-1.7	< 0.001
SDQ-Peers problems	3.4-1.9	3.1-1.7	.524
SDQ-Prosocial behaviors	7.2-2.1	8-2.1	.127
SDQ-Total difficulty	17.9-4.4	13.5-4.7	< 0.001

PIU: problematic internet users, SDQ: Strengths and Difficulties Questionnaire

**Table 4:** Bivariate correlations of study variables.

Variable	1	2	3	4	5	6	7	8
1. SDQ <sup>a</sup> -Emotional problems	-							
2.SDQ-Behavioral problems	0.173	-						
3.SDQ-Hyperactivity-inattention	0.350**	0.214	-					
4.SDQ-Peers problems	0.023	0.224	-0.064	-				
5.SDQ-Prosocial behaviors	-0.007	-0.298*	-0.017	-0.147	-			
6.SDQ-Total difficulty	0.712**	0.621**	0.630**	0.441**	-0.174	-		
7.IAT <sup>b</sup>	0.244	0.343**	0.434**	0.083	-0.182	0.452**	-	
8.SAS-SV <sup>c</sup>	0.272*	0.424**	0.352**	-0.080	-0.198	0.402**	0.692**	-

\* P < 0.05, \*\* P < 0.001, a: Strengths and Difficulties Questionnaire(SDQ) b: The Young s Internet Addiction Test (IAT), c:Smartphone Addiction Scale-Short Version (SAS-SV)

smartphone use has significantly increased during pandemic restrictions. This may be explained by the extensive usage areas of smartphones and internet. Pandemic restrictions have caused social isolation, lack of physical relationships, and contact with friends and relatives (8,27). In this case, the combined use of the internet and smartphones may have provided communication, games, entertainment, occupation, obtaining information, and coping with loneliness. Serra et al. (2021) have shown in their study that an increase in smartphone use because of its functions such as telephone calls, videos, online chats, and social networks (8). It is essential for adolescents to be a member of a group and connect with their peers (28). In support of this, in our study, it was determined that the most common use of smartphones was social media and communication. Thus, during the pandemic, adolescents provided the necessary communication and interactions for their psychosocial development through smartphones and the internet. Consistently, a previous study has reported high rates of social media and communication applications among adolescents during the pandemic (29). In addition, another study conducted in Turkey showed that problematic internet use was associated with loneliness (30).

Our study shows that the SDQ emotional, hyperactivity-inattention and prosocial subscores of adolescents are worse during the pandemic compared to pre-pandemic times. In the literature, although very few longitudinal studies, there are many studies investigating the impacts of the pandemic on mental health in many particular populations (13,31,32). Longitudinal studies have figured out

**Table 5:** Multiple regression results on the effect of problematic internet users

	PIU OR	CI (95%) lower-upper	p
<b>Gender (Male)</b>	0.513	0.128-2.059	
SDQ-Emotional problems	1.000	0.762-1.312	0.999
SDQ-Behavioral problems	1.160	0.773-1.742	0.473
SDQ-Hyperactivity-inattention	1.749	1.181-2.589	<b>0.005</b>
SDQ-Peers problems	1.143	0.804-1.626	0.456
SDQ-Prosocial behaviors	0.848	0.613-1.174	0.320
SDQ-Total difficulty	1.090	0.782-1.520	0.610

SDQ: Strengths and Difficulties Questionnaire scores at T2

an increase in depression, anxiety, and stress (33,34). Additionally, a meta-analysis has shown that depression and anxiety in adolescents increased by double (35). These results need to be interpreted from many perspectives. First of all, emotional and behavioral problems may have increased due to the direct effects of the pandemic, losses, diseases, social isolation, compulsory restrictions such as school closures (35-37). On the other hand, socioeconomic difficulties such as familial unemployment and economic problems caused by the pandemic may have contributed to the existing problems (35).

According to the results of our study, although behavioral problems did not change during the pandemic, the participants reported a significant increase in attention and hyperactivity problems. It was also reported that hyperactivity and attention problems increased in the follow-up study conducted with 1-month intervals at the beginning of the pandemic (34). These attention and hyperactivity problems might be associated with life changes, social isolation, online schooling-related concentration problems, and pandemic stress (36,38-40).

In addition, the findings of our study have shown that although the daily smartphone and internet usage times of the participants increased almost twice, there was no difference in IAT and SAS scores. One of the most important reasons why there was no difference in the scores despite the increase in the duration may have been that these uses did not cause a loss of functionality due to closures during the pandemic. Besides, contrary to the loss of functionality caused by addiction, it comes to mind that internet and smartphone use may contribute to functionality during the pandemic period. However, in a cohort study conducted with an interval of 2 months, it was reported that smartphone addiction increased (8).

Our findings showed that behavioral and hyperactivity-inattention problems were correlated to high-

er IAT and SAS scores. In addition, regression analysis indicated that hyperactivity-inattention problems increased the risk of problematic internet use. This finding corresponded with other studies about this issue on adolescents (41,42). Furthermore, some studies have shown a significant correlation between psychiatric disorders (e.g. ADHD, MDD, anxiety disorders) and increased risk of internet addiction (43,44). In addition, similar to previous studies, the most common diagnoses we detected in T1 clinical evaluation were depressive disorder, ADHD, and anxiety disorders.

Interpretations of our findings should be taken with caution, and keep in mind the following limitations. First, as alluded to above, adolescents who applied to the outpatient clinic with any problem were included in our study. Therefore generalization to the whole population is restricted. Second, the psychiatric diagnosis interview was only made at T1; therefore, we cannot interpret cases' current diagnosis during the pandemic process. Further studies should conduct follow-up studies in order to clarify how psychiatric diagnoses have changed during the pandemic. Finally, the small sample size

makes it difficult to interpret some data, so longitudinal studies with larger samples are needed.

In conclusion, the strength of our study is that T1 data were collected in the same population before the pandemic, and it allows objective comparison with the data during the pandemic process. Despite the small sample group, the results of our study revealed the negative impacts of the COVID 19 pandemic on the mental health and internet and smartphone usage features of adolescents. The current data do not yet give precise information about how long the pandemic will last. Therefore, this study suggests that while fighting the pandemic, both the pandemic and restrictive measures have negative effects on mental health, and this issue should be carefully kept in mind in the long-term fight against the pandemic.

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