



# The role of loneliness and aggression on smartphone addiction among university students

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## Abstract

The COVID-19 pandemic has become a major health problem worldwide. In addition to the physical effects of COVID-19 on individuals, it has caused psychological and social problems on individuals. One of these problems is related to feelings of loneliness they experienced during the pandemic process and the increase in aggression and smartphone addiction levels, which are thought to be related. The main goal of current research is to explore the effects of loneliness and aggression behaviors on smartphone addiction. The data of the study were obtained from 843 university students (565 female and 278 male; 17–54 age range) who voluntarily participated in the research from 68 of 81 provinces in Turkey. Research data were obtained based on participants' self-reports through an online questionnaire. Personal information form, Smartphone Addiction Scale, UCLA Loneliness Scale, and Buss-Perry Aggression Questionnaire were used as data collection tools. Research findings show that the feeling of loneliness affects aggression behaviors and smartphone addiction, and aggression behaviors also affect smartphone addiction. Therefore, it can be said that loneliness and aggression are variables in predicting university students' smartphone addiction.

**Keywords** Smartphone addiction · Loneliness · Aggression

## Introduction

The 21st century, which has experienced rapid developments in technology, has witnessed technological developments that have left a trace in every aspect of life. In addition to technological developments, this period also witnessed an important health problem worldwide such as the COVID-19 pandemic. COVID-19 has caused psychological and social problems as well as physical effects and health problems

on individuals. With COVID-19, social relations decreased and individuals had to cope with feelings of loneliness during the pandemic process. This loneliness has made them more dependent on their smartphones and moreover, their aggression levels have increased. Smartphone addiction, aggression, and loneliness behaviors are among the issues that need to be examined both in relation to each other and their effects on each other.

Smartphones used by almost every age group have become a very important and indispensable component of daily life. Especially with the outbreak of COVID-19, the increase in the use of mobile phones, especially with the COVID-19 epidemic, causes physical and mental health problems in individuals. Indeed, it has been stated in the literature that the frequency of smartphone addiction among individuals is high during the epidemic period (Duan et al., 2021; Kayis et al., 2021). Smartphones are a popular tool especially for school and university students in terms of their use of the internet, social media, and communication purposes. Smartphones are small, easy to use and they have internet, entertainment, navigation, communication, games, etc. They make daily life easier because they contain many applications. However, this situation causes individuals not

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to be able to spend even an hour without checking their phones and to leave their smartphones (Lepp et al., 2015). This leads to smartphone addiction. Smartphones are changing people's lifestyles and even their learning styles (Aker et al., 2017; Meena et al., 2021). It has been determined that students who are addicted to smartphones are constantly interrupted by other applications on their phones while studying and do not have sufficient control in the learning process (Lee et al., 2015). Studies have pointed out that excessive and incorrect use of mobile phones in courses distracts students and negatively affects the learning process, thus reducing the targeted educational outcomes (Hill, 2000).

Although the smartphone has many advantages in planning daily activities, academic research, knowledge, innovation, etc., the addiction factor should be considered (Meena et al., 2021). As a result of the studies, it is expected that smartphone addiction will continue and this increase will bring more negative effects (Aljomaa et al., 2016). As there are many behaviors that are the result of smartphone addiction, there may be many factors that trigger this addiction. Internet addiction or smartphone addiction, regardless of its name, is a behavior associated with addiction and aggression. When the sub-dimensions of aggression are examined, loneliness is observed (Sun et al., 2021). For these reasons, loneliness, aggression, and smartphone addiction are variables that should be examined together (Mosallanejad et al., 2019). Therefore, in this study, we examined the structural relationships between smartphone addiction, loneliness, and aggression. Previous research findings that investigate the structural relationships between the variables of loneliness, aggression, and smartphone addiction are limited. In addition, it is a curious point how these variables create a model for university students. In the research, we examined the structural relationships between loneliness, aggression, and smartphone addiction of university students in the context of Turkish culture. In this sense, the study has a new and original value, and it is thought that the results of the research will increase the flow and depth of research on the subject.

## Background

### Smartphone Addiction

Smartphones have become an important part of individuals' life with their numerous features and all the applications they offer to users. Especially young people use this technology to increase their social mobility and expand their communication network. However, this situation brings addiction and many negative emotions. Researches reveal that 99.2% of users become anxious if they leave their phones (Thomson, 2021), while 75.4 of users are addicted to their smartphones (Abbott, 2020). As the use of smartphones increases, the

number of people who are addicted is increasing and society is starting to experience problems (Hong et al., 2012). Strong addiction to smartphones is a distinct and complex problem that researchers are working on explicitly and implicitly. Today, as smartphones become more advanced with all their functions, young people use their smartphones not only for access and communication but also for other functions such as entertainment and multimedia. Thus, they become more and more dependent on their smartphones, which can sometimes be a decision-maker and sometimes a guide for them.

### Loneliness

People need social behaviors such as communication, cooperation, and interaction. However, they can also enter a process where these social behaviors are disrupted, this is called loneliness.

Loneliness defined as the perception of deterioration in terms of quantity and quality in the relationship of the individual with other individuals or society (Peplau et al., 1979). Loneliness deteriorates interpersonal relationships, and when there is an inconsistency between actual and perceived expectations, a complex, unpleasant and emotionally distressing psychological experience emerges (Fitts et al., 2009). Being a university student is an important stage when physical separation from family and friends begins and loneliness becomes evident. Lonely people prefer being alone to social activities and spend more time on the internet, so loneliness and internet addiction seem to be significantly related. According to Engelberg and Sjoberg (2004), people who use the internet more frequently have weaker social skills. A similar situation is thought to be possible for smartphone addiction.

### Aggression

One of the most important social needs of individuals is to be in contact with other individuals and to establish healthy social relations. However, aggressive behavior can precede these relationships. It is an open, harmful, social interaction that includes emotions such as aggression, anger, or hostility, and aims to harm another individual or create other unpleasantness (Shobha et al., 2019). Aggressive behaviors create a more negative self-perception (Yavuzer et al., 2019). According to Buss and Perry (1992), the behavioral component of aggression includes all forms of physical or verbal behavior aimed at harming. Anger occurs when the individual encounters obstacles and aggressive behaviors occur when anger cannot be controlled.

It is seen that aggression is classified in different ways. According to Buss and Perry (1992), aggression contains 4 sub-dimensions: physical, verbal, hostility and anger.

Physical and verbal aggressions have been defined as motor behaviors that involve hurting others. Hostility is the attitude that causes the person to evaluate others negatively, including feelings of dislike and injustice, and has been defined as the cognitive dimension of aggression. Anger, on the other hand, acts as a bridge between physical, verbal aggression, and hostility dimensions and constitutes the emotional dimension of aggression.

### Loneliness and Aggression

Aggression and loneliness are associated variables in the literature. Studies show that lonely people are angry and behave aggressively, while those who exhibit aggressive behavior are becoming increasingly lonely (Sun et al., 2021; Pavri, 2015). Lonely individuals describe themselves with negative characteristics and have negative thoughts about others. For this reason, loneliness causes individuals to develop a negative perception of themselves, such as being unwanted and not accepted by others and leads individuals to aggression, which is a method they use force to control other people in interpersonal relationships (Kurtyılmaz, 2011). Some studies show that loneliness results in higher levels of aggression (Anwar et al., 2019; T'ng et al., 2020; Yavuzer et al., 2019). The point that needs to be investigated here is how loneliness affects aggression.

**H1:** *Loneliness significantly affects aggression.*

### Loneliness and Smartphone Addiction

Loneliness is another element that can be encountered among smartphone users. In the literature, the big development of technology and the high number of smartphone users are shown as an indicator of smartphone addiction and loneliness (Mosalanejad et al., 2019). According to Enez Darcin et al. (2016), individuals with psycho-social problems such as social isolation and loneliness may become dependent on devices such as smartphones by overusing them. Differently, Iqbal and Nurdiani (2016) did not find a significant relationship between smartphone addiction and loneliness in their study. The point that needs to be investigated here is how loneliness affects smartphone addiction.

**H2:** *Loneliness significantly affects smartphone addiction.*

### Aggression and Smartphone Addiction

Studies show that people with aggressive features have a smartphone addiction. Kim et al. (2015) stated that smartphone addiction tendency is affected by psycho-social factors such as depression and aggression. Shobha et al. (2019)

stated that smartphone addiction has a potential impact on depression and aggression among young adults. According to the researchers, those who use smartphones for various uses such as the internet and social media for a longer period of time have an increased tendency to aggression that can harm others. Moreover, it can lead to poor academic performance. According to Zarei (2021), one of the important factors impacting the aggressive behavior of university students is problematic smartphone use. According to researchers, focusing on students with smartphone addiction and early intervention for aggression is critical. The point that needs to be investigated here is how loneliness and aggression affect smartphone addiction.

**H3:** *Aggression significantly affects smartphone addiction.*

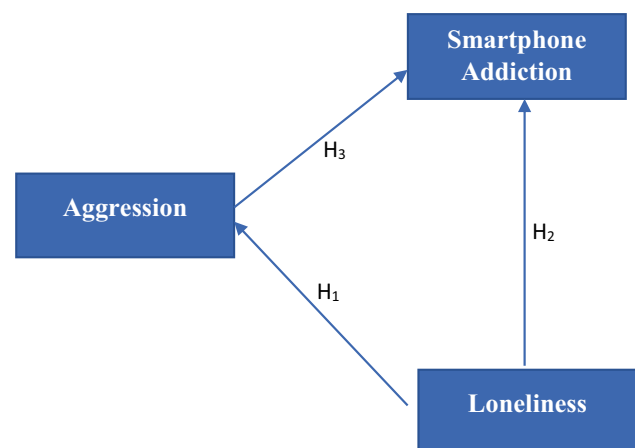
The research model put forward in line with the hypotheses described above is shown in Fig. 1.

When Fig. 1 is examined, it is assumed that loneliness and aggression have a direct effect on smartphone addiction and these assumptions are tested within the scope of the research. In addition, in the hypothetical model in Fig. 1, it is assumed that loneliness has a direct effect on aggression and this assumption is tested within the scope of the research.

## Method

### Participants and Procedure

The participants of the research consist of university students who voluntarily participated in the research from 68 of the 81 provinces in Turkey. Data from students were obtained through a web-based questionnaire. 843 university students



**Fig. 1** The hypothetical model of

participated in the research (%67 N=565 were female, %33 N=278 were male).

The convenience sampling method was used in this research and it is cross-sectional due to the nature of the convenience sampling method. The G\*Power program (Faul et al., 2009) was used to determine the sample size to be reached within the scope of the research. G\*power is a free program that calculates statistical power for researchers in calculating sample size. As a result of the analysis made in the G\*power program, it was determined that a participant consisting of 190 students could be sufficient for two predictive variables with real power of .99. In addition, the N:q rule (Kline, 2005), which is a useful general rule for the relationship between sample size and model complexity, is also used. Considering Kline's (2005) expectation of 20:1 as the N:q ratio, the sample size in this study was more than adequate.

The web-based survey was created using Google Forms. The link of the survey was sent to the student group e-mail addresses of the universities and also spread over the social media accounts of the authors. Students were asked to share the survey link with their fellow students. Thus, as in the snowball sampling method, the number of participants was tried to be increased by sharing the questionnaire with other students. As a result, participants from different cities and universities in Turkey were included in the research. The participation of the students was on a voluntary basis, and the students were not given any incentive to participate in the research. In the web-based questionnaire, the participants were first asked to answer the personal information section. After the personal information section, it was asked to answer the scales of smartphone addiction, loneliness, and aggression. When the participants answer all the questions in the survey, they can send the survey. Consequently, there is no missing data in this research. Detailed information about participants of this research is given in Table 1.

As seen in Table 1 the age range of the participants was 17-54 years (Mean=22.71 years). %99 of the participants have a smartphone with an internet connection.

## Measures

**Smartphone Addiction** Smartphone Addiction Scale was used to define the smartphone addiction status of the participants within the scope of research. Smartphone Addiction Scale was developed by Kwon et al. (2013). Demirci et al. (2014) adapted the scale into Turkish. The scale is 6-point Likert (1: definitely not, 6: absolutely yes), the lowest score to be taken from the scale is 33 and the highest score is 198. The higher the score obtained from the scale means the level of smartphone addiction is higher. Within the scope of the research, the reliability of the scale was recalculated and it was found to be high (Cronbach's alpha=.89). Some of the sample items in the scale are as follows: “I can't complete

**Table 1** Characteristics of participants

Variable	Frequency (n)	%
<i>Gender</i>		
Female	565	67
Male	278	33
<i>Having a Smartphone with Internet Connection</i>		
Yes	834	99
No	9	1
<i>Daily Average Smartphone Usage Status</i>		
Less than 1 hour	42	5
1-2 hour range	295	35
2-3 hour range	363	43
3-5 hour range	84	10
More than 5 hours	59	7

*my scheduled work due to my smartphone use”, “I have difficulty concentrating in class while doing homework or working due to my smartphone use”, “I feel pain in my wrists or the back of my neck when using a smartphone”.*

**Loneliness Scale** The UCLA Loneliness Scale, developed by Russell et al. (1978) and adapted into Turkish by Demirci (1989), was used to measure the loneliness levels of the participants. The UCLA Loneliness Scale consists of 20 items. The scale is in the form of a 4-point Likert (1 = never -4 = often). The lowest score that can be obtained from the scale is 20, and the highest score is 80. The higher the score obtained from the scale means the level of loneliness is higher. Some of the sample items in the scale are as follows: “I feel in harmony with the people around me”, “I feel like a part of a group of friends”, “I am no longer intimate with anyone”. Within the scope of the research, the reliability of the scale was recalculated and it was found to be high (Cronbach's alpha=.87).

**Aggression** The Buss-Perry Aggression Questionnaire was used to determine the aggression status of the participants within the scope of the research. Buss-Perry Aggression Questionnaire was developed by Buss and Perry (1992). The questionnaire was adapted to Turkish by Demirtas Madran (2013). The questionnaire consists of 29 items. The questionnaire comprises four factors (ie, physical aggression, hostility, and verbal aggression). The questionnaire is 5-point Likert (1: extremely uncharacteristic of me, 5: extremely characteristic of me) and the lowest score to be obtained from the scale is 29, the highest score is 145. The higher the score obtained from the scale means the level of aggression is higher. The reliability of the scale was recalculated within the scope of the study and it was found to be high (Cronbach's alpha=.87) Some of the sample items in the scale are as follows: “When frustrated, I let my irritation show”.

## Data Analysis

Within the scope of the current research, descriptive statistics, correlation analysis and structural equation modeling analyzes were performed in the analysis of the data. Univariate and multivariate normality analysis was performed to test whether the research data showed a normal distribution. In order to test the univariate normality assumption, skewness and kurtosis values and their critical ratios were taken into account. Skewness and kurtosis values between  $\pm 1$  indicate a normal distribution (Schumacker & Lomax, 2004). VIF and tolerance (T) indices were used for multivariate normality analysis (Hair et al., 2014). As a result of the normality analysis, it was determined that the data showed a normal distribution.

For the structural equation modeling, the compatibility of the data obtained from each scale was examined. For this, maximum likelihood (ML) analysis was performed. To examine the model fit, CFI (Comparative Fit Index), GFI (Goodness of Fit Index), AGFI (Adjusted Goodness of Fit Index), IFI (Incremental Fit Index), TLI (Tucker Lewis Index), RMSEA (Root-Mean-Square Error of Approximation) and SRMR (Standardized Root Mean Square Residual) fit indices were tested. The results of the fit index are reported in the findings section.

## Results

### Students’ Responses to Smartphone Addiction, Loneliness, and Aggression

Descriptive statistics are given in Table 2.

As presented in Table 2, the total mean score of participants from smartphone addiction is 89.72 (2.72 out of 6), and mean score of loneliness is 38.79 (1.94 out of 4), and the mean score of the aggression is 77.98 (2.69 out of 5). In this context, it can be said that students' smartphone addiction and aggression scores are moderate, and their loneliness scores are low.

### Relations Between Students’ Smartphone Addiction, Loneliness, and Aggression

The Pearson correlation has been used with the aim of investigating relationships between smartphone addiction, loneliness, and aggression.

As given in Table 3, the correlation values between the scale scores; Smartphone Addiction - Loneliness ( $r=.187, p<.01$ ), Smartphone Addiction - Aggression ( $r=.452, p<.01$ ) and Loneliness - Aggression ( $r=.141, p<.01$ ). According to Pallant (2001) correlation values  $r = .10$  to  $.29$  small;  $r = .30$  to  $.49$  moderate;  $r = .50$  to  $1.0$  strong indicates the relationship. According to these findings, it can be said that there is a low correlation between Smartphone Addiction – Loneliness, Loneliness – Aggression and a moderate relationship between Smartphone Addiction - Aggression.

### Path Analyses with Structural Equation Modeling Technique

The model fit indices obtained in the study and their reference criterias for acceptable fit are presented in Table 4.

Acceptable model fit indices (Hooper et al., 2008; Hu & Bentler, 1999; Kline, 2005; Tabachnick & Fidel, 2001) and calculated values of the fit indices at the level .05 levels are presented in Table 4. As observed in Table 4, it was found that fit index values of  $\chi^2/df$ , GFI, IFI, TLI, CFI, RMSEA, and SRMR had a slightly better fit, and the model was significant at the .05 level.

The path model, constructed based on the ML method, is shown in Fig. 2.

As shown on Fig. 2, aggression had a significant direct effect on smartphone addiction ( $\beta=0.35, R^2=.20$ ). Also, loneliness had a significant direct effect on smartphone addiction ( $\beta=0.11, R^2=.04$ ) and aggression ( $\beta=0.26, R^2=.02$ ).

The acceptance and rejection of the hypotheses are given in Table 5.

It is seen that (Table 5) all hypotheses are accepted. Consequently, it can be said that loneliness and aggression are predictors of smartphone addiction. Loneliness is also a predictor of aggression.

**Table 3** Correlations between smartphone addiction, loneliness and aggression

	Smartphone Addiction	Loneliness	Aggression
Smartphone Addiction	r		
Loneliness	r	.187**	
Aggression	r	.452**	.141**

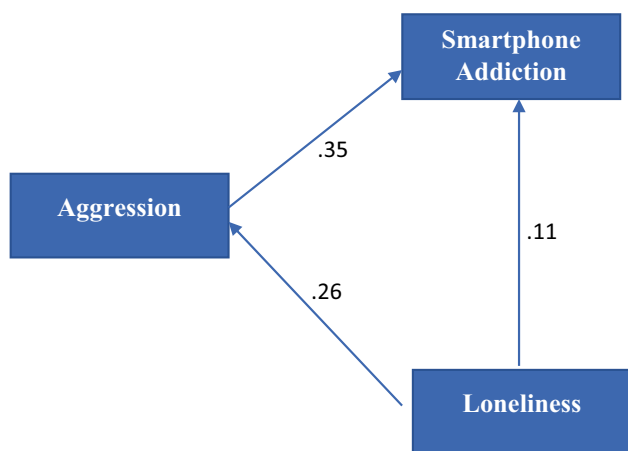
\*\* . Correlation is significant at the 0.01 level (2-tailed).

**Table 2** Descriptive statistics

Scales	Number of items	The lowest score	The highest score	$\bar{X}$	ss	$\bar{X}/k$
Smartphone Addiction	33	33.00	166.00	89.72	31.56	2.72
Loneliness	20	20.00	71.00	38.79	10.69	1.94
Aggression	29	38.00	135.00	77.98	18.61	2.69

**Table 4** Values of the goodness of fit index in structural equation model

	Model value	Perfect fit	Acceptable fit
$\chi^2/df$	3,967	$0 \leq \chi^2/df \leq 3$	$3 < \chi^2/df \leq 5$
CFI	.96	$.95 \leq CFI \leq 1$	$.90 \leq CFI < .95$
GFI	.93	$.95 \leq GFI \leq 1$	$.90 \leq GFI < .95$
AGFI	.88	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI < .90$
IFI	.96	$.95 \leq IFI \leq 1$	$.90 \leq IFI < .95$
TLI	.94	$.95 \leq TLI \leq 1$	$.90 \leq TLI < .95$
RMSEA	.08	$.00 \leq RMSEA \leq .05$	$.05 < RMSEA \leq .08$
SRMR	.06	$.00 \leq SRMR \leq .05$	$.05 < SRMR \leq .10$



**Fig. 2** The results of the hypothetical model of structural relations

### Discussion and Conclusion

In the research, we examined the structural relationships between smartphone addiction, loneliness, and aggression of Turkish university students. Our findings revealed that loneliness significantly affected smartphone addiction and aggression behaviors. According to another result of this research, aggression significantly affected smartphone addiction. Consequently, loneliness was positively correlated with smartphone addiction and aggression, also aggression was positively correlated with and smartphone addiction.

In reviewing the literature, various research results examining the relationship between loneliness and aggression

**Table 5** Results of hypotheses tests

Hypothesis	Antecedents	Supported?
H1	Loneliness → Smartphone Addiction	Yes
H2	Aggression → Smartphone Addiction	Yes
H3	Loneliness → Aggression	Yes

have been determined. Odacı and Çelik (2013) carried out research on Turkish university students and found that loneliness was positively correlated with aggression. Besides, internet addiction did not correlate with loneliness, while internet addiction was positively correlated with and aggression behaviors. In the research of Yavuzer et al. (2019), it was determined that loneliness significantly predicted the aggression behaviors of Turkish university students. Yilmaz et al. (2018) conducted research on Turkish high school students, and a positive relationship among loneliness, aggression behaviors, and game addiction was found. Our findings revealed that loneliness was positively correlated with aggression behaviors in Turkish university students. In addition, it has been determined that game addiction is associated with loneliness and aggression behaviors. In this sense, the findings are consistent with the literature.

Recent researches examine the relationship between loneliness and smartphone addiction. Bian and Leung (2014, 2015) show that loneliness was correlated with smartphone addiction among university students in China, and the probability of being smartphone-addicted is higher due to the increase in loneliness scores. On the other hand, Enez Darcin et al. (2016) conducted a study on university students, and it was concluded that loneliness was correlated with and smartphone addiction. Mahapatra (2019) concluded that loneliness was correlated with smartphone addiction in her research on adolescents. Jiang et al. (2018) conducted a study on international students studying at universities in China and revealed that international students in China are a high-risk population in terms of both severe loneliness and smartphone addiction. It has been determined that loneliness was correlated with smartphone addiction. In the study conducted by Kim et al. (2017) on nursing students, it was determined that students' loneliness was correlated with smartphone addiction. Liu et al. (2020) found a low but positive relationship between loneliness and smartphone addiction in their research on Chinese adolescents. In the study of Sönmez et al. (2021), it was found that smartphone addiction and loneliness scores of nursing students in Turkey were the moderate relationships between smartphone addiction and loneliness. Kayis et al. (2021) found a low but positive significant relationship between loneliness and smartphone addiction in their study on the Turkish general population. Aktürk et al. (2018) did not find a significant relationship between loneliness and smartphone addiction in their study on Turkish high school and university students. Also, there are differences between the research results in the literature. It is thought that these differences may be due to factors such as the culture in which the study was carried out, age level, the field of study. When evaluated in general, it was seen that loneliness and smartphone addiction were positively related in the majority of studies. These findings are consistent with the results of our study.

Previous researches have investigated the relationships among aggression and smartphone addiction. Kim et al. (2015) concluded that smartphone addiction was correlated with aggressive behaviors in Korean high school students. Up to now a number of studies have reported that aggression was correlated with smartphone addiction among primary school students (Lim & Kim, 2018; Park & Kim, 2016). A limited number of studies examine the relationship between smartphone addiction and aggressive behaviors in university students. In the current study, it has been concluded that smartphone addiction was correlated with aggressive behaviors. Consistent with the literature, the result of our research reveals that there is a positive and significant relationship between smartphone addiction and aggression behaviors in the context of Turkish university students.

The cultural context of the students, who constitute the sample of the research, may have been effective on the findings obtained from the research, as well as demographic characteristics such as gender and age. In other words, differences such as culture, gender, age may affect research findings. When the results of the research are examined, it is seen that loneliness and aggression play a role in predicting university students' smartphone addiction. Therefore, the increase in students' loneliness levels leads to an increase in aggression behaviors. The increase in aggressive behavior leads students to more smartphone addiction. It is thought that in societies where students who feel lonely in terms of culture, age, and gender characteristics are common, students' aggression and smartphone addiction levels may be high. For example, Lopez-Fernandez et al. (2018) examined the relationship between mobile gaming and problematic smartphone use in their research on Belgian and Finnish participants. As a result of the research, it was found that mobile games are not related to problematic smartphone use on Belgian and Finnish participants. However, studies conducted in different cultural contexts and age groups have reported significant positive relationships between aggression and smartphone addiction among primary school students (Lim & Kim, 2018; Park & Kim, 2016). Therefore, it can be said that the results related to smartphone addiction may vary according to the cultural context and demographic characteristics of students. From this point of view, cross-cultural comparative studies can be conducted in future studies, and the effects of various demographic characteristics of students on research results can be examined.

The results of this research show that in the context of Turkish university students, students' loneliness and aggression behaviors significantly affect smartphone addiction. Moreover, it can be said that taking measures to reduce students' feelings of loneliness and aggression may be effective in reducing students' smartphone addiction. In this direction, it is important to detect and monitor students' loneliness and aggression behaviors in reducing students' feelings of loneliness. Psychological support can be provided to students who

experience feelings of loneliness and aggression, and the factors underlying their feelings of loneliness and aggression can be determined. Then, measures can be taken to reduce these factors. Again, awareness-raising training can be given to parents in order to reduce the students' feelings of loneliness and aggression. In this way, parents can better understand the situation of their children. These measures, which can be taken to reduce students' feelings of loneliness and aggression, will contribute to the reduction of students' smartphone addiction. This research was executed with a limited sample of Turkish university students. The research can be repeated with a larger sample in future studies. Similarly, research findings can be compared by repeating the research in the context of different cultures (for example, on citizens of low-middle and high socio-economic countries, etc.). In future studies, the effectiveness of interventionist training programs to reduce loneliness, aggression, and smartphone addiction can be examined.

**Code Availability** The authors used AMOS functions for their statistical analyses.

**Data Availability** The authors are willing to share their data, analytics methods, and study materials with other researchers upon request.

## Declarations

**Ethical Approval** All procedures performed in these studies were in accordance with the APA ethical guidelines, the ethical standards of the institutional research committee, and the 1964 Helsinki declaration and its later amendments.

**Conflict of Interest** The authors have no conflicting or competing interests to declare.

**Informed Consent to Participate** All participants gave full informed consent to participate.

**Consent for Publication** All participants gave consent for their data to be used in publication.

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