



RESEARCH ARTICLE

Evaluation of The Relationship Between Internet and Smartphone Addiction and Loneliness Among University Students

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Abstract

The present study investigated the relationships between Internet addiction, smartphone use, and loneliness among university students, and compared these variables according to demographic characteristics. A total of 384 university students participated in this study, which employed a cross-sectional design. Data were collected using the Internet Addiction Test, Smartphone Addiction Scale, and UCLA Loneliness Scale. Descriptive statistics, correlation analyses, and multiple comparison tests were used for data analysis. The results revealed significant positive correlations between internet addiction, smartphone use, and loneliness, highlighting the interrelated nature of these constructs. Sociodemographic factors such as age, department, leisure activities, and family relationships were significantly associated with the study variables. Specifically, younger age groups and students from Health Sciences and Business and Management departments reported higher scores for Internet addiction and smartphone use. Moreover, engaging in sports or reading during leisure time was associated with lower scores in these areas. To conclude, findings emphasize the importance of considering sociodemographic factors and promoting alternative leisure activities when designing interventions to mitigate the negative effects of excessive technology use. Further research is needed to explore the underlying mechanisms and potential strategies for addressing internet addiction, smartphone use, and loneliness among university students.

Keywords

Internet, Smartphone Addiction, Loneliness, Sociodemographic Factors

INTRODUCTION

In recent years, the pervasive use of smartphones and the Internet has become an integral part of daily life, particularly among Generation Z university students. The history of Internet addiction research dates back to the mid-1990s, when Dr. Kimberly Young presented her initial findings at the American Psychological Association's annual conference (Young, 1998). Digital devices have transformed how people communicate, access information, and engage in various forms of

entertainment. However, excessive use of smartphones and the Internet has raised concerns about addiction and its potential consequences on mental health, social well-being, and academic performance.

Smartphone addiction, defined as the excessive and uncontrollable use of smartphones that interferes with an individual's daily life, has emerged as a significant issue among university students. Numerous studies have investigated the prevalence of smartphone addiction and its various risk factors, including personality traits, sociodemographic

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factors, and mental health conditions (Gökçearslan et al., 2018; Noyan et al., 2015). Research has indicated that excessive smartphone use can lead to various negative consequences, including sleep disturbances, anxiety, depression, and reduced academic performance (Demirci et al., 2014; Ozcan and Acimis, 2021; Öztürk et al., 2023).

Loneliness is a complex emotional state characterized by a subjective feeling of social isolation and dissatisfaction with one's social relationships. It is not merely the absence of social interaction but rather the perception of being disconnected from others and lacking meaningful connections. Loneliness has been associated with a range of negative physical and mental health outcomes including increased stress, depression, anxiety, and reduced cognitive function (Hawkley and Cacioppo, 2010; Peplau, 1982; Perlman, 1982).

Research has identified loneliness as both a risk factor and consequence of smartphone and Internet addiction (Aktaş and Yılmaz, 2017; Aslan, 2023; Yalçın et al., 2020). Early studies on Internet addiction, such as those conducted by Young (Young, 1998), suggested that excessive Internet use might lead to social withdrawal and increased feelings of loneliness, as individuals substitute online interactions for face-to-face connections. In a similar manner, Shapira et al. (Kwon et al., 2013; Noyan et al., 2015) explored the association between problematic internet use and loneliness and found a significant positive correlation between the two constructs.

With the rise of smartphones, researchers have extended these findings to examine the relationship between smartphone addiction and loneliness. A recent study by Chóliz (Chóliz, 2010) found that heavy smartphone users were more likely to report higher levels of loneliness than moderate users, indicating that excessive smartphone use may contribute to social disconnection and feelings of isolation. A study by Sahin et al. (2013) observed a positive correlation between smartphone addiction and loneliness in university students, highlighting the potential consequences of excessive smartphone use on social well-being.

This study aimed to comprehensively understand the relationship between Internet and smartphone addiction and loneliness among university students. By examining risk factors, consequences, and potential interventions, this research seeks to contribute to the ongoing academic

discourse on digital addiction and its impact on university students' mental health and well-being.

MATERIALS AND METHODS

This study was conducted with voluntary university students aged 18 and 35 who participated from June 1, 2021, to July 10, 2022. Informed consent was obtained from all the participants using voluntary information. This research was conducted with undergraduate, graduate, and postgraduate students attending Istanbul Esenyurt University and Istanbul Kent University. This study was conducted in accordance with ethical principles and guidelines for research involving human subjects. The research protocol was approved by the Institutional Review Board (IRB) of Istanbul Esenyurt University and Istanbul Kent University. The IRB approved the study before data collection commenced. Date and numbered: 01.10.2021/E-12483425-299-8712.

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All participants were informed of the study's purpose and procedures, and voluntary participation was ensured. Informed consent was obtained from each participant by using voluntary information. Participants were assured of their right to withdraw from the study at any time, without any consequences. Confidence and anonymity of the participants' data were maintained throughout the study and used solely for research purposes. Also Declaration of Helsinki rules have been followed. . Also Declaration of Helsinki rules have been followed.

In total, 450 online surveys were conducted. Convenience sampling and survey techniques were employed to collect the data. The sample size was calculated using a formula for quantitative research with variable features.

Study used validated scales to measure Internet addiction, smartphone addiction, and loneliness. Internet addiction was assessed using a scale developed by Gönül (Murat and Günüş, 2009). Smartphone addiction was measured using the Smartphone Addiction Scale (SAS) developed by Kwon et al. (2013) and its short version for adolescents by Noyan et al. (2015) and Demirci et al. (2014) validated the Turkish version of the SAS.

Internet Addiction Scale

Young developed the Internet Addiction Scale, which consists of 20 items rated on a 5-point Likert scale (1 = never, 5 = very often] (de Jong Gierveld, Psychology at Ege University examined the scale translated from English to Turkish. The standardized alpha reliability of the translated test was 0.91, and the Spearman-Brown value was 0.87, suggesting that the test was reliable.

Smartphone Addiction Scale

Kwon developed the initial Smartphone Addiction Scale based on Young's Internet addiction items and the future of smartphones (Young, 1998). The Turkish version of the scale was developed by Kwon et al. (2013) was developed by Demirci et al. (2014). The Cronbach's Alpha value for the original scale was 0.98, while it was 0.93 for the adaptation study. The Likert-type Smartphone Addiction Scale consisted of 33 items with a single-factor structure. Responses were evaluated on a scale of 1 to 6. The minimum and maximum response scores were 33 and 198, respectively. Those with higher scores were considered at-risk smartphone users, indicating an addiction.

UCLA Loneliness Scale (ULS-8)

Russell et al. developed the UCLA Loneliness Scale (Pretorius, 1993). The scale's reliability was examined, and the internal consistency coefficient was found to be 0.94. The test-retest reliability was found to be significant ($r = 0.73$). The scale consists of 20 items, with 10 coded positively and 10 coded negatively. The negatively coded items are as follows: 1, 4, 5, 6, 9, 10, 15, 16, 19, 20. Demir and Fişiloğlu (1999) and Demir (1989) examined the validity and reliability of a one-dimensional UCLA Loneliness Scale in Turkey. Yıldız and Duy (2014) adapted the short form of the scale. The factor analysis revealed a single factor. The factor loadings of the items range from 0.31 and 0.71. All fit indices for the ULS-8 indicated a good fit.

RESULTS

A total of 175 survey responses were collected online. However, it was observed that eight participants answered only the demographic questions and not the scale questions; thus, they were removed from the dataset. Consequently, the

1998; Young, 1998). The scale was evaluated on the basis of a single-dimension total score. The internal consistency reliability coefficient of the scale is 0.85. Five faculty members from the Department of analyses were conducted using responses from 167 participants.

Among the participants, 76.1% were female, and 23.9% were male. The age groups of the participants were as follows: 25.8% in the 18-20 age group, 44.2% in the 21-23 age group, 13.5% in the 24-26 age group, and 16.6% in the ≥ 27 age group. The majority of the participants were studying in the field of Health Sciences (50.3%), followed by Vocational Schools (17.8%), Graduate Programs (14.4%), and Business and Management Sciences (6.7%). Regarding academic achievement, 14.7% of the participants described themselves as very good, 53.4% as good, 30.1% as average, and 1.8% as poor.

It was observed that 76.1% of the participants were from nuclear families, whereas 23.9% were from extended families. The number of individuals in the family was found to be 1-3 in 17.8%, 4-5 in 54.0%, 6-7 in 21.5%, and 8 or more in 6.7% of cases. The family status of the participants was as follows: 89.6% lived with both parents, 1.2% had a deceased mother, 4.9% had a deceased father, and 4.3% had divorced or separated parents. The relationships among family members were described as very supportive in 32.5%, supportive in 36.2%, normal in 23.9%, conflicting in 5.5%, and highly conflicting in 1.8% of cases. The participants reported living with their families in 77.3% cases, with relatives in 3.1%, dormitories in 8.0%, and roommates in 6.7%. Table 1 presents the participants' demographic and family information (Table 1).

Among them, 1.2% evaluated their economic status as very good, 33.1% as good, 57.7% as normal, 6.7% as poor, and 1.2% as very poor. Most participants (68.7%) reported spending a significant portion of their lives in metropolitan areas. Additionally, 16.6% of the participants lived in cities, 10.4% in towns, and 3.7% in villages. It was found that participants spent their leisure time as follows: 27.6% on the Internet, 25.8% on their mobile phones, 19.0% listening to music, 12.3% reading books, and 10.4% engaging in sports activities. Table 2 presents socioeconomic information of the survey participants (Table 2).

Table1. Demographic characteristics of the participants

		N	%
Your gender	Female	124	76.1%
	Male	39	23.9%
Your age	18-20	42	25.8%
	21-23	72	44.2%
	24-26	22	13.5%
	27+	27	16.6%
Your department	Business and Management sciences	11	6.7%
	High School of Physical Education and Sports	7	4.3%
	School of Applied Sciences	3	1.8%
	Faculty of Engineering and Architecture	6	3.7%
	Faculty of Health Sciences	82	50.3%
	Vocational School	29	17.8%
	Faculty of Humanities and Social Sciences	2	0.6%
	Graduate	23	14.1%
How successful do you think you are in school?	Very good	24	14.7%
	Good	87	53.4%
	Middle	49	30.1%
	Bad	3	1.8%
Family structure:	Nuclear family	124	76.1%
	Extended family	39	23.9%
Number of members in your family (including you)	2-3	29	17.8%
	4-5	88	54.0%
	6-7	35	21.5%
	8+	11	6.7%
Your family	Living together	146	89.6%
	Mother passed away	2	1.2%
	Father passed away	8	4.9%
	Divorced/separate	7	4.3%
How do you evaluate your relationship with your family members?	Very supportive	53	32.5%
	Supportive	59	36.2%
	Normal	39	23.9%
	Conflicted	9	5.5%
	Very conflicted	3	1.8%
Who do you live with?	With my family	126	77.3%
	With my relative	5	3.1%
	In the dormitory	13	8.0%
	Roommate	11	6.7%
	Other	8	4.9%

Table 2. Evaluation of the participants' economic situation, place of residence and leisure time

		N	%
How would you describe your overall economic situation?	Very good	2	1.2%
	Good	54	33.1%
	Middle	94	57.7%
	Bad	11	6.7%
	Too bad	2	1.2%
Where have you lived the longest in your life?	Big city	112	68.7%
	City	27	16.6%
	District	17	10.4%
	Bay	6	3.7%
Which of the following hobbies do you do most often in your spare time?	Other	1	0.6%
	Reading books	20	12.3%
	To do sport	17	10.4%
	Cinema theater	3	1.8%
	Listen to music	31	19.0%
	Spending time on the internet	45	27.6%
	Spending time with cell phone	42	25.8%
To watch TV	5	3.1%	
Other	0	0.0%	

Exploratory Factor Analysis and Reliability of the Scales Used in the Study

Before conducting the analysis, the factor structure and reliability of the scales used in this study were examined. Exploratory factor analysis was performed on each scale to ensure that the underlying factor structure was consistent with the original studies. Additionally, reliability analysis was conducted to assess the internal consistency of the scales, and Cronbach's alpha coefficients were calculated for each scale. The results of the factor and reliability analyses of the Internet Addiction Scale, Smartphone Addiction Scale, and UCLA Loneliness Scale are presented in this section.

Exploratory Factor Analysis of the Internet Addiction Scale

In the exploratory factor analysis of the Internet Addiction Scale, three items were excluded from the analysis because they had standard factor-loading values below 0.50. These items were: "How often do you form new relationships with fellow online users?", "How often do you check your email before starting an assignment?" and "How often does your school performance suffer from Internet use?". A factor analysis was conducted using the remaining 17 items. performance suffer from Internet use?". r analysis was conducted using the remaining 17 items. performance suffer from Internet use?". A factor analysis was conducted using the remaining 17 items. items were: "How often do you form new relationships with fellow online users?", "How often do you check your email before starting an assignment?" and "How often does your school performance suffer from Internet use?". A factor analysis was conducted using the remaining 17 items.

Exploratory Factor Analysis of the Smartphone Usage Scale (SUS)

In the Smartphone Usage Scale (SUS) exploratory factor analysis, all items had standard factor loading values above 0.50, resulting in no items being excluded from the analysis. The Bartlett's test of sphericity was significant ($p < 0.05$), indicating that the dataset was suitable for factor analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.889, suggesting excellent suitability for factor analysis. Principal Component Analysis (PCA) was chosen as the extraction method for analysis.

Consistent with the literature, the SUS was found to have a single-factor structure in the present study sample. The explained variance is 51.37%. Standard factor loadings ranged from 0.552 to 0.814.

In the exploratory factor analysis of the ULS, two items with standard factor loading values below 0.50 were excluded from the analysis. These items were "I don't feel lonely" and "My social relationships are superficial." The Bartlett's test of sphericity was significant ($p < 0.05$), indicating that the dataset was suitable for factor analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.877, suggesting excellent suitability for factor analysis. Principal Component Analysis (PCA) was chosen as the extraction method for analysis. Consistent with the literature, the ULS was found to have a single-factor structure in the present study sample. The explained variance is 45.11%. Standard factor loadings ranged from 0.508 to 0.788.

Reliability and Internal Consistency of the Scales in the Study

The reliability and internal consistency measures for the scales used in the study were calculated and are presented in the table, along with the number of items. Accordingly, the Cronbach's alpha value for the Internet Addiction (IA) scale, which was analyzed with 17 items in the exploratory factor analysis, was 0.909. The Cronbach's alpha value for the Smartphone Use (SU) scale, which consists of 10 items, was 0.982, and for the UCLA Loneliness (UL) scale, which was analyzed with 18 items, the Cronbach's alpha value was 0.895. All three scales were found to have a "high reliability" level, with alpha values above the threshold of 0.80.

Correlational Analyses

To investigate the relationships between the dimensions of the scales used in this study, correlational analyses were conducted. Pearson correlation coefficients were calculated to determine the strength and direction of the relationships between the Internet Addiction (IA), Smartphone Use (SU), and UCLA Loneliness (UL) scales. The results of correlational analyses provide insights into the associations between these variables and contribute to a better understanding of how they might influence each other. For a more comprehensive interpretation of the results, it was essential to consider the effect sizes of the correlations.

Generally, correlations above 0.10 are considered small, above 0.30 are considered medium, and above 0.50 are considered large effect sizes. Considering these effect sizes, the findings can be interpreted more accurately, and the scale dimensions' potential relationships can be better understood.

Correlational Analyses Between Scale Dimensions

In the correlational analyses conducted between the scales used in the study, significant

positive relationships were found between the loneliness variable and Internet Addiction ($r=0.329$; $p<0.05$) and between the loneliness variable and Smartphone Use ($r=0.342$; $p<0.05$). Additionally, a significant positive relationship was found between Smartphone Use and Loneliness ($r=0.790$; $p<0.05$). Table 3 presents the correlational analyses of the scale dimensions.

Table 3. Correlation analysis between scale dimensions

Scales	One	2	3
1 Internet Addiction	One		
2 Smartphone Usage	,790 **	One	
3 UCLA Loneliness	,329 **	,342 **	One

** $p<0.01$ * $p<0.05$

These findings suggest that as the level of Internet Addiction or Smartphone Use increased, so did the level of loneliness among participants. It is essential to consider these relationships when developing interventions or policies to address Internet and smartphone addiction issues and their potential impact on mental health and well-being.

Regression Analysis: Explaining Internet Addiction by Smartphone Use

The regression coefficient ($\beta=0.790$; $p<0.05$) was found to be significant in the regression model explaining the Internet Addiction variable by Smartphone Use variable. According to this finding, an increase in mean Smartphone Use also increases Internet Addiction. Regarding the Internet Addiction variable, 62.5% of the variation can be attributed to Smartphone Use. Table 4 presents the regression analysis results, which indicate that Smartphone Use is a significant predictor of Internet Addiction.

Table 4: Prediction of Internet addiction variable by smartphone use variable

Model	Coefficient		Standard coefficient	T	P	R2 -
	B	SE	B			
Smartphone Usage	,532	,033	,790	15,908	,000**	,625

** $p<0.01$ * $p<0.05$

These results highlight the potential influence of Smartphone Use on Internet Addiction among participants. Interventions or policies designed to address Internet and smartphone addiction should consider the strong association between these two factors.

Regression Analysis: Explaining Loneliness by Smartphone Usage and Internet Addiction

In the regression model, explaining the loneliness variable by both Smartphone Usage and Internet Addiction variables, the regression coefficient for Internet Addiction ($\beta=0.165$; $p<0.05$)

was positive and significant, and the regression coefficient for Smartphone Usage ($\beta=0.214$; $p<0.05$) was positive and significant. According to these findings, an increase in Internet Addiction and Smartphone Usage positively affects the mean loneliness variable. In the Loneliness variable, 14.3% of the variation could be explained by both Internet Addiction and Smartphone Usage. Table 5 presents the regression analysis results, indicating that both Internet Addiction and Smartphone Usage were significant predictors of loneliness.

Table 5. Prediction of Loneliness by Internet Addiction and smartphone use variables

	Coefficient		Standard coefficient	T	P	R2 -
	B	SE	B			
Internet addiction	,126	,099	,165	3,273	,015*	,143
Smartphone Usage	,110	,067	,214	3,650	,010*	

**p<0.01 *p<0.05

These findings suggest that both Internet addiction and smartphone use are important factors in understanding and addressing loneliness among participants. Policies or interventions aimed at mitigating loneliness should consider significant associations between these factors.

Comparison of Scale Scores According to Demographic Characteristics

To investigate the relationships between scale scores (Internet Addiction, Smartphone Usage, and Loneliness) and the demographic characteristics of the participants, statistical analyses such as t-tests, ANOVAs, or non-parametric tests (e.g., Mann-Whitney U, Kruskal-Wallis) can be used, depending on the distribution of the data and the type of variables. These analyses can help determine whether there are significant differences in scale scores among different demographic groups.

For example, scale scores can be compared across categories, such as

1. Gender: The scale scores of males and females to investigate potential gender differences in Internet Addiction, Smartphone Usage, and Loneliness.

2. Age: Scale scores across different age groups were compared to explore whether Internet Addiction, Smartphone Usage, and Loneliness vary by age.

Table 6. Comparison of scale dimensions by gender

	Gender	N	Mean	SD	T	P
Internet addiction	Woman	121	1,386	,7053	1,962	,052
	Male	39	1,133	,6874		
Smartphone Usage	Woman	120	2,140	1.0010	3,957	,000**
	Male	37	1,389	1.0346		
Loneliness	Woman	112	1,814	,5756	,208	,835
	Male	35	1,792	,4914		

**p<0.01 *p<0.05 AM: Arithmetic mean SD: standard deviation t: independent sample table value

Significant differences were found in the scores on the Internet addiction, smartphone use, and loneliness scales based on age groups (p<0.05). The sources of differences in the multiple comparison tests were identified as follows. In Internet Addiction, the average scores for the 24-26 age group (1.546) and the 18-20 age group (1.459) were

3. Education level: Investigating whether there are differences in scale scores among participants with different levels of education, such as high school, undergraduate, and postgraduate.

4. Socioeconomic status: Scale scores across participants with different socioeconomic backgrounds were compared to examine whether socioeconomic factors influence Internet Addiction, Smartphone Usage, and Loneliness.

5. Urban/rural residence: Investigating potential differences in scale scores between urban, suburban, and rural participants.

The results of these comparisons can provide insights into the prevalence and patterns of Internet Addiction, Smartphone Usage, and Loneliness among various demographic groups. This information can be valuable in designing targeted interventions or policies to address these issues and promote overall well-being.

This study found significant differences in smartphone use and loneliness scale scores based on gender (p<0.05). • The average score for women in smartphone use (2.14) was higher than that for men (1.389). • The average loneliness score for women (1.84) was higher than that of men (1.792). Table 6 presents a detailed comparison of scale dimensions by gender.

found to be higher than those of the other groups. • In smartphone use, the average scores for the 24-26 age group (2.215) and the 18-20 age group (2.220) were found to be higher than those of the other groups. • In the Loneliness variable, the average score for the 24-26 age group (2.168) and the 18-20 age

group (2.220) were found to be higher than those of the other groups. Table 7 presents a detailed

comparison of the scale dimensions by age group.

Table 7. Comparison of scale sizes by age groups

		N	AM	SD	F	P
Internet addiction	18-20	42	1,459	,6216	2,865	,039*
	21-23	70	1,288	,6424		
	24-26	21	1,546	,8753		
	27+	27	1,035	,7784		
	Total	160	1,324	,7073		
Smartphone Usage	18-20	40	2,220	1,0204	4,181	,007**
	21-23	70	1,970	,9989		
	24-26	20	2,215	1,0703		
	27+	27	1,378	1,0624		
	Total	157	1,963	1,0553		
Loneliness	18-20	35	1,862	,5162	4,592	,004**
	21-23	64	1,677	,4853		
	24-26	21	2,168	,6393		
	27+	27	1,771	,5874		
	Total	147	1,809	,5551		

**p<0.01 *p<0.05 AM: Arithmetic mean SD: standard deviation F: ANOVA table value

Significant differences were found only in the scores of smartphone use based on the department in which education was received (p<0.05). The sources of differences in the multiple comparison tests were identified as follows.

In Smart Phone Use, the average scores for students in the Faculty of Health Sciences (2.265) and those studying Business and Management Sciences (2.020) were found to be higher than those of the other groups. Table 8 presents a detailed comparison of the scale dimensions by department.

Table 8. Comparison of scale sizes by division

		N	AM	SD	F	P
Internet addiction	Business and Management sciences	10	1,118	,6063	1,768	,138
	Faculty of Health Sciences	80	1,457	,7302		
	Vocational School	29	1,282	,5658		
	Graduate	23	1,072	,8662		
	Other	18	1,242	,5518		
	Total	160	1,324	,7073		
Smartphone Usage	Business and Management sciences	11th	2,027	,8684	4,733	,001**
	Faculty of Health Sciences	77	2,265	1,0495		
	Vocational School	29	1,831	,8418		
	Graduate	22	1,282	1,1742		
	Other	18	1,678	,9214		
	Total	157	1,963	1,0553		
Loneliness	Business and Management sciences	10	1,865	,5980	,207	,934
	Faculty of Health Sciences	74	1,820	,5825		
	Vocational School	24	1,784	,4765		
	Graduate	22	1,727	,5062		
	Other	17	1,869	,6196		
	Total	147	1,809	,5551		

**p<0.01 *p<0.05 AM: Arithmetic mean SD: standard deviation F: ANOVA table value

These findings suggest that the field of study may play a role in determining the extent of smartphone use among students. Students in the Health Sciences and Business and Management Sciences may be more prone to excessive smartphone use, which could potentially impact their academic performance and overall well-being. Educators and administrators should be aware of these differences and consider implementing targeted interventions and support for students in these departments.

No significant differences were found in the scores for Internet addiction, smartphone use, and loneliness based on academic achievement ($p > 0.05$). The scale scores did not vary according to academic success. This finding suggests that there may not be a direct relationship between Internet addiction, smartphone use, and loneliness and academic achievement among students. However, it is crucial to note that these results do not rule out the potential indirect effects of these variables on academic performance or overall well-being. No significant differences were found in the scores for Internet addiction, smartphone use, and loneliness based on family structure ($p > 0.05$). The scale scores did not show variations based on family structure. These findings imply that family structure may not directly affect Internet addiction, smartphone use, and loneliness among students. However, it is important to note that these results do not dismiss the potential indirect effects of family structure on these variables.

Significant differences were found in the Internet Addiction scores based on the department in which education was received ($p < 0.05$). Multiple comparison tests identified the sources of the differences as follows: In smartphone use, the average scores for students in the Faculty of Health Sciences (2.265) and Business and Management Sciences (2.020) were higher than those of other groups. Results indicate that there are differences in Internet addiction levels depending on the department in which students are enrolled. Students from the Faculty of Health Sciences and those from Business and Management Sciences seem to have higher Internet addiction levels than their peers from other departments.

No significant differences in Internet addiction, smartphone use, and loneliness scores based on family structure ($p > 0.05$) were found. The scale scores did not show any variation according to family structure. Findings suggest that family

structure does not significantly influence internet addiction, smartphone use, or loneliness. It is essential to consider that other factors, such as individual differences, coping mechanisms, and social support systems, may play a more significant role in explaining variations in these variables.

No significant differences in Internet addiction, smartphone use, and loneliness scores based on the living environment ($p > 0.05$) were found. The scale scores did not vary according to living environment. Findings suggest that living environment does not significantly influence the study's Internet addiction, smartphone use, and loneliness levels. It is important to consider that other factors, such as individual differences, coping mechanisms, and social support systems, may play a more significant role in explaining variations in these variables.

No significant differences in Internet addiction, smartphone use, and loneliness scores based on economic status ($p > 0.05$) were found. The scale scores did not show any variation according to economic status. Results indicate that participants' economic status did not significantly affect their Internet addiction, smartphone use, or loneliness levels. It is crucial to acknowledge that other factors such as individual personality traits, coping strategies, and social support may play a more significant role in explaining variations in these variables.

No significant differences in Internet addiction, smartphone use, and loneliness scores based on the longest-lived location ($p > 0.05$) were found. The scale scores did not vary according to the location of residence. Findings indicate that in this study, Internet addiction, smartphone use, and loneliness levels were not significantly affected by the longest-lived location of the participants. It is essential to recognize that other factors, such as individual personality traits, coping strategies, and social support, may play a more significant role in explaining the variations in these variables.

A significant difference was found in the smartphone use scores based on relationships with family members ($p < 0.05$). The sources of the differences in the multiple comparison tests were determined as follows: The average smartphone use score of those with very supportive families (1.539) was higher than those of other family relationship types. Table 9 compares the scale dimensions based on relationships with family members.

Table 9. Comparison of scale dimensions according to the relationship with family members

		N	AM	SD	F	P
Internet addiction	Very supportive	53	1,168	,7024	1,372	,246
	Supportive	58	1,410	,6514		
	Normal	38	1,407	,7964		
	Conflicted/very conflicted	11th	1,310	,4567		
	Total	160	1,324	,7073		
Smartphone Usage	Very supportive	49	1,539	1.1189	3,516	,09**
	Supportive	59	2,188	,9967		
	Normal	38	2,092	,9545		
	Conflicted/very conflicted	11th	2,438	,6610		
	Total	157	1,963	1.0553		
Loneliness	Very supportive	46	1,684	,5365	1,308	,270
	Supportive	54	1,893	,5261		
	Normal	38	1,845	,5940		
	Conflicted/very conflicted	9	1,941	,6900		
	Total	147	1,809	,5551		

**p<0.01 *p<0.05 AM: Arithmetic mean SD: standard deviation F: ANOVA table value

These findings suggest that relationships with family members play a role in smartphone use, with individuals experiencing more supportive family relationships and showing higher levels of smartphone use. It is crucial to consider the possible reasons behind this relationship and investigate whether supportive families facilitate healthier smartphone use or whether there is a potential downside to increased smartphone use within this context. A significant difference was found in Internet addiction and smartphone use scores based on how the participants spent their leisure time (p<0.05). The sources of the

differences in the multiple comparison tests were determined as follows: The average Internet addiction scores for those who engaged in sports during their free time (0.799) and those who read books (0.919) were considerably lower compared to other leisure time methods. The average smartphone use scores for those who engaged in sports during their free time (1.18) and those who read books (1.365) were considerably lower compared to other leisure time methods. Table 10 presents a comparison of scale dimensions based on how participants spent their leisure time.

Table 10. Comparison of scale dimensions according to the way they spend their free time

		N	AM	SD	F	P
Internet addiction	Reading books	19	,919	,3836	7,508	,000**
	To do sport	17	,799	,4348		
	Cinema theater/music	34	1,452	,7022		
	Spending time on the internet	44	1,311	,6353		
	Spending time with cell phone	41	1,683	,7202		
	To watch TV	5	1,012	,3179		
	Total	160	1,324	,7073		
Smartphone Usage	Reading books	20	1,365	,9522	5,053	,000**
	To do sport	18	1,188	1.0019		
	Cinema theater/music	29	2,207	,9419		
	Spending time on the internet	45	1,907	,9642		
	Spending time with cell phone	40	2,463	1.0521		
	To watch TV	5	1,760	,7635		
	Total	157	1,963	1.0553		
Loneliness	Reading books	19	1,619	,5035	2,064	,061
	To do sport	14	1,811	,4511		
	Cinema theater/music	29	1,747	,5551		
	Spending time on the internet	43	1,715	,4644		
	Spending time with cell phone	38	1,989	,6571		
	To watch TV	4	2,044	,6006		
	Total	147	1,809	,5551		

**p<0.01 *p<0.05 AM: Arithmetic mean SD: standard deviation F: ANOVA table value

These findings indicate that engaging in activities such as sports or reading during leisure time is associated with lower levels of internet addiction and smartphone use. This suggests that promoting healthier leisure activities might be useful for reducing excessive technology use and its potential negative effects.

DISCUSSION

Sociodemographic Characteristics of Participants

The participants' sociodemographic characteristics revealed significant differences in internet addiction, smartphone use, and loneliness scores based on age group. In particular, younger age groups (18-20 and 24-26) displayed higher scores in these areas, suggesting that they are at a higher risk of experiencing adverse effects related to technology use. This finding is consistent with previous studies that reported increased technology use and associated risks among younger individuals (Kuss et al., 2014; Odacı and Çıkrıkçı, 2014). Possible reasons for this finding may include increased exposure to digital technology and social media in these age groups, which may exacerbate feelings of loneliness and contribute to addiction (Bozoglan and Demirer, 2015). Consequently, interventions targeting younger age groups may be crucial in preventing further complications such as mental health issues, social isolation, and reduced academic performance.

Exploratory Factor Analysis and Reliability of the Scales Used in the Study

Factor analysis and reliability assessment of the scales in this study provided robust evidence for the validity and reliability of the measures. This strengthens the results and allows for meaningful interpretations and comparisons with the existing literature. Previous studies using similar scales, such as Young's Internet Addiction Test (Young, 1998) and the UCLA Loneliness Scale (Pretorius, 1993), have also demonstrated satisfactory psychometric properties, indicating their applicability in various populations and contexts (Andreassen et al., 2016; Pretorius, 1993). These scales can be utilized in future research to examine Internet addiction, smartphone use, and loneliness in various populations and contexts.

Correlational Analyses Between Scale Dimensions

This study found significant positive correlations between Internet addiction, smartphone use, and loneliness, indicating that these constructs

are interrelated. This finding aligns with existing research, such as studies by Wang et al. (2011) and Tokunaga (2015), which suggest that excessive use of digital technology may contribute to feelings of loneliness, which in turn may perpetuate addiction. To address this issue, interventions can promote healthy technology use, foster social connections, and provide support for individuals experiencing loneliness, as suggested by Cacioppo and Cacioppo (2018) and Van Rooij et al. (Carras et al., 2017).

Comparison of Scale Scores According to Demographic Characteristics

Comparisons based on demographic characteristics revealed significant differences in scale scores. For instance, Health Sciences and Business and Management department students reported higher smartphone use scores. This finding suggests that the nature of these fields or the academic demands placed on students may contribute to increased technology use. Lepp et al. (2015) and Alt (2018) also found similar results, pointing to the role of academic factors in shaping technology use patterns. Therefore, it is essential to consider these factors when developing targeted interventions for specific populations.

Moreover, the study found that students who engaged in sports or reading during their leisure time had lower Internet addiction and smartphone use scores. This finding highlights the importance of promoting alternative leisure activities that foster well-being and reduce the risk of technology-related complications. Previous research by Zhang et al. (2022) and Weinstein et al. (2015) supports the idea that encouraging participation in sports, reading, or other activities that build social connections and contribute to mental health could be an effective strategy to mitigate the negative effects of excessive technology use. This study's findings have several practical implications for policymakers, educators, and mental health professionals. First, the results highlight the need for early intervention programs targeting younger age groups, given their higher risks of Internet addiction, smartphone use, and loneliness. Implementing school-based prevention and awareness programs could help promote healthy technology use and prevent the negative consequences associated with excessive use (28). Second, the significant differences in technology use based on department and leisure activities suggest the importance of tailoring interventions for specific populations. For instance, Health Sciences and Business and Management department educators

could incorporate discussions about responsible technology use within their curricula. Universities can offer workshops and support services to help students balance technology use with other aspects of their lives (Alan, 29-30). Furthermore, this study highlights the potential benefits of promoting alternative leisure activities like sports and reading to reduce technology-related problems. In addition to;

- **Mental Health and Well-being Services:** Enhance mental health and well-being services available to students, including counseling, support groups, and workshops on stress management, time management, and mindfulness.
- **Promote Alternative Leisure Activities:** Encourage students to engage in alternative leisure activities, such as sports, reading, and arts, to foster social connections, improve mental health, and reduce reliance on digital technology.
- **Parental and Community Involvement:** Involve parents and the community in efforts to promote healthier technology use and address loneliness among university students. Collaborate with local organizations and community groups to create supportive environments encouraging social connections and well-being.
- **Tailored Interventions:** Develop targeted interventions for specific at-risk groups, such as younger individuals and students in certain fields of study. These interventions may include mentorship programs, peer support networks, or specialized workshops that address the unique challenges faced by these groups.

Limitations and Future Research

While this study provides valuable insights into the relationship between Internet addiction, smartphone use, and loneliness, it also has some limitations. First, the cross-sectional design precludes the establishment of causal relationships between variables. Future research employing longitudinal or experimental designs could provide more robust evidence regarding the causal relationships among technology use, loneliness, and addiction. Second, the study relied on self-report measures, which may have been subject to social desirability bias or inaccurate recall. Future research

could employ more objective measures, such as tracking technology use, to corroborate self-report.

Finally, the study focused on a specific population of university students, which may have limited the generalizability of the findings. Future research should examine the relationships between Internet addiction, smartphone use, and loneliness in other populations, such as adolescents, working adults, and older adults, to comprehensively understand these issues across different age groups and contexts.

Future Research Directions

Based on the findings and limitations of this study, several future research directions can be suggested to explore further the relationships between internet addiction, smartphone use, and loneliness.

1. **Longitudinal Studies:** Conduct longitudinal research to establish causal relationships and better understand the temporal dynamics of Internet addiction, smartphone use, and loneliness.

2. **Mediating and Moderating Factors:** Investigate potential mediating and moderating factors such as personality traits, coping strategies, and social support to better understand the mechanisms underlying the relationships between these variables.

3. **Diverse samples:** The study was replicated with more diverse samples, including different age groups, educational backgrounds, and cultural contexts, to enhance the generalizability of the findings.

4. **Objective Measures:** Incorporate objective measures of technology use, such as digital usage tracking, to complement self-reported data and provide a more comprehensive assessment of the phenomena under investigation.

5. **Intervention Studies:** Design and evaluate interventions to reduce Internet addiction, smartphone use, and loneliness among university students, focusing on the effectiveness and sustainability of the implemented strategies.

Conflict of interest

The authors declare no conflicts of interest. No financial support has been received.

Ethics Committee

The study was confirmed by Istanbul Esenyurt University Ethics Committee which is a recognized review board or ethics committee on 01.10.2021 (Approval no: E-12483425-299-8712).

Author Contributions

Study Design, YS; Data Collection, İS; Statistical Analysis, İS; Data Interpretation, YS; Manuscript Preparation, YS,İS; Literature Search, YS, İS. The published version of the manuscript has been read and approved by all authors.

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