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Original Article

Factors Influencing Smartphone Screen Time among Korean Adolescents: Insights from the Korea Youth Health Behavior Survey

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Abstract

Background: This study is a secondary analysis aimed at identifying risk factors for smartphone overuse among adolescents, utilizing data from the 18th Korea Youth Health Behavior Survey (KYHBS) conducted in 2022.

Methods: A total of 50,071 participants were included, with schools selected through a stratified proportional allocation method that considered factors such as city/province, city size, and school type. Students were excluded from the survey if they had long-term absences, were special needs children unable to participate in the survey, or had reading disabilities. The survey encompassed students from the first year of middle school to the third year of high school across 800 schools nationwide.

Results: Several factors were significantly associated with increased smartphone screen time, including gender, education level, academic performance, economic condition, BMI, self-reported health, feelings of aloneness, insufficient sleep, breakfast consumption, fast food intake frequency, late-night meals, physical activity, current smoking, current alcohol consumption, and sexual experience.

Conclusion: These results underscore the complex interplay of various factors shaping adolescents' smartphone use patterns. Recognizing and addressing these factors is crucial for developing targeted interventions aimed at promoting healthier screen habits and mitigating the negative impacts of excessive smartphone use among adolescents. These findings underscore the complex interplay of various demographic, behavioral, and health-related factors that contribute to adolescents' smartphone use patterns.

Keywords: Adolescents; Smartphones; Screen time; Overuse; Health

Introduction

In modern society, smartphones have become the most prevalent personal medium, dominating all other forms of media (1). In South Korea, the smartphone penetration rate exceeded 90% in 2020, with ownership among adolescents reaching an estimated 97% (2). Adolescents utilize smartphones not only for social interactions but also for educational purposes and entertainment (3). While smartphones play a significant role in shaping today's youth culture and can have positive effects, they also contribute to issues such as excessive dependence among adolescents, who are still in the process of forming their identities, leading to diminished self-control (4).

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The problematic use of smartphones is closely tied to screen time. According to the 2019 Smartphone Overdependence Survey of 4,434 adolescents, uncontrolled smartphone screen time was identified as a major contributing factor to problematic usage (5). Rozgonjuk et al. also found a strong correlation between problematic smartphone use and increased screen time (6). Excessive smartphone use can lead to various negative outcomes in adolescents, including depression (7), decreased sleep quality (8), reduced happiness (9), and suicidal ideation (10).

The onset of the COVID-19 pandemic in 2019 dramatically altered daily life, particularly through social distancing measures designed to curb the spread of the virus. This has negatively affected both adults and adolescents (11). According to results released by the Ministry of Science and ICT, the proportion of at-risk smartphone users increased to 23.30%, up by 3.30% compared to 2019 (12). The social isolation resulting from the pandemic has heightened anxiety and depression levels among adolescents (13), subsequently leading to increased smartphone usage and online gaming, thereby elevating the risks associated with internet addiction (14).

Existing research highlights that adolescents' smartphone screen time directly impacts the likelihood of developing smartphone addiction. For instance, Ha demonstrated a direct relationship between increased screen time and smartphone addiction (15), while Ju and Cho examined daily average smartphone usage and its role in addiction (16). It is evident that individuals who are addicted to smartphones tend to spend significantly more time on these devices than their non-addicted peers, suggesting that prolonged screen time correlates with a greater propensity for addiction (17). The implications of smartphone overuse are profound, potentially affecting adolescents' academic performance and personal lives. Prior studies have identified general characteristics, such as gender and household economic status, along with stress levels and screen time, as significant predictors of problem behaviors related to smartphone addiction (18). Moreover, factors contributing to adverse experiences and issues stemming from smartphone use include academic performance, drinking and smoking habits, mental health indicators such as depression, stress-related health behaviors, and the types of services used (19, 20).

Despite the evident implications of smartphone use, few empirical studies have been conducted in Korea to explore the nuances of smartphone usage and its related factors in the post-COVID-19 context. Therefore, this study aimed to explicitly investigate the main research question: "What are the health and behavioral effects of increased smartphone use among Korean adolescents after COVID-19?" Using data from the KYHBS, this research analyzes the risk factors associated with smartphone overuse in adolescents following the pandemic.

Methods

Material

This study was a secondary analysis aimed at identifying risk factors for smartphone overuse among adolescents, utilizing original data from the 18th Korea Youth Health Behavior Survey (KYHBS) conducted in 2022. The cross-sectional study design allows for an examination of the relationship between smartphone use and various health and behavioral factors at a specific point in time.

The sample of schools was selected using a stratified proportional allocation method, considering factors such as city/province, city size, school type (male/female for middle schools, regular/specialized for high schools), and group. A total of 800 schools nationwide participated in the survey, which included students from the first year of middle school to the third year of high school. Ultimately, 798 schools (398 middle schools and 400 high schools) participated, with 51,850 students taking part, resulting in a participation rate of 92.2% based on the number of enrolled students on the day of the survey. Notably, among the sampled students, those with long-term absences, children with disabilities unable to

participate, and students with reading disabilities were excluded from the analysis.

The KYHBS was conducted anonymously at the participating schools, collecting data with statistical approval from the National Statistical Office (Approval No. 117058). All participants provided informed consent prior to taking part in the survey.

Smartphone screen time

The average weekly smartphone screen time was calculated based on responses to the question, "How many times a day have you used your smartphone during the past weekdays and weekends?" Respondents were categorized into two groups: those using less than 240 minutes per week and those using more than 240 minutes per week. The cutoff of 240 minutes was chosen based on previous research indicating this threshold as a significant indicator of smartphone overuse (20, 21).

Subject characteristics

Subject characteristics included gender, education level, academic performance, economic condition, body mass index (BMI), self-reported health, loneliness (formerly "aloneness"), insufficient sleep, breakfast consumption, fast food intake frequency, late-night meals, physical activity, current smoking, current alcohol consumption, and sexual experience.

Gender was classified as 'male' or 'female' to provide a clear distinction between participants, while to capture differences by school grade, participants were categorized into middle and high school groups. Academic performance and household economic condition were assessed using a five-point Likert scale, with values ranging from 1 (low) to 5 (high), allowing for a nuanced understanding of their academic and economic backgrounds. BMI (kg/m^2) was calculated using self-reported weight and height measurements, which facilitated the examination of physical health in relation to smartphone overuse.

Self-reported health status was classified on a scale of 1 (very bad) to 5 (very good), with higher scores indicating better health, providing insight into participants' overall well-being. Loneliness was assessed using a scale from 1 (not at all lonely) to 5 (always lonely), where higher scores indicated greater feelings of loneliness, highlighting potential mental health issues among adolescents. Insufficient sleep was measured using a five-point Likert scale, categorized as 'sufficient' (≤3 points) or 'insufficient' (>3 points), enabling comparisons of smartphone usage patterns between well-rested and sleep-deprived participants. Breakfast consumption was categorized as 'daily' or 'none,' and fast food intake frequency was classified as 'did not eat in the last 7 days,' 'once or twice a week,' or 'more than three times a week,' which helped assess dietary habits related to smartphone usage. Late-night meals were categorized as 'ate (yes)' or 'did not eat (no)' within the last 7 days, providing additional context on eating patterns. Physical activity was defined as engaging in over 60 minutes of physical activity daily ('yes') or less ('no'), even if participants experienced shortness of breath, indicating the level of their engagement in physical health activities.

Current smoking was defined as smoking on more than one day in the past 30 days, while current alcohol consumption was classified as 'yes' if individuals reported drinking at least one cup on more than one day in the last 30 days, offering insights into behavioral risks. Lastly, sexual experience was categorized as 'yes' or 'no' based on self-reported history, further enriching the understanding of participants' backgrounds and potential risk factors associated with smartphone overuse.

Statistical analysis

Data analysis was conducted using IBM SPSS Statistics Version 21.0 for Windows (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to define smartphone overuse and examine subject characteristics, presented as n (%) for categorical variables. For continuous variables, such as academic performance, economic condition, BMI, self-reported health, and fast food intake frequency, mean and standard deviation (mean ± SD) were reported to provide a more detailed understanding of the sample's

characteristics.

Bivariate associations between smartphone overuse and subject characteristics were evaluated using chi-square tests. To control for potential confounders and further explore the relationship between these variables, significant predictors from the chi-square analysis were included in the logistic regression model. Variables were selected for inclusion based on both theoretical relevance and prior research, with additional consideration given to variables with $P < 0.2$ in the bivariate analysis.

Logistic regression analysis was employed to identify factors influencing smartphone overuse. We tested for multicollinearity by calculating Variance Inflation Factor (VIF) values, all of which ranged from 1.02 to 1.24, indicating no issues with multicollinearity. Results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). A P -value of <0.05 was considered statistically significant. To assess the goodness of fit of the logistic regression model, the Hosmer-Lemeshow test was performed, yielding a chi-square statistic of 7.06 with a P -value of 0.53, indicating a good model fit.

Results

Table 1 shows the results of analyzing whether or not smartphone overuse is according to the subject characteristics.

Logistic regression analysis was conducted to determine the factors affecting smartphone screen time. The model was statistically significant, indicating that the independent variables collectively predicted the likelihood of smartphone overuse. Other results are showed in Table 2.

Table 1: Comparisons by smartphone screen time (P<0.01)

Categories (mean±SD)		Overuse/n(%)*			χ^2
		Total	Yes	No	
Gender	Male	25,150(50.2)	15,610(45.1)	9,540(61.8)	1200.24
	Female	24,921(49.8)	19,031(54.9)	5,890(38.2)	
Education level	Middle	27,334(54.6)	17,994(51.9)	9,340(60.5)	317.55
	High	22,737(45.4)	16,647(48.1)	6,090(39.5)	
Academic performance (2.07±0.83)	≤3	30,916(61.7)	23,318(67.3)	7,598(49.2)	1476.26
	>3	19,154(38.3)	11,322(32.7)	7,832(50.8)	
Economic condition (2.32±0.66)	≤3	29,131(58.2)	21,531(62.2)	7,600(49.3)	730.52
	>3	20,938(41.8)	13,108(37.8)	7,830(50.7)	
BMI (21.38±3.76)	<25	40,701(83.3))	27,827(82.6)	12,874(84.8)	37.67
	≥25	8,177(16.7)	5,872(17.4)	2,305(15.2)	
Self-reported health (2.53±0.68)	<3	18,366(36.7)	13,597(39.3)	4,769(30.9)	319.99
	≥3	31,705(63.3)	21,044(60.7)	10,661(69.1)	
Aloneness	yes	27,367(54.7)	19,907(57.5)	7,460(48.3)	358.20
	no	22,704(45.3)	14,734(42.5)	7,970(51.7)	
Insufficient sleep	yes	22,805(45.5)	16,641(48.0)	6,164(39.9)	281.72
	no	27,266(54.5)	18,000(52.0)	9,266(60.1)	
Eating breakfast	yes	38,905(77.7)	26,028(75.1)	12,877(83.5)	426.75
	no	11,161(22.3)	8,610(24.9)	2,551(16.5)	
Fast food intake frequency (2.19±0.85)	Not at all	8,157(16.3)	5,134(14.8)	3,032(19.6)	462.30
	1-2	28,569(57.0)	19,370(55.9)	9,199(59.6)	
	>3	13,345(26.7)	10,137(29.3)	3,208(20.8)	
Late-night meal	yes	29,763(59.4)	21,263(61.4)	8,500(55.1)	175.38
	no	20,308(40.6)	13,378(38.6)	6,930(44.9)	
Physical activity	yes	33,457(66.8)	22,455(64.8)	11,002(71.3)	202.22
	no	16,614(33.2)	12,186(35.2)	4,428(28.7)	
Current smoking	yes	2,073(4.1)	1,822(5.3)	251(1.6)	355.01
	no	47,998(95.9)	32,819(94.7)	15,179(98.4)	
Current alcohol drinking	yes	6,369(12.7)	5,215(15.1)	1,154(7.5)	551.81
	no	43,702(87.3)	29,426(84.9)	14,276(92.5)	
Sexual experience	yes	2,765(5.5)	2,223(6.4)	542(3.5)	172.63
	no	47,306(94.5)	32,418(93.6)	14,888(96.5)	

*Exclude no response

Table 2: Logistic regression of factors affecting the increase in smartphone screen time ($P<0.01$)

Categories (Ref.)		B	SE	OR(95%CI)
Gender(Male)	Female	0.71	0.02	2.02(1.94-2.11)
Education level(High)	Middle	0.08	0.02	1.09(1.04-1.13)
Academic performance((>3)	≤3	0.63	0.02	1.87(1.79-1.95)
Economic condition(>3)	≤3	0.31	0.04	1.37(1.27-1.47)
BMI(<25)	≥25	0.25	0.03	1.19(1.14-1.36)
Self-reported health(≥3)	<3	0.11	0.02	1.12(1.07-1.17)
Aloneness(no)	yes	0.14	0.02	1.15(1.10-1.20)
Insufficient sleep(no)	yes	0.08	0.02	1.09(1.04-1.14)
Eating breakfast(yes)	no	0.44	0.02	1.55(1.49-1.63)
Fast food intake frequency(Not at all)	> 3/week	0.54	0.03	1.72(1.61-1.83)
	1-2/week	0.20	0.03	1.22(1.16-1.29)
Late-night meal(no)	yes	0.09	0.02	1.09(1.05-1.14)
Physical activity(yes)	no	0.41	0.02	1.51(1.44-1.57)
Current smoking (no)	yes	0.71	0.08	2.04(1.75-2.36)
Current alcohol drinking (no)	yes	0.52	0.04	1.67(1.55-1.80)
Sexual experience(no)	yes	0.26	0.06	1.29(1.16-1.44)

Discussion

This study sought to understand the degree of smartphone scree time in Korean adolescents and to analyze risk factors of smartphone screen time in adolescents after the COVID-19 pandemic. In the case of adolescents, emotional instability experienced at the developmental stage makes them vulnerable to smartphone dependence (22). In previous studies, as physical problems caused by excessive smartphone use, neck pain and accidents caused by smartphone use during walking were reported (23, 24). In addition, excessive use of smartphones increases aggression, anger, hostility, lacking self-control, and reduces interest and motivation in life and study, leading to social and academic problems (25, 26). Furthermore, the results of several studies found that the severity of smartphone addiction was closely related to the increase in the frequency and time of smartphone use; thus, guidelines and management of smartphone scree time for adolescents are needed in a situation where the educational environment such as online classes has changed due to COVID-19 (27, 28). Teenagers who have excessively used smartphones tend to be anxious and nervous, dissipate a great deal of energy, are distracted, and have problems at home and at school when they are suddenly forbidden from using smartphones (5). Therefore, management and education for proper smartphone use of adolescents are required.

Regarding the relationship between the risk of smartphone overuse and subject characteristics, the risk of smartphone overuse increases for females, middle school, and low academic performance and economic status. Previous studies have found that when looking at the difference between males and females when using adolescent smartphones, schoolgirls were more dependent on smartphones than schoolboys (29). The reason for this is that female students were more likely to become immersed or addicted to social network services (SNS) due to their relatively higher relationship orientation than male students (4). In case of academic performance and economic status, the lower the school performance and the better the financial condition, the lower the dependence on smartphones (13). However, smartphone addiction increased with higher economic conditions (18). Since each study showed various results, it is necessary to repeatedly check whether academic performance

and economic status are related to problematic behaviors related to smartphone use.

Smartphone usage could contribute to unhealthy behaviors linked to obesity, with its severity not yet fully recognized (30). Additionally, smartphone addiction has been associated with decreased physical activity, suggesting that excessive smartphone use may diminish physical activity levels, thereby potentially leading to weight gain by reducing energy expenditure (31). Moreover, smartphone addiction can also contribute to obesity through factors such as poor sleep quality or insufficient sleep, both of which are recognized risk factors for obesity (32). The study results showed that the risk of smartphone overuse increased in the case of insufficient sleep and aloneness. Persistent smartphone over-dependence is associated with impaired sleep patterns and increased psychological distress (33). Furthermore, insufficient sleep is associated with both obesity and mental health issues, underscoring the necessity for integrated care approaches in adolescents.

In this study, it was confirmed that the risk of smartphone overuse in adolescents was related to physical activity, eating breakfast, fast food intake frequency, late-night meal, alcohol drinking, smoking and sexual experience. Excessive smartphone use and immersion can cause obstacles in daily life and side effects in various aspects such as physical and mental health problems (29), and these problems can have a great impact on life in the future. Due to the various changes in daily life to prevent the spread of COVID-19, adolescents are mainly able to communicate using smartphones at home, play games, and watch media at home; therefore, the problem of smartphone overuse is highly likely to cause problems to the adolescents in family, social relations and studies (34). Physical activity was related to smartphone overuse. Smartphone addiction was reported to affect sports activity time and participation frequency; the lower the frequency and time of participation in sports activities, the higher the risk of smartphone addiction (35). Regarding the case of eating breakfast, fast food intake and late-night meal, it was found that smartphone overuse affects eating habits. Previous studies have reported that the more smartphone use, the more irregular eating habits, result in nutritional imbalance and impeding growth (36). In the case of smoking and alcohol drinking, in a previous study (37), the Internet addiction group was easily exposed to drugs, problematic drinking, and significant associations with smoking were reported. This study showed similar results so that comprehensive management including smartphone use with respect to drinking and smoking would be necessary. In the case of sexual experience, it has been reported that the likelihood of engaging in sexual intercourse increases when the average time spent on a smartphone exceeds 3 hours (38). This finding aligns with the results of this study.

Limitations and future directions

While this study provides valuable insights into the patterns of smartphone over-use among Korean adolescents, several limitations must be considered. These limitations may affect the interpretation of the results and the generalizability of the conclusions, warranting cautious application of the findings to broader populations.

The use of cross-sectional data makes it challenging to establish causal relation-ships between smartphone overuse and the associated risk factors. Longitudinal studies are necessary to understand these dynamics over time and provide stronger evidence of cause-and-effect relationships. Another limitation is the generalizability of the findings. The sample for this study consisted solely of Korean adolescents, meaning the conclusions may not be applicable to adolescents in other cultural or geographic contexts. Cultural factors, such as differences in parenting styles, educational systems, and societal norms around technology use, can significantly influence adolescent behavior. Therefore, caution should be exercised when applying these findings to populations outside of South Korea.

Conclusion

The study highlights the need for proactive measures to address excessive smartphone screen time among adolescents and underscores the importance of fostering supportive environments conducive to their overall well-being and development in the digital age.

Journalism Ethics considerations

This study was exempted from deliberation by the Institutional Review Board of Kunsan National University (IRB No. 1040117-202212-HR-039-01).

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Conflict of Interest

The author declares that there is no conflict of interest.

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