



Association between smartphone overdependence and mental health in South Korean adolescents: a secondary data analysis

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Purpose: The rising prevalence of smartphone overdependence among adolescents and its detrimental impact on mental health have become a growing concern. This study aimed to investigate the association between smartphone overdependence and the mental health of Korean adolescents. **Methods:** Participants were drawn from the 16th Korea Youth Risk Behavior Web-based Survey conducted in 2020. The dependent variable as smartphone overdependence, while the main exposure of interest was mental health, encompassing generalized anxiety disorder (GAD), perceived stress, sources of perceived stress, perceived loneliness, and perceived depressive symptoms. The study employed the Rao-Scott chi-square test and multiple logistic regression using IBM SPSS version 26.0. **Results:** The participants comprised 54,948 adolescents aged 13 to 18 years. Among them, 25.1% (n=13,775) were categorized as smartphone overdependence group. Specifically, 20.3% of adolescents who reported GAD ≥ 10 and 22.5% of those who reported experiencing high levels of perceived loneliness were identified as smartphone overdependent. The GAD increased a risk of smartphone overdependence by 2.61 times (95% confidence interval [95% CI]: 2.46–2.77). Perceived loneliness was associated with 1.98-fold (95% CI: 1.87–2.09) increased risk of smartphone overdependence. Additionally, conflict with peers was found to increase the risk of smartphone overdependence by 4.63-fold (95% CI: 3.89–5.52), followed by conflict with parents (odds ratio [OR]: 4.52, 95% CI: 3.84–5.31), and family environment (OR: 4.52, 95% CI: 3.75–5.46). **Conclusion:** The findings underscore a significant association between smartphone overdependence and mental health in Korean adolescents. Healthcare services to improve their emotional coping and interpersonal skills are necessary.

Keywords: Adolescent; Korea; Mental health; Smartphone; Behavior, addictive

INTRODUCTION

Smartphones, characterized by their remarkable convenience and accessibility, serve as an essential part of our daily lives for tasks such as accessing information, communication, education, commerce, healthcare, and entertainment [1]. It is estimated that the global smartphone user count will reach approximately 6.7 billion in 2023 [2]. Notably, smartphone

ownership is ubiquitous in the United States (72%) and various European countries, including Spain (71%), the United Kingdom (68%), and Germany/Italy (60%) [3]. The highest rate of smartphone ownership can be observed in South Korea [3], where a staggering 97.4% of the population owns a smartphone [4]. Among the younger demographic, smartphones are even more prevalent, with 95% of adolescents in the United States [5] and 99.1% of youth in South Korea own-

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ing a smartphone [6]. This underscores the profound and pervasive influence of smartphones in the lives of young people [7]. Adolescents rely on smartphones to access information, learn, connect with others, and entertain [8]. Despite the widespread ownership and the benefits associated with smartphones [7], there is a growing global concern regarding overdependence on smartphones among young individuals [7,8].

During adolescence, social interaction with peers holds significant developmental importance [7]. The use of smartphone for social media by adolescents contributes to initiating, sustaining, and strengthening their social bonds through communication with peers [7,9]. In particular, the extended period of reduced in-person interactions due to social distancing measures during the COVID-19 pandemic has expedited adolescents' creation of their own virtual spaces for social connections with peers [10]. This situation has also heightened their smartphone dependency among adolescents [10]. The prevalence of Korean adolescents at risk of smartphone dependency has shown a consistent year-over-year rise, with the largest increase observed compared to all other age groups: 35.8% in 2020, 37.0% in 2021, and 40.1% in 2022 [11].

Smartphone overdependence mirrors other addictive behaviors, involving excessive and uncontrolled usage that adversely affects daily life and interpersonal relationships [1,12]. Adolescents often turn to smartphones for instant gratification from content such as videos, games, and social media [1,7]. This overdependence can lead to mental health issues like depression and anxiety, reduced concentration, poor sleep quality, and lower academic achievement [1,8,13].

Overindulgent smartphone usage in adolescents often corresponds to the excessive use of social media platforms [9]. This extended use of social media can result in low self-esteem and heightened feelings of depression, anxiety, and stress as adolescents tend to constantly compare themselves with others [8]. Furthermore, adolescents who develop an addiction to social media frequently experience increased loneliness [8,14]. During adolescence, a period when peer relationships hold significant importance, adolescents often feel pressured to use social networks to avoid being left out of their social circles [8,15]. As smartphone usage becomes more frequent and extensive, adolescents become increasingly reliant on their devices [16] which can hinder their ability to socialize effectively in the real world, eventually leading to feelings of isolation [17].

Mental health issues associated with excessive smartphone overdependence among adolescents have become a global concern [8,13]. It is well-established that problematic smartphone use can exacerbate mental health issues. However, it is less-explored association: individuals with poor mental health have a tendency to become overly dependent on their smartphones [12]. This study aims to bridge this gap by identifying the relationship between mental health and smartphone overdependence. A heightened risk of smartphone overdependence has been identified in individuals with a harm-avoidant temperament, who used to experience elevated anxiety and stress from external factors, leading to excessive smartphone usage as a coping mechanism [18]. Our hypothesis posits that adolescents with poor mental health are more prone to smartphone overdependence, creating a detrimental cycle. To identify at-risk groups, screening for smartphone overdependence can be instrumental in delivering timely mental health support services. Therefore, this study aims to determine the prevalence of smartphone overdependence and investigate its association mental health indicators, including generalized anxiety disorder (GAD), perceived stress, sources of perceived stress, perceived depressive symptoms, and perceived loneliness among Korean adolescents.

METHODS

Ethical statements: This study received an Institutional Review Board (IRB) review exemption from the IRB of Yonsei University Health System (No. 4-2021-1237) due to the use of secondary data with anonymity.

1. Study Design

This study employed cross-sectional and correlational research involving the analysis of secondary data from the 16th Korea Youth Risk Behavior Web-based Survey (KYRBWS; Korea Disease Control and Prevention Agency [KDCA] 2020). The reporting of this study was based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [19].

2. Sample

The primary data was sourced from the 16th KYRBWS

[20], a government-approved statistical survey conducted annually by the Ministry of Education, the Ministry of Health and Welfare, and the KDCA since 2005. The KYRBWS is designed as an anonymous, self-reported web-based questionnaire to identify risk behaviors among Korean adolescents, such as smoking, drinking, physical activity, and mental health. It plays a crucial role in providing data that informs the development of youth-oriented health promotion policies. The 16th KYRBWS, conducted from August to November 2020, covered 103 items across 15 domains. particularly included an in-depth inquiry into mental health, smartphone overdependence, and health equity.

The KYRBWS was designed as a complex sample survey to ensure the sample's representativeness through stratification (by region and school level), stratified cluster sampling (with the school as a primary sampling unit and the class as a secondary sampling unit), and a multi-stage sampling approach. Additionally, the survey data was weighted to account for the extraction rate, response rate, and demographic composition of the study population. In 2020, the survey encompassed 57,925 students from a total of 800 schools (comprising 400 middle schools and 400 high schools). Finally, 54,948 students from 793 schools (398 middle and 395 high schools) participated in the 16th KYRBWS. Based on the number of students, the participation rate stood at 94.9%. Long-term absent students, those with special needs who cannot participate in the survey on their own, and those with literacy disabilities were excluded from the survey.

3. Variables

1) Dependent variable: smartphone overdependence

The dependent variable is smartphone overdependence using the smartphone overdependence scale designed for adolescents [21]. This scale consists of a 10-item self-reported questionnaire, organized into three sub-domains: salience, out of control, and serious consequences. Respondents rate each item on a four-point Likert scale. The total score ranges from 10 to 40 points, with a higher score indicating a higher level of smartphone overdependence. Based on the total score obtained, individuals can be classified into three groups: a normal group (10–22), a potential-risk group (23–30), and a high-risk group (31–40). For this study, we merged the potential-risk group and high-risk group into the risk group (scores ≥ 23) and compared it with the normal group (scores < 23). Cronbach's alpha was .84 in the original study

and .92 in this study.

2) Main exposure variable: mental health

The main exposure variable of interest in this study was mental health, encompassing GAD, perceived stress, sources of perceived stress, perceived loneliness, and perceived depressive symptoms. GAD was measured using the 7-item generalized anxiety disorder scale (GAD-7) [22]. Respondents rated their responses on a 4-point Likert scale. The total score on the GAD-7 scale ranged from 0 to 21, with a higher score indicating a higher level of anxiety. A cut-off point of 10 or higher on the GAD-7 scale indicated significant anxiety. Cronbach's alpha was .92 in the original study, and it was .898 in this study. Perceived stress was measured through a single question about the level of stress, rated on a 5-point Likert scale. The responses ranged from one (not at all) to five (very much), with a higher score indicating a higher level of perceived stress. Participants were categorized into two groups: a high perceived stress group (four to five points) and a low perceived stress group (one to three). The sources of perceived stress included eight categories: conflict with peers, conflict with teachers, conflict with parents, family environment, physical appearance, pressure on grades and career paths, health problem, others, and not applicable. Perceived loneliness was measured using one item, rated on a 5-point Likert scale, ranging from one (never) to five (always). Higher scores indicated more frequent feelings of perceived loneliness. Participants were categorized into two groups: a high perceived loneliness group (four to five points) and a low perceived loneliness group (one to three). Perceived depressive symptoms were measured using one item. Responses were divided into two categories: those who reported having experienced such feelings in the last 12 months and those who did not.

3) Sociodemographic variables

Sociodemographic variables included gender, school type, household economic status, and average time of using smartphone per day.

4. Data Analysis

The KYRBWS employs a complex sample design that requires the application of weights to accurately represent the sample design for data analysis. First, descriptive statistics were used to examine adolescents' demographics, mental

health variables, average smartphone usage, and smartphone dependence. Second, a Rao-Scott Chi-square test was performed to identify the differences in proportions between the normal group and risk group of smartphone overdependence in relation to adolescents' general characteristics and mental health variables like GAD, perceived stress, sources of perceived stress, perceived loneliness, and perceived depressive symptoms. Third, we conducted a multiple logistic regression analysis to identify the factors associated with smartphone overdependence. Given the complex sample design of the KYRBWS, we applied the weighted values, strata, and colony (cluster) provided by the user guidelines. Statistical analyses were performed using IBM SPSS Statistics for Windows (version 26.0; IBM Corp.), with significance level set at .05, two-tailed.

RESULTS

1. General Characteristics of the Study Population and the Results of Chi-square Tests for Smartphone Overdependence

Table 1 displays the general characteristics of the study population and the results of chi-square tests for smartphone overdependence. Of the total participants ($n=54,948$), 25.1% ($n=13,775$) were classified as belonging to the smartphone overdependence group. Girls (57.7%) were significantly more prone to smartphone overdependence than boys (42.3%), and high school students (50.2%) were significantly more likely than middle school students (49.8%) to exhibit this behavior. Those classified as smartphone overdependent were more likely to experience poor academic achievement (13.6%) and less likely to come from a high household economic status (8.3%). The smartphone-overdependent group was significantly more likely to report a GAD-7 score of 10 or higher (20.3%), high perceived stress (45.2%), high perceived loneliness (22.5%), and perceived depressive symptoms (35.7%) compared to the normal group. Among adolescents overly dependent on smartphones, the highest proportion identified grades and career pressure as their primary sources of perceived stress (51.0%), physical appearance (13.6%), and conflict with parents (12.2%). The likelihood of being at risk for smartphone overdependence increased with the frequency of smartphone usage per day. The distribution of these two groups exhibited a statistically significant difference ($p < .001$).

2. Results from Multiple Logistic Regressions for Smartphone Overdependence

Table 2 displays the results of multiple logistic regressions for smartphone overdependence. Compared to boys, girls had a 1.36-fold increased risk of smartphone overdependence (95% confidence interval [95% CI]: 1.29–1.43; $p < .001$). High school students had a 1.14-fold increased risk compared to middle school students (95% CI: 1.09–1.20; $p < .001$). Poor academic achievement had a 1.43-fold increased risk compared to good academic achievement (95% CI: 1.31–1.56; $p < .001$) and low household economic status had a 1.29-fold increased risk compared to high household economic status (95% CI: 1.12–1.50; $p < .001$). Individuals who reported GAD-7 more than 10 had a 2.61-fold increased risk of smartphone overdependence (95% CI: 2.46–2.77; $p < .001$). High levels of perceived stress had a 1.68-fold higher risk of smartphone overdependence (95% CI: 1.62–1.75; $p < .001$) and various stress sources, including conflict with peers (odds ratio [OR]: 4.63, 95% CI: 3.89–5.52), conflict with parents (OR: 4.52, 95% CI: 3.84–5.31), family environment (OR: 4.52, 95% CI: 3.75–5.46), physical appearance (OR: 4.32, 95% CI: 3.69–5.06), and grade and career pressure (OR: 3.56, 95% CI: 3.05–4.15; $p < .001$) increased the risk significantly. Those who reported high levels of perceived loneliness showed a 1.98-fold increased risk for smartphone overdependence (95% CI: 1.87–2.09; $p < .001$), and those who reported perceived depressive symptoms showed a 1.78-fold increased risk (95% CI: 1.70–1.86; $p < .001$). Compared to the reference group of individuals who used smartphones for less than 2 hours daily, those who used smartphones for 6–8 hours had a 4.06-fold increased risk (95% CI: 3.61–4.56; $p < .001$), while those who used smartphones for more than 8 hours had a 5.21-fold increased risk (95% CI: 4.64–5.85; $p < .001$).

DISCUSSION

This study examined the link between smartphone overdependence and the mental health of Korean adolescents. The findings revealed that poorer mental health, including conditions such as GAD, perceived stress, perceived loneliness, and perceived depressive symptoms, heightened the risk of adolescents developing smartphone overdependence. Pressure from grades and career paths, physical appearance, and conflicts with parents significantly increased the risk of smartphone overdependence. This finding may indicate that,

Table 1. Results of Chi-square Test for Smartphone Overdependence Depending on Sample Characteristics (N=54,948)

Variables	Total	Smartphone overdependence		χ^2	p
	n (%)	Risk group n (%)	Normal group n (%)		
Total no.	54,948 (100.0)	13,775 (25.1)	41,173 (74.9)		
Sex				563.77	<.001
Boy	28,353 (51.9)	5,832 (42.3)	22,521 (54.7)		
Girl	26,595 (48.1)	7,943 (57.7)	18,652 (45.3)		
Educational stage				97.54	<.001
Middle school (age 13–15 years)	28,961 (52.7)	6,865 (49.8)	22,096 (53.7)		
High school (age 16–18 years)	25,987 (47.3)	6,910 (50.2)	19,077 (46.3)		
Academic achievement				346.67	<.001
Good	6,736 (12.2)	1,281 (9.3)	5,455 (13.2)		
Average	42,679 (77.7)	10,625 (77.1)	32,054 (77.9)		
Poor	5,533 (10.1)	1,869 (13.6)	3,664 (8.9)		
Household economic status				156.69	<.001
High	6,039 (11.0)	1,137 (8.3)	4,902 (11.9)		
Middle	47,634 (86.7)	12,262 (89.0)	35,372 (85.9)		
Low	1,275 (2.3)	376 (2.7)	899 (2.2)		
GAD-7				1,580.67	<.001
< 10	48,849 (88.8)	10,972 (79.7)	37,877 (92.0)		
≥ 10	6,099 (11.2)	2,803 (20.3)	3,296 (8.0)		
Perceived stress				980.20	<.001
Low	36,286 (66.0)	7,555 (54.8)	28,731 (69.8)		
High	18,662 (34.0)	6,220 (45.2)	12,442 (30.2)		
Sources of perceived stress				610.49	<.001
Conflict with peers	3,019 (5.5)	931 (6.8)	2,088 (5.0)		
Conflict with parents	5,611 (10.1)	1,687 (12.2)	3,924 (9.5)		
Family environment	1,330 (2.3)	392 (2.8)	938 (2.3)		
Physical appearance	6,493 (11.8)	1,875 (13.6)	4,618 (11.2)		
Pressure on grade and career paths	27,943 (50.9)	7,027 (51.0)	20,916 (50.8)		
Health problems	1,650 (2.9)	383 (2.8)	1,267 (3.1)		
Conflict with teachers	413 (0.8)	93 (0.7)	320 (0.8)		
Others	6,471 (11.8)	1,211 (8.8)	5,260 (12.8)		
Not applicable	2,018 (3.6)	176 (1.3)	1,842 (4.5)		
Perceived loneliness				1,087.14	<.001
Low	47,182 (85.9)	10,669 (77.5)	36,513 (88.7)		
High	7,766 (14.1)	3,106 (22.5)	4,660 (11.3)		
Perceived depressive symptoms				1,059.80	<.001
No	41,108 (74.8)	8,861 (64.3)	32,247 (78.3)		
Yes	13,840 (25.2)	4,914 (35.7)	8,926 (21.7)		
Time of using smartphone (hour/day)				2,142.98	<.001
< 2 hours	5,242 (9.5)	520 (3.8)	4,722 (11.5)		
2–4 hours	13,625 (24.8)	2,309 (16.8)	11,316 (27.5)		
4–6 hours	15,144 (27.6)	3,673 (26.6)	11,471 (27.9)		
6–8 hours	9,484 (17.3)	2,961 (21.5)	6,523 (15.8)		
> 8 hours	11,453 (20.8)	4,312 (31.3)	7,141 (17.3)		

GAD-7, generalized anxiety disorder 7-item.

prior to smartphone overdependence, adolescents classified as overly dependent on smartphones may have experienced poor mental health symptoms such as those associated with depression, anxiety, perceived stress, and loneliness.

The prevalence of GAD among Korean adolescents stood at 11.2%, a figure comparable to the 11.5% observed among

Chinese adolescents in 2020 during the COVID-19 pandemic [23]. In our study, GAD-7 (≥10) was linked to a 2.61-fold increase in smartphone overdependence. This is a smaller ratio than a previous study, which found that the group addicted to smartphones reported anxiety 4.41 times more than the normal group [24], it is still significantly higher. Anxiety lev-

Table 2. Results of Multiple Logistic Regression for Smartphone Overdependence (N=54,948)

Variables	Smartphone overdependence		p
	OR	95% CI	
Sex			
Boy	1.00		< .001
Girl	1.36	1.29–1.43	
Educational stage			
Middle school (age 13–15 years)	1.00		< .001
High school (age 16–18 years)	1.14	1.09–1.20	
Academic achievement			
Good	1.00		< .001
Average	1.09	1.02–1.17	
Poor	1.43	1.31–1.56	
Household economic status			
High	1.00		< .001
Middle	1.25	1.16–1.34	
Low	1.29	1.12–1.50	
GAD-7			
< 10	1.00		< .001
≥ 10	2.61	2.46–2.77	
Perceived stress			
Low	1.00		< .001
High	1.68	1.62–1.75	
Sources of perceived stress			
Conflict with peers	4.63	3.89–5.52	< .001
Conflict with parents	4.52	3.84–5.31	< .001
Family environment	4.52	3.75–5.46	< .001
Physical appearance	4.32	3.69–5.06	< .001
Pressure on grade and career paths	3.56	3.05–4.15	< .001
Health problems	3.35	2.78–4.03	< .001
Conflict with teachers	3.05	2.31–4.02	< .001
Others	2.42	2.06–2.86	< .001
Not applicable	1.00		
Perceived loneliness			
Low	1.00		< .001
High	1.98	1.87–2.09	
Perceived depressive symptoms			
No	1.00		< .001
Yes	1.78	1.70–1.86	
Time of using smartphone (hour/day)			
<2 hours	1.00		< .001
2–4 hours	2.01	1.80–2.26	
4–6 hours	2.96	2.64–3.32	
6–8 hours	4.06	3.61–4.56	
> 8 hours	5.21	4.64–5.85	

CI, confidence interval; GAD-7, generalized anxiety disorder 7-item; OR, odds ratio.

els were observed to rise with advancing academic year, lower levels of social support, limited positive coping strategies, heightened use of negative coping mechanisms, or poorer family functioning [23]. Individuals often turn to excessive smartphone use as an inappropriate coping mechanism for negative emotions [25]. In an effort to relieve anxiety stemming from fear of missing out on peer interactions, girls

tended to turn to social media, while boys leaned toward online games [17]. Consequently, the risk of smartphone overdependence tended to be higher among girls primarily because of their usage patterns in social media [17]. These findings underscore the importance of promoting positive coping strategies among adolescents to effectively cope with anxiety.

Adolescents who reported higher levels of perceived stress

had a 1.68 times greater likelihood of being at risk for smartphone overdependence. More than 50% of Korean adolescents both at-risk and not at risk for smartphone overdependence reported pressure on grades and career paths as the leading source of perceived stress, followed by physical appearance accounting for more than 10% of adolescents. Korea's competitive academic environment exerts significant pressure on adolescents to achieve high academic results, resulting in considerable stress [26], and, Koreans are reportedly concerned about their appearance [26]. These sociocultural characteristics make Korean adolescents more susceptible to stress, which increases the risk of smartphone overdependence and suicidal ideation [26,27].

As a response to stress from various sources, such as conflict with peers and parents, family environment, physical appearance, pressure on grade and career paths, and conflict with teachers, adolescents may resort to using smartphones as an inappropriate coping mechanism [17]. Both the at-risk and normal adolescent groups reported similar rates of stressors, suggesting that coping was more important than the source of perceived stress. Given the worsening mental health indicators among adolescents, there is an urgent need to provide students with practical strategies for effectively coping with stress. In the United States, health guidelines for social media use during adolescence have been published [9], the United Kingdom developed a guide for age-appropriate regulations for smartphone use, and a 2022–2024 plan to prevent smartphone addiction has been published in Korea [28]. Most guidelines, regulations, and plans focus on the moderation of smartphone usage. However, from a long-term public health perspective, policies and practices need to be implemented to improve adolescents' mental health and help them cope with stress.

The greater the frequency of experiencing perceived loneliness, the greater the risk of developing smartphone overdependence by a factor of 1.98. Previous studies have identified perceived loneliness as a contributing factor to internet and smartphone addiction among adolescents [14], with increased levels of loneliness associated with increased time spent on smartphones [29]. Adolescents worldwide are increasingly lonely, with girls reporting more loneliness and loneliness associated with greater smartphone and internet use [30,31]. The phenomenon known as the "fear of missing out", which generates a strong desire or urge to stay connected to social reference groups and keep abreast of their activities, can drive heightened use of social media and smart-

phone usage through social and self-referential processes [15]. Particularly, the COVID-19 pandemic has intensified the social isolation experienced by youth, resulting in increased feelings of perceived loneliness and a greater propensity to immerse themselves in virtual worlds [32]. Therefore, adolescent loneliness must be addressed to combat smartphone overdependence.

In this study, adolescents who reported experiencing perceived depressive symptoms were 1.78 times more likely to exhibit smartphone dependence. A well-established relationship exists between depression and problematic smartphone use [27], with heightened depressive symptoms linked to excessive smartphone use among adolescents [27,33]. Notably, the levels of depression and suicidal ideation were most pronounced in the group identified as smartphone addicts among the Korean adolescent population [30]. Alarming, suicide stands as the leading cause of death among South Korean adolescents [34], a concerning trend that has persisted since 2011. In 2020, suicide accounted for more than half (50.1%) of all youth deaths in South Korea [34]. Given the gravity of teen suicide as a pressing societal issue, it is imperative that more attention and proactive measures be directed towards addressing both teen depression and smartphone overdependence.

Time spent on a smartphone is a widely used variable for assessing smartphone dependence [16]. There exists a reciprocal relationship between the amount of time spent on a smartphone and the risk of developing smartphone overdependence [16]. In this study, those who spent more than eight hours per day on their smartphones had a risk of smartphone overdependence that was 5.21 times greater than those who used smartphones for less than two hours per day. However, it is important to exercise caution when interpreting these results because the survey only inquired about the amount of time spent on a smartphone, not the specific types of apps used or the purposes for which the smartphone was used. Given that the risk of smartphone addiction escalates with prolonged use of social media and gaming apps [17], it is essential to consider not only the duration but also the content consumed and the purpose. Moreover, the frequency of smartphone use serves as an indicator of the extent to which smartphone usage distracts or interferes with daily life [16]. Therefore, it would be more meaningful to include this measure as well to comprehensively assess smartphone dependence.

Impaired psychological well-being significantly increases

susceptibility to smartphone overdependence in the Korean adolescent population. Therefore, proactive interventions should be implemented for adolescents at risk of smartphone overdependence, aimed at facilitating effective coping mechanisms for managing negative emotions, with the ultimate goal of improving their mental health.

This study had several limitations that warrant consideration. First, the data was based on self-reporting by adolescents, which may introduce issues related to data reliability, such as recall, estimation, and social desirability bias [35]. Second, the measurement of perceived stress, loneliness, and depressive symptoms in adolescents utilized single-item assessments as categorical variables, which constrained the ability to perform more in-depth exploratory analyses. For example, the measurement of depressive symptoms relied on a single question with a dichotomous response in the KYRBWS, imposing limitations on the analysis and interpretation of the findings. Given that the KYRBWS is a nationally approved survey for Korean adolescents, there is a need to enhance its granularity to yield more meaningful insights into adolescent mental health.

CONCLUSION

This study investigated the association between smartphone overdependence in adolescents and their mental health. The findings revealed a significant association between smartphone overdependence and poor mental health among Korean adolescents. High levels of GAD, perceived stress, perceived loneliness, and perceived depressive symptoms significantly heightened the risk of smartphone overdependence in adolescents. Given the established link between problematic smartphone use and heightened mood disturbances as well as symptoms of depression [33], it is imperative to assess the mental health of adolescents at risk of developing smartphone overdependence. Moreover, tailored interventions must be offered to address this issue effectively.

ARTICLE INFORMATION

Authors' contribution

Conceptualization: all authors; Data collection, Formal analysis: Hyeseon Yun; Writing-original draft: Hyeseon Yun; Writing-review and editing: Eun Kyoung Choi; Final approval of

published version: all authors.

Conflict of interest

Eun Kyoung Choi has been an editor of *Child Health Nursing Research* since 2020. She was not involved in the review process of this article. No existing or potential conflict of interest relevant to this article was reported.

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Data availability

Please contact the corresponding author for data availability.

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