



Risk Factors for Smartphone Addiction in Korean Adolescents: Smartphone Use Patterns

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With widespread use of the smartphone, clinical evidence for smartphone addiction remains unclear. Against this background, we analyzed the effect of smartphone use patterns on smartphone addiction in Korean adolescents. A total of 370 middle school students participated. The severity of smartphone addiction was measured through clinical interviews and the Korean Smartphone Addiction Proneness Scale. As a result, 50 (13.5%) were in the smartphone addiction group and 320 (86.5%) were in the healthy group. To investigate the effect of smartphone use patterns on smartphone addiction, we performed self-report questionnaires that assessed the following items: smartphone functions mostly used, purpose of use, problematic use, and parental attitude regarding smartphone use. For smartphone functions mostly used, the addiction group showed significantly higher scores in "Online chat." For the purpose of use, the addiction group showed significantly higher "habitual use," "pleasure," "communication," "games," "stress relief," "ubiquitous trait," and "not to be left out." For problematic use, the addiction group showed significantly higher scores on "preoccupation," "tolerance," "lack of control," "withdrawal," "mood modification," "conflict," "lies," "excessive use," and "loss of interest." For parental attitude regarding children's smartphone use, the addiction group showed significantly higher scores in "parental punishment." Binary logistic regression analysis indicated that "female," "use for learning," "use for ubiquitous trait," "preoccupation," and "conflict" were significantly correlated with smartphone addiction. This study demonstrated that the risk factors for smartphone addiction were being female, preoccupation, conflict, and use for ubiquitous trait; the protective factor was use for learning. Future studies will be required to reveal the additional clinical evidence of the disease entity for smartphone addiction.

Keywords: Smartphone; Addiction; Adolescent

INTRODUCTION

Smartphone use has rapidly increased worldwide. It was estimated that worldwide use of smartphones surpassed 1 billion in 2012, which means that 1 out of 7 people use smartphone (1). In Korea, the number of smartphone users has constantly increased, with 32.7 million in 2012, 37.5 million in 2013, 40.6 million in 2014, and 43.7 million in December 2015 (2).

With widespread use of the smartphone, many social problems among adolescents have emerged. The 2013 Korean smartphone survey reported that 25.5% of Korean adolescents were in a smartphone addiction risk group, which was about 2.9 times higher than adults. In particular, frequent use of smartphones may easily arouse instability and impulsiveness in teenagers and cause loss of controlling tolerance and withdrawal symptoms (3). What is more, school violence has moved to the cyber and mobile spaces, including mobile messengers and social network services (SNS), according to the National Information

Society Agency (NIA) (3).

The social problems caused by smartphones were similar to the features of behavioral addiction. The Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) defined a behavioral addiction as the cognitive and behavioral symptoms, such as progressive loss of controlling tolerance and withdrawal symptoms, similar to substance-related addiction. In addition, it expanded the scope of behavioral addiction diagnosis such as substance-related addiction by suggesting internet gaming disorder as a condition for further study (4). Prior studies also supported the similarity between smartphone addiction and behavioral addiction. For instance, Seo et al. (5) examined 195 adolescents and found a strong correlation between smartphone addiction and internet gaming disorder.

Nevertheless, studies revealing disease entity about smartphone addiction are still limited. Smetaniuk (6) examined 362 adults and reported that young age, depression, and extroverted disposition were risk factors for smartphone addiction. In

Korea, Seo et al. (7) reported that smartphone addiction in teenagers was strongly correlated with physical symptoms, depression, anxiety, delinquency, and aggressiveness. However, current studies were insufficient to provide clinical evidence of disease entity about smartphone addiction, because many investigators have just focused on the media used, not smartphone use patterns. But actually, behavioral features were more important than the media used in determining behavioral addiction (8). For example, for internet gambling addiction, it was diagnosed as a gambling disorder not as an Internet addiction (4). Against this background, it is necessary to analyze smartphone use patterns in order to more clearly understand smartphone addiction.

In this context, we analyzed the severity of smartphone addiction and use patterns for middle school students in Daegu Metropolitan City. The study aim was to identify the risk factors for smartphone addiction by analyzing smartphone use patterns in Korean adolescents. We expect the study findings will be beneficial in revealing the clinical evidence of the disease entity for smartphone addiction

MATERIALS AND METHODS

Participants

This study was based on the self-report questionnaire administered at the program “Home-based daily journal for smartphone (HDJ-S) use during vacation.” This program was performed at one middle school in Daegu Metropolitan City in August 2014 and encouraged middle school students to complete the HDJ-S with their parents for two weeks (9). The program purpose was to strengthen adolescents’ self-control for their smartphone use and parents’ concerns for their children’s smartphone use. A total of 421 students participated, but this study included only 370 students who completed the entire questionnaire. Among the 370 students, 182 were male and 188 were female, and the mean age was 13.15 years old.

Assessment tools

The definition of smartphone addiction is still a controversy in the academic world of psychiatry. But many investigators agreed that smartphone addiction has close relations with behavioral addiction such as internet addiction (5). Thus, in this study, we defined smartphone addiction as loss of controlling tolerance and withdrawal symptoms to smartphone use based on internet gaming disorder in DSM-5 (4).

For sociodemographic data, we asked the participants to report four categories, such as age, gender, duration of smartphone use, and time on smartphone use per day. The severity of smartphone addiction was measured through clinical interviews and the Korean Smartphone Addiction Proneness Scale. In terms of smartphone use patterns, there is currently no standardized

scale. Thus, we asked the following items based on the questionnaire in the parent education program manual for smartphone addiction to identify the smartphone use patterns that may affect smartphone addiction: “most frequently used function,” “purpose of use,” “problematic use,” and “parental attitude regarding smartphone use” (10).

Korean Smartphone Addiction Proneness Scale

To measure the severity of participants’ smartphone addiction, we performed the Korean Smartphone Addiction Proneness Scale and clinical interviews performed face-to-face by a well-trained psychiatrist (11). This scale contains 15 questions, such as daily life disturbances, directivity to the virtual world, withdrawal, and tolerance. The participants reported each item themselves from 1 (absolutely not true) to 5 (completely true). They were defined as having a smartphone addiction in the following cases: when the total points were higher than 42, when daily life disturbance was higher than 14, when withdrawal was higher than 12, or when tolerance was higher than 13 (11). Cronbach’s alpha for this scale is 0.880 (12).

Most frequently used function

The questionnaire about most frequently used function of smartphone comprised “telephone call,” “SNS (Twitter, Facebook, etc.),” “online chat (Kakaotalk, My people, etc.),” “game,” and “Internet.” The participants reported each item from 1 (never used) to 5 (very frequently) (Supplementary Table 1). We used the scores for each item to compare the most frequently used functions of smartphones.

Purpose of use

We used an 18-item scale to evaluate the purpose of smartphones use. The questionnaire comprised “habitual use” (Q1–Q2), “pleasure” (Q3–Q4), “communication” (Q5–Q6), “games” (Q7–Q8), “multitasking” (Q9–Q10), “stress relief” (Q11–Q12), “learning” (Q13–Q14), “ubiquitous trait” (Q15–Q16), and “not to be left out” (Q17–Q18) (Supplementary Table 2). The participants reported each item from 1 (not at all) to 5 (very frequently).

Problematic use

The questionnaire about problematic use of smartphone comprised 36 items with the following categories: “preoccupation” (Q1–Q4), “tolerance” (Q5–Q8), “lack of control” (Q9–Q12), “withdrawal” (Q13–Q16), “mood modification” (Q17–Q20), “conflict” (Q21–Q24), “lies” (Q25–Q28), “excessive use” (Q29–Q32), and “loss of interest” (Q33–Q36) (Supplementary Table 3). The participants reported each item from 1 (not at all) to 5 (very frequently).

Parental attitude regarding smartphone use

The parents of participants reported their attitude regarding children’s smartphone use. The questionnaire comprised 25

items, such as “surveillance” (Q1–Q4), “restriction” (Q5–Q10), “punishment” (Q11–Q16), “explanation” (Q17–Q21), and “permission” (Q22–Q25) (Supplementary Table 4). The parents reported each item from 1 (not at all) to 5 (very frequently).

Statistical analysis

We used the SPSS for Windows ver. 18.0 (SPSS Inc., Chicago, IL, USA) for the statistical analyses in this study, and a *P* value of 0.05 indicates statistical significance. To compare between two groups, an independent sample *t*-test was performed for quantitative variables and χ^2 test was performed for the categorical data. Additionally, we compared the smartphone use patterns between the two groups via an analysis of covariance (ANCOVA) with the difference of sociodemographic factors as a covariance. To assess the factors that affect smartphone addiction in adolescents, we conducted a binary logistic regression analysis with demographic characteristics and smartphone use patterns as the independent variables.

Ethics statement

The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the Daegu Catholic University Medical Center (DCUMC IRB approval No. CR-16-035) approved the study. The current study was exempted from informed consent as we analyzed preexisting anonymous data; parental consent was sought for those younger than 18 years of age in the original study.

RESULTS

Sociodemographic data

A total of 370 adolescent subjects participated in this study, with 320 of them in the healthy group (HG) (86.5%) and 50 in the smartphone addiction group (SAG) (13.5%). When these two groups were compared, there were no significant differences in their ages and duration of smartphone use. However, the proportion of females was significantly higher in the SAG ($\chi^2 = 10.385$; $P = 0.001$). Regarding daily smartphone use, the SAG had significantly greater smartphone use weekdays ($t = -2.151$; $P = 0.032$), weekends ($t = -3.674$; $P < 0.001$), and for total hours of use ($t = -2.827$; $P = 0.005$) (Table 1).

Results of the questionnaire on smartphone use patterns

Most frequently used function

Although there were no differences between the two groups for “phone call,” “SNS,” “games,” and “Internet,” the SAG used the “online chat” function significantly more than the HG ($F = 4.570$; $P = 0.033$) (Table 2).

Purpose of use

For purpose of use, the two groups did not show a difference in

Table 1. Sociodemographic characteristics of the study population

Parameters	HG (n = 320)	SAG (n = 50)	t or χ^2	P value
Age, yr	13.13 \pm 0.81	13.28 \pm 0.86	-1.222	0.223
Sex			10.385	0.001*
Male	168 (52.5)	14 (28.0)		
Female	152 (47.5)	36 (72.0)		
Duration of smartphone use, yr			3.947	0.267
< 1	46 (14.4)	4 (8.0)		
> 1 to < 2	81 (25.3)	9 (18.0)		
> 2 to < 3	110 (34.4)	23 (46.0)		
> 3	83 (25.9)	14 (28.0)		
Time on smartphone use, hr/day				
Weekday	2.65 \pm 2.17	3.36 \pm 2.03	-2.151	0.032*
Weekend	3.24 \pm 2.20	4.53 \pm 2.84	-3.674	< 0.001*
Total	2.82 \pm 2.02	3.70 \pm 2.12	-2.827	0.005*

Data are shown as mean \pm SD or number (%).

HG = healthy group, SAG = smartphone addiction group, SD = standard deviation.

*A statistically significant difference between groups.

“multitasking” and “learning,” but the SAG showed significantly higher “habitual use” ($F = 21.808$; $P < 0.001$), “pleasure” ($F = 9.248$; $P = 0.003$), “communication” ($F = 9.070$; $P = 0.003$), “games” ($F = 7.985$; $P = 0.005$), “stress relief” ($F = 14.379$; $P < 0.001$), “ubiquitous trait” ($F = 15.911$; $P < 0.001$), and “not to be left out” ($F = 7.350$; $P = 0.007$) (Table 2).

Problematic use

For problematic use patterns, all of the following sub-dimensions were significantly higher in the SAG compared to the HG: “preoccupation” ($F = 55.014$; $P < 0.001$), “tolerance” ($F = 20.147$; $P < 0.001$), “lack of control” ($F = 45.031$; $P < 0.001$), “withdrawal” ($F = 58.669$; $P < 0.001$), “mood modification” ($F = 40.281$; $P < 0.001$), “conflict” ($F = 78.282$; $P < 0.001$), “lies” ($F = 45.200$; $P < 0.001$), “excessive use” ($F = 53.652$; $P < 0.001$), and “loss of interest” ($F = 21.293$; $P < 0.001$) (Table 2).

Parental attitude regarding smartphone use

Although there were no significant differences between the two groups in “surveillance,” “restriction,” “explanation,” “permission” attitudes of parents, and “punishment” ($F = 14.352$; $P < 0.001$), attitude was significantly higher for the parents of SAG (Table 2).

Binary logistic regression analysis in accordance with sociodemographic background and smartphone use pattern

We performed a binary logistic regression analysis with the sociodemographic data and smartphone use patterns as the independent variables to assess the factors that affect smartphone addiction. We found that “female” (odds ratio [OR], 2.720; $P = 0.014$) (sociodemographic features), “learning” (OR, 0.773; $P = 0.042$) and “ubiquitous trait” (OR, 1.315; $P = 0.015$) (purpose of use), and “preoccupation” (OR, 5.326; $P = 0.021$) and “conflict” (OR, 1.466; $P < 0.001$) (problematic use) had significant effects

Table 2. ANCOVA regarding the factors affecting smartphone addiction

Covariance	Range	HG (n = 320)	SAG (n = 50)	F	P value
Smartphone functions mostly used					
Telephone calls	0–5	2.91 ± 1.17	3.00 ± 1.34	0.198	0.657
SNS (Twitter, Facebook, etc.)	0–5	2.60 ± 1.41	3.22 ± 1.56	3.640	0.057
Online chat (Kakaotalk, My people, etc.)	0–5	3.47 ± 1.26	4.04 ± 1.14	4.570	0.033*
Game	0–5	2.57 ± 1.37	2.52 ± 1.45	1.026	0.312
Internet	0–5	3.08 ± 1.23	3.30 ± 1.34	1.055	0.305
Purpose of use					
Habitual use	0–10	5.40 ± 1.79	6.84 ± 1.80	21.808	< 0.001*
Pleasure	0–10	5.31 ± 1.91	6.10 ± 1.73	9.248	0.003*
Communication	0–10	6.33 ± 2.26	7.68 ± 2.05	9.070	0.003*
Game	0–10	4.13 ± 2.15	4.64 ± 2.33	7.985	0.005*
Multitasking	0–10	5.65 ± 2.17	6.28 ± 2.10	1.822	0.178
Stress relief	0–10	5.31 ± 1.99	6.48 ± 1.53	14.379	< 0.001*
Learning	0–10	5.41 ± 1.82	5.66 ± 1.55	0.217	0.641
Ubiquitous trait	0–10	5.80 ± 2.17	7.28 ± 1.83	15.911	< 0.001*
Not to be left out	0–10	3.74 ± 1.83	4.46 ± 2.04	7.350	0.007*
Problematic use					
Preoccupation	0–20	8.82 ± 3.08	12.52 ± 3.02	55.014	< 0.001*
Tolerance	0–20	6.87 ± 2.80	8.74 ± 3.23	20.147	< 0.001*
Lack of control	0–20	6.66 ± 2.81	9.70 ± 3.48	45.031	< 0.001*
Withdrawal	0–20	6.69 ± 2.96	10.22 ± 3.65	58.669	< 0.001*
Mood modification	0–20	7.18 ± 3.01	10.08 ± 3.58	40.281	< 0.001*
Conflict	0–20	6.29 ± 2.44	9.60 ± 2.69	78.282	< 0.001*
Lies	0–20	5.71 ± 2.53	8.14 ± 3.72	45.200	< 0.001*
Excessive use	0–20	6.98 ± 2.93	10.40 ± 3.43	53.652	< 0.001*
Loss of interest	0–20	5.28 ± 2.34	6.78 ± 3.40	21.293	< 0.001*
Parental attitude regarding smartphone use					
Surveillance	0–20	7.01 ± 3.61	7.50 ± 3.62	2.028	0.155
Restriction	0–30	11.54 ± 5.25	12.46 ± 4.81	3.024	0.083
Punishment	0–30	10.84 ± 4.53	12.98 ± 3.65	14.352	< 0.001*
Explanation	0–25	15.31 ± 4.19	15.20 ± 3.78	0.012	0.914
Permission	0–20	8.49 ± 3.42	8.88 ± 2.98	1.923	0.166

Data are shown as mean ± SD. ANCOVA was performed.

ANCOVA = analysis of covariance, HG = healthy group, SAG = smartphone addiction group, SNS = Social Network Services, SD = standard deviation.

*A statistically significant difference between groups.

Table 3. Binary logistic regression analysis for the factors affecting smartphone addiction

Variables	B	SE	Walds	OR	95% CI		P value
					Lower	Higher	
Sociodemographic characteristics							
Sex (female)	1.001	0.408	6.027	2.720	1.224	6.047	0.014*
Purpose for use							
Learning	0.258	0.127	4.136	0.773	0.603	0.991	0.042*
Ubiquitous trait	0.274	0.112	5.976	1.315	1.056	1.637	0.015*
Problematic use							
Preoccupation	0.165	0.071	5.326	1.179	1.025	1.356	0.021*
Conflict	0.382	0.080	23.100	1.466	1.254	1.713	< 0.001*

Nagelkerke $R^2 = 0.393$.

B = regression coefficient, SE = standard error, OR = odds ratio, CI = confidence interval.

*A statistically significant difference between groups.

on smartphone addiction in adolescents. Nagelkerke R^2 was 0.393, which can be interpreted as the model explaining 39.3% of all variables (Table 3).

DISCUSSION

In this study, we assessed the severity of students' smartphone addiction and divided them into the SAG and the HG. Then, we examined the factors that affect smartphone addiction by com-

paring the smartphone use patterns and the parental attitudes regarding their children's smartphone use. The results showed that being female (sociodemographic features), learning and ubiquitous trait (purpose of use), and preoccupation and conflict (problematic use) were identified as the factors with significant effects on smartphone addiction in the Korean adolescents. The present study is meaningful in that it was the first research that attempted to reveal a disease entity for smartphone addiction by analyzing adolescents' smartphone use patterns.

The study findings showed that the proportions of female and using online chat were higher in the SAG than the HG. The results of logistic regression analysis also showed that females had 2.7 times more risk for smartphone addiction than males. Furthermore, using SNS was relatively higher trend in the SAG, although the difference was not statistically significant ($F = 3.640$; $P = 0.057$). These results are in line with prior studies that the proportions of females as well as using SNS and online chats were higher in the SAG (8,9). In fact, smartphones can be used for social interaction anywhere at any time because they are specialized in using mobile messengers and SNS. Moreover, women are known to have stronger desires for social relationships, which may have contributed to the significantly higher proportion of females with smartphone addictions (13). However, from a different perspective, such use patterns could be changed as smartphone functions are rapidly evolving. Generally, men are known to be more vulnerable to the internet gaming disorder than women (14). Therefore, if smartphones develop to be able to play high performance games, being male could become a risk factor for smartphone addiction (8).

Regarding purpose, using for habit, pleasure, communication, game, stress relief, ubiquitous trait, and not to be left out were significantly higher in the SAG than the HG. Additionally, the logistic regression analysis results showed that risk for smartphone addiction was reduced when smartphones were used for learning. However, risk for smartphone addiction was increased when smartphones were used for ubiquitous trait. Smartphone functions are based on the Internet and are similar to computers, but are more vulnerable to addiction because they can be used anywhere at any time (15). Actually, many problems associated with smartphone are not limited within households, but the influence on the person's whole life, such as work and school. For these reasons, parents and teachers should keep in mind that if smartphones are used anywhere at any time without specific purposes, the risk for addiction could rise, and also encourage adolescents to use smartphones for specific purposes, such as searching for information or learning in order to overcome smartphone addiction.

Regarding problematic use of smartphones, preoccupation, tolerance, lack of control, withdrawal, mood modification, conflict, lies, excessive use, and loss of interest were all significantly higher in the SAG compared to in the HG. These nine problem-

atic use patterns are the same diagnostic criteria for internet gaming disorder defined by the DSM-5 (4). However, the most important thing was that only preoccupation and conflict among the nine problematic use patterns had significant effects on smartphone addiction according to the logistic regression analysis. It was known that the most common pathology of addiction is tolerance and withdrawal symptoms due to alternation of reward pathway (16,17). However, in this study, these factors were not verified as significant risk factors for smartphone addiction. Based on these results, we could think that current problems associated with smartphone addiction are not actually associated with the psychopathology of an addiction; rather, increasing the use of smartphones just has led to preoccupation and conflict. However, the pathology of smartphone addiction could not be defined simply based on the smartphone use patterns only. Thus, we think that further brain imaging and neurobiological studies would be required to reveal the definite psychopathology of smartphone addiction.

Regarding parental attitude toward children's smartphone use, parents of the SAG showed significantly higher punishment attitudes than those of the HG. Although parental attitude toward children's smartphone use was not found to have a significant effect on smartphone addiction in the logistic regression analysis, it was known that family education is necessary to treat adolescents with addiction problems. Prior studies also supported the need for such a family education. For instance, Han et al. (18) examined internet gaming addicted adolescents and found that three-week family therapy increased the activity of the caudate nucleus, which was highly associated with parental attachment and also stabilized the dopamine addiction pathway, reducing the desire for internet games. Based on such findings, current treatment for internet gaming disorder comprises family therapy, cognitive behavior therapy and motivational interviewing for their parents and children (19). Therefore, we suggest that various psychosocial treatments involving participation from both parents and children would be one of the treatment options for smartphone addiction, because a definite treatment guideline for smartphone addiction has not been established yet. Additional studies should be performed to confirm the treatment guideline for smartphone addiction.

There were several study limitations. First, there is currently no standardized scale to measure the purpose of smartphone use, problematic use, and parental attitude regarding smartphone use. Therefore, in this study, we measured these based on the treatment manual for smartphone addiction in adolescents distributed by the Ministry of Gender Equality and Family (10). However, more meaningful results would be produced if standardized scales are developed in the future. Second, one limitation of self-reporting scales is that they are susceptible to recall bias. Third, this was a cross-sectional study that examined adolescents' smartphone addiction and smartphone use pat-

terns; therefore, the result was limited to infer causative relationships regarding the factors that affect smartphone addiction. Fourth, the study samples comprised middle school students from only one school in Daegu. In addition, adolescents with conduct problems could drop out due to insincere attitude. Therefore, the sample would not accurately represent the entire population.

We identified a disease entity and risk factors for smartphone addiction by analyzing adolescents' smartphone use patterns. Our results revealed that the risk factors for smartphone addiction were female, preoccupation, conflict, and use for ubiquitous trait, while the protective factor was use for learning. As smartphone use is rapidly increasing worldwide, we insist that more research, including brain imaging and neurobiological studies, should be performed to reveal clinical evidence of disease entity about smartphone addiction.

DISCLOSURE

The authors have no potential conflicts of interest to disclose.

AUTHOR CONTRIBUTION

Conceptualization: Kim JW, Choi TY. Data curation: Lee H, Kim JW, Choi TY. Investigation: Lee H, Kim JW, Choi TY. Writing - original draft: Lee H. Writing - review & editing: Lee H, Kim JW, Choi TY.

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