Smartphone use and smartphone addiction in middle school students in Korea: Prevalence, social networking service, and game use

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Abstract

This study aimed to examine smartphone use patterns, smartphone addiction characteristics, and the predictive factors of the smartphone addiction in middle school students in South Korea. According to the Smartphone Addiction Proneness Scale scores, 563 (30.9%) were classified as a risk group for smartphone addiction and 1261 (69.1%) were identified as a normal user group. The adolescents used mobile messengers for the longest, followed by Internet surfing, gaming, and social networking service use. The two groups showed significant differences in smartphone use duration, awareness of game overuse, and purposes of playing games. The predictive factors of smartphone addiction were daily smartphone and social networking service use duration, and the awareness of game overuse.

Keywords

awareness, game, health, smartphone addiction, social networking service, use duration

Introduction

The Internet is very useful for a variety of purposes, such as convenient electronic commerce, rapid sharing of information, contact with other cultures, emotional support, and entertainment (Kraut et al., 1998; Morahan-Martin, 1999; Scherer, 1997). A smartphone combines the services of the Internet and a mobile phone. Smartphones offer qualitatively different services in addition to the benefits that the Internet offers. Young people watch videos, express themselves, communicate with friends, and search for information using smartphones, while older people use their smartphone for having video calls with their children living far away and for playing games. The portability and accessibility of a smartphone make it possible to use it anywhere, for any duration.

Worldwide, smartphones were used by 1.85 billion people in 2014. This number is expected to be 2.32 billion in 2017 and 2.87 billion in 2020 (Statista, 2017). In 2015, a median of 54 percent across 21 emerging and developing countries such as Malaysia, Brazil, and China reported using the Internet at least occasionally or owning a smartphone. In comparison, a median of 87 percent reported the same across 11 advanced economies, including the United States and Canada, major Western European nations, developed Pacific nations (Australia, Japan, and South Korea), and Israel (Pew Research Center, 2016). In the findings of a survey conducted in 40 nations, South Korea showed the highest rate of smartphone ownership (88%) followed by Australia (77%), and the United States (72%). In a survey on Korean smartphone use in 2016, 83.6 percent of Koreans aged over 3 years were found to use a smartphone. Among them, 86.7 percent of males and 80.6 percent of females reported using a smartphone, and 95.9 percent of teenagers were found to use a smartphone (Korea Internet and Security Agency, 2017). Indeed, smartphone users are increasing across the world.

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Smartphones offer several conveniences in our life, but we also need to be aware of the negative effects of smartphone use, the most concerning aspect being smartphone addiction. Smartphone addiction is a phenomenon that pertains to uncontrollability of smartphone use. People with this problem encounter social, psychological, and health problems (Heron and Shapira, 2004; Young, 1999).

Specifically, adolescents are a high risk group for smartphone addiction. Adolescents are strongly attached to their smartphone, and they regard a smartphone as their second self. Many smartphone users have reported that they would not be able to live without a smartphone (Wajcman et al., 2007). Developmentally, adolescents experience several physical and psychological changes. While, on one hand, they are dependent on their parents with reference to their life and identity, on the other hand, they are trying to be independent of their parents, to establish their identity and to create an independent space for themselves. During these changes, a smartphone becomes indispensable for adolescents. They are interested in new technology and get used to the operation of such devices more easily than adults do. Adolescents, as digital natives, express their thought in an online space, try to keep up with fashion, use many kinds of applications (apps), and search for emotional relationships and support. They are good in multitasking, and they pursue instant reactions and feedback (Tapscott, 2009). When these characteristics, including novelty seeking in adolescents, are combined with their immature control competence, they are placed at a high risk of smartphone addiction (Chambers et al., 2003).

In this study, we targeted adolescents aged 13 to 15 years, to examine the characteristics of their smartphone addiction. In addition, we compared a risk group for smartphone addiction and a normal user group in terms of their smartphone use patterns and examined the risk factors for smartphone addiction.

Literature review

Smartphone addiction

Smartphone addiction is considered to be rooted in Internet addiction due to the similarity of the symptoms and negative effects on users. Internet addiction is defined as an impulse control disorder, characterized by pathological Internet use (Goldberg, 1996; Young, 1998). Smartphone addiction could be categorized as a behavioral addiction, such as Internet addiction. Behavioral and chemical addictions have seven core symptoms in common, that is, salience, tolerance, mood modification, conflict, withdrawal, problems, and relapse (Grant et al., 2010; Griffiths, 2005). These common points are not integrally researched, but each symptom has been found in smartphone addiction studies. For instance, Lin et al.

(2014) reported four features of smartphone addiction, that is, compulsion, functional impairment, tolerance, and withdrawal. Bianchi and Phillips (2005) suggested that smartphone overuse associated with psychological symptoms constitutes a form of behavioral addiction. Smartphone addiction is also considered a technological addiction that involves human–machine interaction (Griffiths, 1995).

Smartphone addiction is considered as the inability to control the smartphone use despite negative effects on users. The use of a smartphone not only produces pleasure and reduces feelings of pain and stress but also leads to failure to control the extent of use despite significant harmful consequences in financial, physical, psychological, and social aspects of life (Shaffer, 1996; Van Deursen et al., 2015; Young, 1999). Addiction to media has been characterized as excessive or poorly controlled preoccupations, and compulsive needs or behaviors that lead to impairment (Demirci et al., 2014; Shaw and Black, 2008). A study reported that media addicts could not manage real-life activities (Greenfield, 1999; Young, 2007). The people using the Internet longer had poor social support and higher levels of loneliness (Nie and Erbring, 2000). Children using the cell phone displayed more behavioral problems such as nervousness, temperament, mental distraction, and indolence, and these problems worsened if the children began using a cell phone at an early age (Divan et al., 2012).

Awareness regarding the severity of smartphone addiction has already been reflected in clinical science and praxis. The *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*-5, American Psychiatric Association (APA), 2013) introduced the diagnostic criteria for Internet gaming disorder and encouraged further research for listing it as a formal diagnosis. Oulasvirta et al. (2012) reported that the awareness of problems with repeated use of smartphones was underestimated, and only a few reported that they were aware of it. The few respondents reported repeated usage of a smartphone as annoying, addicting, "a trap," and distracting. They were aware that repeated use could lead to addiction; however, they were not aware of the severity of the repeated and intense use of a smartphone. If one is aware of the risks posed by smartphone addiction, one would do something against it. The awareness of the severity of smartphone addiction can, therefore, play a role in preventing it.

Life satisfaction pertains to the normal evaluation of one's surroundings, and subjective happiness or personal contentment (Diener et al., 1985; Scheufele and Shah, 2000). Addiction to media could increase depressive symptoms and substance use, and it could decrease well-being (Ha and Hwang, 2014; Yoo et al., 2014). Samaha and Hawi (2016) showed that smartphone addiction is not directly linked to life satisfaction, but it is linked via perceived stress and academic performance.

Socioeconomic status

Gender, specifically, being male, is a risk factor for pathological Internet use (Frangos et al., 2011). Results from multivariate logistic regression analyses have suggested 50 percent increased odds for males to be addicted to the Internet (odds ratio (OR) = 1.5, 95% confidence interval (CI) = 1.1, 2.2) as compared with females (Lam et al., 2009). Women use the Internet mostly for social purposes and males do so for downloading programs, getting information, and for visiting pornographic sites (Tsitsika et al., 2009; Ybarra and Mitchell, 2005). In contrast to Internet addiction, studies on smartphone addiction reported that females were more dependent on smartphones than males were (Billieux et al., 2008). Females are more likely to be involved with their mobile than males are (Walsh et al., 2011), owing to the differences in the purpose of use of mobile phones. Males are more likely to use their phones for functional purposes, such as work-related use, whereas females primarily use their phones to keep in contact with valued people (Lemish and Cohen, 2005; Rees and Noyes, 2007). Thus, it seems that males and females have different smartphone use patterns.

Adolescents would be more at risk of smartphone addiction as compared with adults because adolescents are yet to develop self-control in smartphone use. Adolescents with working parents could be at a risk of smartphone addiction, possibly because such children could not be cared by their parents after school and they would use smartphones without any rules and guidance.

Regarding the income of smartphone users, there were different research results. While one study reported that students from higher income families spent more time and money on their mobile phone, another revealed that lower income students used their mobile phones more often (Chakraborty, 2006; Zulkefly and Baharudin, 2009). A Pew Research Center survey (2016) reported that people with more education and higher income were more likely to use the Internet or own a smartphone than were those with lower income and less education.

Smartphone usage pattern

Smartphone addicts spend considerable time using their smartphone. The daily use duration of a smartphone is one of the most significant indicators of smartphone addiction. Torrecillas (2007) reported that 40 percent of adolescents and adults use smartphones for more than 4 hours a day to make calls and send messages. In addition, such people showed more problems in psychosocial, health, and technological dimensions, and they exhibited more preoccupation with smartphones and smartphone overuse as compared with those who used a smartphone for less than 4 hours per day (Alijomaa et al., 2016).

The causes of smartphone use can be attributed to the technological and content-related features of a smartphone.

Regarding technological features, Oulasvirta et al. (2012) reported that the motivation of smartphone use is triggered by accessibility, portability, easiness of operation, connectedness, user interface, design, music and video player, navigation, and so forth. In Europe, smartphone users touched their phones about 10 to 200 times a day, for a mean duration of 10–250 seconds, and they used up 1–1000 megabyte (MB) data per day (Falaki et al., 2010). Oulasvirta et al. (2012) suggested that smartphone addiction increased owing to the habit of checking the phone on hearing a notification sound or message. With reference to content-related features, Van Deursen et al. (2015) reported that social smartphone use is one of the risk factors increasing smartphone addiction. Salehan and Negahban (2013) suggested that the predictive variable for smartphone addiction is the use of social networking services (SNSs). Park and Lee (2012) reported that smartphone addicts prefer to use SNSs, which could explain why females are more addicted to smartphones than males are. Song et al. (2004) classified the types of Internet use in relation with addictive behaviors. One type is process-related gratifications, which are acquired during consuming or prosuming media. Pleasurable experiences function as rewards and increase the risk of habitual or addictive behaviors. Another type of Internet use is social usage. Smartphone addicts spend most of their time on their smartphone for social purposes (Li and Chung, 2006; Lopez-Fernandez et al., 2014). Furthermore, excessive use of SNSs can negatively impact one's academic performance (Enriquez, 2010; Junco, 2012). In relation gaming, one study reported that the use of a smartphone for gaming and the use of multiple apps for gaming were potential risk factors for smartphone addiction, because, in smartphone gaming, it is easy to interact with other players through other social networking apps. Smartphone gaming, with or without the use of multiple apps, increases the risk of smartphone addiction (Liu et al., 2016).

A study on the relative effects of content types on smartphone addiction showed that, among smartphone contents such as study, entertainment, SNS, and game, except for study-related content, the other three contents were significant predictors of smartphone addiction. SNS had the strongest predictive effect on smartphone addiction, followed by entertainment, and gaming (Jeong et al., 2016; Salehan and Negahban, 2013).

Psychological and physical health problem

Smartphone addiction affects physical and psychological health (Abo-Jedi, 2008). Depression or anxiety can cause technology addiction, in that individuals with depression or anxiety use smartphone as a coping method to deal with depressive and negative emotions (Kim et al., 2015). Smartphone addicts engage in checking behavior and react to notification sounds frequently. That is also a characteristic of depression and anxiety (Cougle et al., 2012; Evraire

and Dozois, 2011). A longitudinal study on heavy users of a computer, social media, and mobile phone showed greater level of prolonged stress, depression, and sleep disturbances (Thomée et al., 2011). Excessive smartphone use at night could keep one awake till late, thus impairing sleep and influencing stress and depression (Lemola et al., 2015). Screen time and Internet usage were found to affect sleep (Brunborg et al., 2011; Vollmer et al., 2012), and SNS addicts were reported to show poorer sleep quality than non-SNS addicts did (Wolniczak et al., 2013).

The negative effects of smartphone overuse on physical health include cancer; brain tumor; nervous disturbances; weakening of the immune system; problems with the eardrum; pain in the wrist, neck, and joints; fatigue; and sleep disorders (Alasdair and Philips, 2017; Richard, 2001).

As stated above, the overuse of the smartphone causes health problems, but the deprivation of a smartphone can also cause health problems. For instance, smartphone addicts were reported to feel distressed when deprived of their smartphone for some time, and adolescents exhibited anxiety, depression, anger, and sleep disturbances when their smartphones were switched off (Assabawy, 2006; Torrecillas, 2007).

Research questions

Research question 1. What is the prevalence of smartphone addiction in middle school students aged 13–15 years?

Research question 2. Would the smartphone addiction group have a lower socioeconomic status as compared with the normal user group?

Research question 3. Would the addiction group show longer duration of smartphone, SNS, game, and Internet use as compared with the normal user group?

Research question 4. Can the addiction and normal user groups be differentiated in terms of the content and purposes of smartphone use?

Research question 5. Would the addiction group have more psychological and physical problems as compared with the normal user group?

Research question 6. Would the addiction group have lower life and relationship satisfaction as compared with the normal user group?

Research question 7. Which factors predict smartphone addiction in middle school students?

Material and methods

Participants

Participants were 1824 middle school students who used a smartphone. They were sampled randomly from strata based on city, age, and sex. The mean age of the participants was 15.6 years (standard deviation (SD) = 0.78), with 51 percent males and 49 percent females. Furthermore, 498 (27.3%) of them were in the first grade, 724 (39.7%) were in the second grade, and 602 (33.0%) were in the third grade of middle school in 17 cities in South Korea, for example, Seoul, Busan, Daegu, and Daejeon. Trained interviewers conducted face-to-face interviews with the participants. Before they were interviewed, the participants were informed about the survey and their consent to participate in the study was sought. Their participation was rewarded by a gift worth 5000 won (US$4). This survey was conducted by Korean Information Society Agency, to investigate the status of smartphone addiction in Korea and the perception of the Korean people on the same.

Questionnaire

The questionnaire included items on demographic variables, smartphone addictive behavior, and risk factors for smartphone addiction. The participants responded to questions on smartphone use patterns, such as the duration of daily smartphone use; commonly used content of a smartphone, such as game, SNS, music, or learning; and the purposes of the content used, such as fun/stress reduction, communication with people, accessing latest information, or passing time. Regarding smartphone content, we asked more about the SNS and game that were used most frequently (e.g. Facebook, Twitter, Kakaostory, Band, Instagram, or others), the duration and purpose of SNS and game use, the time slot of gaming, the awareness of gaming overuse, the use frequency of a PC room (PC room is a place where one can use the fastest PC for gaming by paying some money), and the monthly expenditure for using a PC room.

In addition, we assessed physical and psychological health problems caused by smartphone use. Physical health problems included dry eyes, sleep disturbances, pain in neck/wrist/back, digital dementia, chronic tiredness, and others. Psychological problems included anger, annoyance, anxiety, depression, aggression, lethargy, and others. Participants could choose multiple responses to report the problems that they faced.

Regarding smartphone addiction, we sought responses to questions on the degree of life and relationship satisfaction, and future career plan. These questions were rated on a 4-point Likert-type scale from 1 (*not at all*) to 4 (*very much*), to respond to the following statements: "I am satisfied with my life," "I am satisfied with my relationships," "I have a career plan after graduating from the school" (see Appendix 1).

We assessed the awareness on the severity of smartphone addiction in Korea, experience of prevention education on smartphone addiction, and efficacy of the education using the following questions: "Is the prevention education on smartphone addiction helpful?" The question was rated on a 4-point Likert-type scale from 1 (*not helpful at all*) to 4 (*very helpful*).

Table 1. Prevalence of smartphone addiction in middle school students.

	Risk group for smartphone addiction (*n* = 563)	Normal user group (*n* = 1261)	Total (*n* = 1824)	*t*
Risk group	563 (30.9)	1261 (69.1)		
High risk group	70 (3.8)			
Latent risk group	493 (27.0)			
Smartphone addiction scale				
Total scores *M* (*SD*)	40.48 (4.2)	30.62 (5.3)	33.67 (6.7)	39.14***
Difficulty in daily living	14.06 (1.9)	9.72 (2.4)	11.06 (3.0)	38.29***
Withdrawal	9.92 (1.44)	8.62 (1.9)	9.02 (1.8)	14.85***
Tolerance	10.58 (1.6)	8.23 (1.9)	9.00 (2.1)	39.29***

SD: standard deviation.
***$p < 0.001$.

To measure the prevalence of smartphone addiction in middle school students, we used a validated Smartphone Addiction Proneness Scale (Korean Information Society Agency, 2011). This self-rating questionnaire contains 15 items across three subscales, namely, daily difficulties, intolerance, and withdrawal. Sample items include "My school grades dropped due to excessive smartphone use," "My family or friends complain that I use my smartphone too much," and "I panic when I cannot use my smartphone." The items are rated on a 4-point Likert-type scale from 1 (*never*) to 4 (*always*). Some items are scored in reverse order to avoid a response bias. The scores range from 15 to 60, with a clinical cutoff score of 42. The internal consistency of this tool was $r = 0.82$ (Korean Information Society Agency, 2011).

Data analysis

A chi-square test was conducted to investigate differences in the demographic variables and smartphone use behaviors between the smartphone addiction and normal user groups. A *t* test was used to examine differences in the use duration of smartphone, SNS, game, and messenger services between the two groups. Subsequently, a multiple linear regression analysis was conducted to identify the predictors of smartphone addiction. Results were considered significant at $p < 0.05$. Statistical analyses were performed using SPSS 22.0.

Results

Of the 1824 participants, 563 (30.9%) were identified as a risk group for smartphone addiction and 1261 (69.1%) were classified as a normal user group according to their scores on the Smartphone Addiction Proneness Scale. The risk group for smartphone addiction showed significantly higher scores on the scale as well as on each subscale of the tool as compared with the normal users (Table 1).

Before analyzing the difference in smartphone usage pattern between the two groups, we conducted a chi-square test to examine whether these groups differed in terms of gender, age, income form of parents, monthly family income level, and occupation of parents (Table 2). There were no differences in the demographic variables between the two groups. Both groups consisted of almost equal proportions of women and men. The average age was 15 years in both groups, and 60 percent of them were from a dual income family. There was no difference in monthly average household income and parental occupation. Thus, the two groups showed a homogeneous composition.

The risk group for smartphone addiction used a smartphone for an average of 313.13 minutes per day, which was 33.17 minutes longer than that of the normal user group. This difference was statistically significant ($t = 6.16$, $p = 0.000$). Even regarding smartphone use duration excluding the time spent on calls and text messages, the risk group spent longer than the normal user group ($t = 6.50$, $p = 0.000$). The adolescents were using the mobile messenger for the longest duration, followed by Internet surfing, game, and SNS. Surprisingly, they were using SNSs for the shortest duration. The risk group for smartphone addiction used the mobile messenger, SNS, and Internet for significantly longer as compared with the normal user group. However, the normal user group played games for significantly longer than the risk group (Table 3).

The respondents were instructed to select two contents of a smartphone and SNS that they used most frequently, and the two purposes of using SNSs. As evident from Table 4, 30–40 percent of the respondents used web surfing and instant mobile messenger contents the most, and more than 20 percent of the respondents used music, games, and social networking. There was no difference between the two groups regarding the contents used.

Regarding the commonly used SNSs and the reasons for the same, there was no difference between the two groups. The most frequently used SNSs were Kakaostory

Table 2. Demographic characteristics.

		Risk group for smartphone addiction (n = 563)	Normal user group (n = 1261)	Total (n = 1824)	χ^2/t
		n (%)	n (%)	n (%)	
Sex	Male	278 (49.4)	653 (51.8)	931 (51.0)	0.90
	Female	285 (50.6)	608 (48.2)	893 (49.0)	
Age	Average (SD)	15.08 (0.76)	15.05 (0.78)	15.6 (0.78)	0.91
Income form of parents	Dual income family	332 (59.0)	756 (60.0)	1088 (59.6)	0.16
	Single income family	231 (41.0)	165 (40.0)	736 (40.4)	
Monthly income (won)	1000 thousand	6 (1.1)	12 (1.0)	18 (1.0)	0.77
	1000–2000 thousand	22 (3.9)	54 (4.3)	76 (4.2)	
	2000–3000 thousand	97 (17.2)	212 (16.8)	309 (16.9)	
	3000–4000 thousand	170 (30.2)	365 (28.9)	535 (29.3)	
	4000–5000 thousand	165 (29.3)	371 (29.4)	536 (29.4)	
	More than 5000 thousand	103 (18.3)	247 (19.6)	350 (19.2)	
Occupation of parents	Manager	19 (3.4)	33 (2.6)	52 (2.9)	16.57
	Experts and related workers	30 (5.3)	99 (7.9)	129 (7.1)	
	Office worker	205 (36.5)	436 (35.0)	641 (35.5)	
	Service worker	100 (17.8)	246 (19.7)	346 (19.1)	
	Salesperson	97 (17.3)	230 (18.4)	327 (18.1)	
	Agriculture, forestry, and fishery workers	19 (3.4)	27 (2.2)	46 (2.5)	
	Functional person and related function person	43 (7.7)	112 (9.0)	155 (8.6)	
	Device machine operation and assembly worker	29 (5.2)	35 (2.8)	64 (3.5)	
	Simple laborer	18 (3.2)	28 (2.2)	46 (2.5)	
	Soldier	1 (0.2)	1 (0.1)	2 (0.1)	

SD: standard deviation.

Table 3. Daily use duration of smartphones, mobile messengers, SNSs, games, and Internet.

	Risk group for smartphone addiction (n = 563)	Normal user group (n = 1261)	Total (n = 1824)	t
	Mean (SD)	Mean (SD)	Mean (SD)	
Smartphone	313.13 (103.44)	279.96 (107.47)	290.20 (107.31)	6.16***
Smartphone (except for telephoning, video phone calling, and SMS)	204.09 (77.60)	180.93 (66.70)	188.08 (71.03)	6.50***
Mobile messenger	97.53 (52.98)	81.43 (43.13)	86.39 (46.96)	6.83***
Mobile messenger (family)	42.96 (39.00)	37.45 (31.23)	39.15 (33.90)	3.21***
Mobile messenger (friends)	54.57 (38.46)	43.98 (32.23)	47.24 (34.64)	6.08***
SNS	24.57 (15.22)	22.61 (15.58)	23.21 (15.50)	2.45*
Game	80.07 (50.79)	87.50 (45.93)	85.21 (47.59)	−3.07**
Internet (except for learning)	94.94 (69.60)	91.07 (64.01)	92.26 (65.79)	0.25

SNS: social networking service; SD: standard deviation.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

(67.9%) and Facebook (47.3%). The purposes for using SNS were as follows: 66.5 percent of the participants answered that SNS use was fun and it relieved stress, and 48.3 percent used SNSs for communicating with others (Table 4).

There was a significant difference between the two groups in terms of the awareness of their excessive game use ($\chi^2 = 14.07$, $p = .003$). The proportion of respondents who perceived their game overuse was 16.1 percent in the risk group for smartphone addiction and 16.4 percent in the

Table 4. Mainly used contents of a smartphone and SNS.

	Risk group for smartphone addiction (*n*=563)	Normal user group (*n*=1261)	Total (*n*=1824)	χ^2
	n (%)	*n* (%)	*n* (%)	
Most frequently used contents of a smartphone				
Instant messenger (Kakaotalk, Facebook messenger, Line, etc.)	151 (28.6)	365 (40.0)	516 (30.3)	16.13
Web surfing	182 (34.4)	366 (30.5)	548 (31.7)	
Music	128 (24.0)	316 (26.4)	444 (25.6)	
Ebook, web-toon, web-novel	70 (13.4)	156 (13.0)	226 (13.1)	
Game	118 (22.5)	234 (19.9)	352 (20.6)	
SNS (Facebook, Twitter, Instagram etc.)	112 (21.3)	268 (22.6)	380 (22.2)	
Movie, TV, video	98 (18.4)	203 (16.9)	301 (17.4)	
Learning	16 (3.0)	33 (2.7)	49 (2.8)	
Email	37 (4.0)	96 (3.9)	133 (4.0)	
Searching for learning	85 (15.6)	174 (14.2)	259 (14.6)	
Purchase of goods or services	11 (1.0)	52 (2.2)	63 (1.8)	
Financial transaction	8 (0.8)	35 (1.5)	43 (1.2)	
Location-based services	9 (0.8)	22 (0.9)	31 (0.9)	
Schedule management	1 (0.1)	5 (0.2)	6 (0.2)	
Most frequently used SNS				
Kakaostory	351 (68.0)	799 (67.9)	1150 (67.9)	4.04
Facebook	243 (51.1)	495 (45.5)	738 (47.3)	
Band	124 (25.6)	271 (25.2)	395 (25.3)	
Twitter	138 (29.3)	342 (32.2)	480 (31.3)	
Instagram	107 (22.5)	274 (25.9)	381 (24.8)	
Others	20 (3.7)	41 (3.3)	61 (3.4)	
Purpose of using SNS				
Fun/stress reduction	359 (67.6)	806 (66.1)	1165 (66.5)	6.33
Communication with people	232 (45.4)	585 (49.7)	817 (48.3)	
Getting and sharing new information	145 (28.2)	355 (30.0)	500 (29.5)	
Expressing and sharing opinions	119 (23.2)	282 (24.1)	401 (23.9)	
Passing time or having nothing to do	79 (15.2)	157 (13.3)	234 (13.9)	
Daily record of life	63 (12.3)	139 (10.9)	192 (11.3)	
Habit	42 (8.3)	69 (5.9)	111 (6.5)	

SNS: social networking service.

normal user group. To identify the sources of differences, we further analyzed the positive and negative answers regarding the awareness of game overuse. There was no significant difference in the positive answers to game overuse awareness. However, the percentage of respondents who replied "I strongly disagree" was 23.2 in the risk group and it was 16.9 in the normal users. The percentage of respondents who replied "I disagree" was 60.7 in the risk group and 66.8 in the normal users group. Thus, the risk group showed a stronger denial of their game overuse than the normal user group did.

Regarding the time slot of game use, there was no significant difference between the two groups. Specifically, 69.1 percent of the respondents used a game between 4:00 p.m. and 8:00 p.m., after school and at night, and 18.2 percent used it between 6:00 a.m. and 9:00 a.m., after waking up and on the way to school. In relation with the

purposes of gaming, most of the respondents selected "fun" (66.5%) and "stress reduction" (48.3%), as observed in the reported reasons for SNS use. The risk group for smartphone addiction played games more habitually and they did so for achieving targets on the game, as compared with the normal user group. There was a significant difference in the purpose of gaming between the two groups (χ^2=19.93, p=.001) (Table 5).

The binary logistic regression analysis showed that the variables related to the risk of smartphone addiction were "after school (04:00 p.m. to 08:00 p.m.)" of the time slot of game use, "once in a month," "3 or 4 times in a year," and "never" of the frequency of using PC room. The people who used a game after school (04:00 p.m. to 08:00 p.m.) were 2.65 times more likely to be addicted to the smartphone addiction that gamers in the morning. The people who used a PC room once in a month, or 3 or 4 times in a

Table 5. Game usage pattern and binary logistic regression analysis for risk of smartphone addiction.

Categories	Risk group for smartphone addiction (n = 563)	Normal user group (n = 1261)	χ^2/t	OR (95% CI)
	n (%)	n (%)		
Awareness of a game overuse				
Yes (agree + strongly agree)	90 (16.1)	204 (16.4)	14.037***	1
No (disagree + strongly disagree)	367 (83.9)	1046 (83.7)		1.03 (0.78, 1.36)
Time slot of gaming				
Early morning (00:00 a.m. to 06:00 a.m.)	3 (0.5)	13 (1.0)	74.967	1
Preparation for school (06:00 a.m. to 09:00 a.m.)	103 (18.5)	225 (18.0)		1.99 (0.56, 7.15)
In the morning (09:00 a.m. to 12:00 p.m.)	9 (1.6)	11 (0.9)		0.97 (0.73, 1.30)
Lunch time (12:00 p.m. to 01:00 p.m.)	55 (9.9)	103 (8.2)		0.52 (0.21, 1.29)
Afternoon (01:00 p.m. to 04:00 p.m.)	6 (1.1)	31 (2.5)		0.82 (0.57, 1.19)
After school (04:00 p.m. to 08:00 p.m.)	160 (28.7)	366 (29.3)		2.65 (1.07, 6.53)*
At night (08:00 p.m. to 12:00 a.m.)	221 (39.7)	501 (40.1)		1.03 (0.80, 1.32)
Purpose of game use				
Fun	308 (67.6)	787 (66.1)	19.932***	1
Stress reduction	232 (45.4)	585 (49.7)		0.93 (0.18, 4.78)
Passing time/nothing to do	145 (28.2)	355 (30.0)		1.13 (0.22, 5.96)
Communication with others	119 (23.2)	282 (24.1)		0.70 (0.14, 3.59)
Habitually	79 (15.2)	157 (13.3)		0.60 (0.11, 3.10)
Achieving a target level	63 (12.3)	139 (10.9)		0.81 (0.16, 4.24)
Frequency of using PC room				
3 or 4 times in a week	53 (9.5)	143 (11.4)	30.307***	1
Once in a week	77 (13.8)	163 (13.0)		0.82 (0.57, 1.18)
Once in a month	108 (19.4)	196 (15.7)		0.67 (0.48, 0.93)*
3 or 4 times in a year	147 (26.4)	224 (17.9)		0.60 (0.45, 0.81)***
Never	172 (30.9)	524 (41.9)		0.50 (0.38, 0.66)***
Expenditure for using PC room in a month (unit: won[a])	8.72 (10.77)	10.93 (12.40)	−2.96***	

OR: odds ratio; CI: confidence interval.

[a]Won = Korean money, 1000 won equals ca. US$0.87.

*$p < 0.05$; ***$p < 0.001$.

year, or never showed a 0.50–0.67 times lower rate of risk of smartphone addiction than the people using PC room 3 or 4 times in a week.

The two groups showed a significant difference in the frequency of use and the monthly expenditure on a PC room. A significantly higher proportion of those in the normal user group reported that they had never visited a PC room as compared with their counterparts in the risk group ($\chi^2 = 30.31$, $p = 0.000$). The monthly expenditure for using the PC room was 221 won (ca. US$1.89) higher for the normal user group as compared with that for the risk group ($t = -2.96$, $p = 0.003$).

As evident from Table 6, there was no significant difference between the two groups in terms of the physical and psychological health problems caused by using a smartphone, but an emerging tendency was observed with reference to psychological health problems. The most common physical problems were sleep disturbance (31.7%) and dry eyes and decreased visual acuity (30.2%). The most frequently reported psychological health problems were anger (31.1%) in the risk group for smartphone addiction, and annoyance (30.5%) in the normal user group. Furthermore, the risk group showed more depression and lethargy than the normal user group did. These differences were not significant but showed a tendency for significant differences ($\chi^2 = 12.93$, $p = 0.074$).

In relation with life satisfaction, 82.2 percent of the respondents answered that they were satisfied with their life. The difference in life satisfaction between the two

Table 6. Physical and psychological characteristics.

		Risk group for smartphone addiction (*n* = 563)	Normal user group (*n* = 1261)	Total (*n* = 1824)	χ^2
		n (%)	*n* (%)	*n* (%)	
Physical health problems	Dry eyes/decreased visual acuity	165 (29.3)	385 (30.5)	550 (30.2)	5.83
	Sleep disturbance	180 (32.0)	399 (31.6)	579 (31.7)	
	Pain of neck, wrist, and back	159 (28.2)	377 (29.9)	536 (29.4)	
	Digital dementia	136 (24.2)	274 (21.7)	410 (22.5)	
	Chronic tiredness	65 (11.5)	111 (8.8)	176 (9.6)	
	Others	2 (0.4)	2 (0.2)	4 (0.2)	
	No physical problem	153 (27.2)	368 (29.2)	521 (18.8)	
Psychological health problems	Anger	175 (31.1)	352 (27.9)	527 (28.9)	12.93
	Annoyance	143 (25.4)	385 (30.5)	528 (28.9)	
	Anxiety	118 (21.0)	268 (21.3)	386 (21.2)	
	Depression	131 (23.3)	240 (19.0)	371 (20.3)	
	Aggression	60 (10.7)	135 (10.7)	195 (10.7)	
	Lethargy	36 (6.4)	64 (5.1)	100 (5.5)	
	Others	0 (0.00)	3 (0.2)	3 (0.2)	
	No psychological problem	168 (29.8)	428 (33.9)	596 (32.7)	
Life	Satisfaction	450 (79.9)	1050 (83.3)	1500 (82.2)	7.642
	Dissatisfaction	113 (21.1)	211 (16.8)	324 (27.7)	
Interpersonal relationships	Satisfaction	446 (79.2)	1029 (81.6)	1475 (80.9)	4.986
	Dissatisfaction	117 (20.8)	231 (18.4)	349 (19.1)	
Career plan in future	Yes, I have plans	432 (76.8)	952 (80.5)	1384 (75.9)	823
	No, I don't have any plans	131 (23.3)	309 (24.5)	440 (24.1)	

groups was not significant, but the analysis showed a tendency for significant differences ($\chi^2 = 7.64$, $p = 0.054$). The percentage of respondents who answered that they were satisfied with life was higher in the normal user group as compared with that in the risk group for smartphone addiction.

There was no significant difference in satisfaction with interpersonal relationships and career plans between the two groups. Specifically, 80.9 percent of the respondents answered that they were satisfied with their interpersonal relationships, and 75.9 percent of them had a clear career plan.

There were no significant differences between the two groups regarding the recognition that smartphone addiction was severe in Korea, but the difference showed a tendency for significance ($\chi^2 = 7.20$, $p = 0.07$). The percentage of respondents who considered that the smartphone addiction was severe in Korea was higher in the risk group than it was in the normal user group.

The percentage of people who received prevention education on smartphone addiction was 13.4 percent in both groups. Among the participants who received prevention education, the proportion of those who answered that the education was helpful was 78 percent in the risk group and 64.6 percent in the normal user group. This difference was statistically significant ($\chi^2 = 8.93$, $p = 0.03$; Table 7).

Multiple linear regression

Based on the above findings, the association between predictive factors and smartphone addiction was examined using a multiple linear regression. The dependent variable was the score on the smartphone addiction scale, while the independent variables were those which showed significant differences in the preceding analyses, including duration of smartphone, mobile instant messenger, SNS, and game use; awareness of game overuse; and frequency and expenditure of PC room use. The multicollinearity of the independent variables was not violated because the variance inflation factors (VIFs) were < 10, and the Durbin–Watson was 1.656. However, the resulting regression model explained merely 3.8 percent of the variance in smartphone addiction ($R^2 = 0.038$, $F(7, 1086) = 6.19$, $p = 0.000$). The significant predictors of smartphone addiction were daily use duration of smartphone ($t = 3.86$, $p = 0.000$) and SNS ($t = -3.569$, $p = 0.000$), and awareness of game overuse ($t = -3.111$, $p = 0.002$). The results of this analysis are presented in Table 8.

Discussion

This study aimed to reveal the smartphone usage pattern of addicted and nonaddicted middle school students, and to identify the predictors of smartphone addiction. Therefore, we examined the prevalence of smartphone addiction,

Table 7. Awareness related to smartphone addiction and prevention education.

	Risk group for smartphone addiction ($n=563$)	Normal user ($n=1261$)	Total ($n=1824$)	χ^2
	n (%)	n (%)	n (%)	
Smartphone addiction severity recognition				
Severe	345 (61.3)	717 (56.9)	1062 (58.2)	7.20
Not severe	218 (38.7)	544 (43.1)	762 (41.8)	
Experience of prevention education on smartphone addiction				
Yes	82 (14.6)	162 (12.8)	244 (13.4)	.99
No	481 (85.4)	1099 (87.2)	1580 (86.6)	
Prevention education				
Helpful	64 (78.0)	103 (63.6)	167 (68.4)	8.93*
Not helpful	18 (22.0)	59 (36.4)	77 (31.6)	

*$p<0.05$.

Table 8. Multiple linear regression analyzing predictive factors of smartphone addiction.

	β	t	p	VIF
(Constant)		25.831	0.000	
Daily smartphone use time	.276	3.885	0.000***	5.682
Daily SNS use time	−.226	−3.569	0.000***	4.524
Daily instant mobile messenger use time	.021	0.558	0.577	1.655
Daily game use time	−.038	−1.235	0.217	1.048
Awareness of game overuse	−.094	−3.111	0.002**	1.030
Frequency of PC room use	.000	0.003	0.998	1.995
Expenditure for PC room use	−.055	−1.330	0.184	1.957

β: standardized regression coefficient; *t*: t value of β; VIF: variance inflation factor; SNS: social networking service.
**$p<0.01$; ***$p<0.001$.

demographic characteristics, daily use duration of a smartphone, commonly used content, and SNS and game usage pattern. To explore the risks and predictive factors of smartphone addiction, we examined the physical and psychological health problems caused by smartphone usage, the awareness of smartphone addiction severity, and the effect of prevention education on smartphone addiction.

The prevalence of smartphone addiction in Korean middle school students was 30.9 percent. It is a very high rate compared with that reported in other countries. The percentages of smartphone addiction in adolescents were 10 percent in England, 21 percent in the Philippines, and 18 percent in Hong Kong (Lopez-Fernandez et al., 2014; Mak et al., 2014). The Korean government has recognized the severity of smartphone addiction problems in adolescents, and the Framework Act on National Informatization was established in 2013, to help tackle this problem. According to Article 30 of the act, all schools and public institutions are obliged to carry out prevention education on smartphone addiction. Although this rule exists since 2013, merely 13.4 percent of the present sample reported having received smartphone addiction prevention education, which could be regarded as

very low without considering other circumstances such as budget, reward, and administrative procedures. Among those who received such education, a high proportion of the respondents reported that the prevention education was very helpful or helpful, and this proportion was higher in the risk group for smartphone addiction (78.0%) than that in the normal user group (63.6%). This result indicated that the education was effective, and that it needs to focus more on those at risk of developing smartphone addiction rather than on normal users.

Contrary to our hypothesis, smartphone addiction was not related with gender, family income, or parents' education. These results are consistent with those of some studies that reported that smartphone addiction is not significantly related with gender (Attamimi, 2011; Chung, 2011; Kwon et al., 2013; Prezza et al., 2004). In a study on cell phone usage of children aged 8–18 years, neither household income nor parents' education was found to have an effect on the use of smartphones (Groupe Speciale Mobile (GSMA), 2011). As smartphones offer a variety of content tailored to individual interests, every individual from different socioeconomic backgrounds could find content that he or she is interested in, or which fulfills his or her need or

deficiency. Thus, demographic variables showed no relationship with smartphone addiction.

The main purposes of using SNSs and games were fun, stress reduction, and communication with people. This result seems to be natural, but it should be interpreted by reflecting on the Korean society, which emphasizes greatly on children's education. Adolescents in Korea have been expected to exhibit good academic performance in a competitive social atmosphere. They experience high levels of stress associated with academic performance (Park et al., 2014). They are forced to study for about 7 hours 50 minutes per day for exams to enter a prestigious university. This is much longer as compared with that reported in other countries, where the duration of studies ranges from 3 to 6 hours (National Youth Policy Institute, 2009). Most of the adolescents, thus, spend their little free time on a smartphone, because there are not many leisure activities to relieve stress and have fun. In this environment, promoting smartphone use with the inability to control their smartphone use despite negative consequences could lead to addiction. The high prevalence of smartphone addiction in Korean adolescents should, thus, be interpreted considering the social environment.

Contrary to our hypothesis, the two groups showed no differences in life and relationship satisfaction. Life satisfaction is partly related with social ties (Kahneman and Krueger, 2006), and frequent social communication has been found to exert a positive influence on life satisfaction (Diener et al., 1991). Internet users have fewer face-to-face interactions like heavy television watchers do (Nie, 2001). Smartphone addicts who spend a lot of time on their phone are forced to reduce their face-to-face contact time. Therefore, smartphone addiction is considered to be related with loneliness and shyness (Bian and Leung, 2014). Specifically, the higher one scores on shyness and loneliness, the higher is the likelihood that one would be addicted to a smartphone. In this sense, we hypothesized that the risk group for smartphone addiction will have lower interpersonal and life satisfaction than the normal user group would. However, the risk group merely showed a tendency to exhibit lower life satisfaction as compared with the normal user group. Our result suggested that life and interpersonal satisfaction levels could not explain the addictive use of smartphone alone. Samaha and Hawi (2016) reported that smartphone addiction is not directly linked to life satisfaction, but it is via perceived stress and academic performance. Satisfaction with life should be explained by many other factors such as family support, doing what they want to do, personality, positive thinking, and so on. Future studies should investigate the relationship of smartphone addiction with life satisfaction and other related variables to identify the extent to which smartphone addiction can be explained by life satisfaction, and to reveal the path of the influence of life satisfaction on smartphone addiction. However, the satisfaction of the online interpersonal

relationships in the risk group for smartphone addiction may have offset the low satisfaction with their offline interpersonal relationships. To further examine the relationship between interpersonal satisfaction and smartphone addiction, future studies should examine the effects of both online and offline relationships.

Consistent with other studies (Alijomaa et al., 2016; Torrecillas, 2007), we found that the risk group for smartphone addiction spent more time on the smartphone, mobile messenger, and SNSs than the normal user group did. Specifically, the risk group spent 5.2 hours while the normal user group 4.6 hours. Oulasvirta et al. (2012) reported that though smartphone addicts used a smartphone more frequently and for a shorter duration as compared with non-addicts, the sum of the duration of use in a day was longer for addicts as compared with that for nonaddicts. Another study that analyzed a large data set on actual smartphone usage revealed that the users typically spent almost 1 hour per day on the smartphone, but the duration was less than 1 minute at each instance of use (Boehmer et al., 2011). This study reported also the differences in app usage duration. News apps were accessed most frequently in the morning, whereas communication apps were used throughout the day. Using a data set on smartphone use, Lee et al. (2012) showed that a risk group for smartphone addiction spent more time on smartphone use per day as compared with the nonrisk group, and their use was greater in the morning and evening. The usage sessions initiated by the push notifications were longer for the risk group, which demonstrated that notifications acted as external cues related to problematic usage patterns. In addition, the risk group consumed significantly more online content that can provide instant gratification (e.g. pass time, entertainment, and information seeking).

The multiple linear regression analysis revealed that the daily use duration of a smartphone and SNS, and the awareness of game overuse predicted smartphone addiction. As expected, longer daily use duration of a smartphone predicted higher scores on the smartphone addiction scale, but the awareness of game overuse predicted lower scores on the smartphone addiction scale. Surprisingly, the shorter daily use duration of SNS negatively predicted smartphone addiction, which was contrary to our hypothesis and that of other studies. Roberts et al. (2014) found that, among college undergraduates, one of the predictors of mobile phone addiction was time spent on SNSs. In a European cross-sectional study, Lopez-Fernandez et al. (2017) reported that daily use of a mobile phone, increased social networking, female gender, not necessarily monthly payment as type of contract, online shopping, viewing TV shows, downloading-related activities, and messaging and chatting predicted mobile phone dependence in young adults. However, the above studies focused on young adults, and we could not find any studies on SNS use duration in adolescents aged 13–15 years. This study showed that the long SNS

use duration was not related to smartphone addiction in adolescents because the Pearson's correlation coefficient of SNS use duration with the smartphone addiction score was not significant ($r=0.012$, $p=0.604$). However, the SNS use duration could function as a protective factor in combination with other variables. That is, when adolescents use a smartphone daily for a long duration, using SNS could protect them from smartphone addiction by engaging in the use of mobile messengers or gaming apps. It seems that using SNS has a positive function of preventing smartphone addition. This result must however be verified in a future study.

Limitations

While this study provides new insights into the smartphone usage pattern of middle school students in Korea, who are in a specific social environment, and the different usage patterns of the addiction and normal user groups, this study has some limitations.

First, this survey was conducted using face-to-face interviews. Therefore, social desirability may have influenced the adolescents' responses. Intentionally or unintentionally, they might not have been frank about the use duration and content used on a smartphone. Lin et al. (2015) revealed a significant discrepancy in self-reported and in-application recorded smartphone use duration. Often, smartphone users underestimate the use duration, and this underestimation is greater in more frequent users than in nonfrequent users. To improve the awareness of smartphone use, future studies should investigate the difference between self-reported and technological records of smartphone use. Self-reported data and actual smartphone use data could provide a comprehensive explanation about smartphone usage patterns.

Second, some variables were measured subjectively, using simple questions rather than standardized scales. For instance, life and interpersonal relationship satisfaction, and health and psychological problems were based on subjective evaluations. Therefore, to obtain objective data on these variables, it is necessary to use standardized assessment scales and diagnostic interviews conducted by a psychological or psychiatric professional.

Third, the prevalence of smartphone addiction was high in this study as compared with that observed in other countries, but the prevalence could not be compared with other studies because each study used different scales to assess smartphone addiction. Cross-country studies need to be conducted to using a common smartphone addiction scale to enable comparisons and interchange of strategies for preventing and treating smartphone addiction.

Fourth, this study provided a broad picture of smartphone use and addiction, but this study could not provide a more focused and deep understanding. This study was a part of a national survey on the state of smartphone

addiction and awareness of Koreans regarding it. Future studies should focus on one theme, for example, type of smartphone addiction, such as SNS, game, shopping, or sexual content. Various addiction types would show different usage patterns and user characteristics. Therefore, a deeper understanding of the same would be helpful for developing effective therapies and preventive programs according to the needs of the individual.

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Appendix 1. Smartphone Addiction Proneness Scale.

No.	Contents	Strongly disagree	Disagree	Agree	Strongly agree
1	My school grades dropped due to excessive smartphone use.	①	②	③	④
2	Using a smartphone is more enjoyable than spending time with family or friends.	①	②	③	③
3	I cannot imagine my life without a smartphone.	①	②	③	③
4	I tried to reduce the time I spend on a smartphone but failed.	①	②	③	③
5	I have a hard time doing what I have planned (study, do homework, or go to after-school classes) due to using smartphone.	①	②	③	③
6	When I cannot use a smartphone, I feel like I have lost the entire world.	①	②	③	③
7	I get anxious and nervous without a smartphone.	①	②	③	③
8[a]	I can control my smartphone usage time.	①	②	③	③
9	People frequently comment on my excessive smartphone use.	①	②	③	③
10[a]	I am not anxious without a smartphone.	①	②	③	③
11	Even when I know I should stop, I continue to use my smartphone.	①	②	③	③
12	Family or friends complain that I use my smartphone too much.	①	②	③	③
13[a]	My smartphone does not distract me from studying.	①	②	③	③
14	I panic when I cannot use my smartphone.	①	②	③	③
15	Spending a lot of time on a smartphone has become my habit.	①	②	③	③

[a]The items are scored in reverse order to avoid a response bias.