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ORIGINAL ARTICLE

# Association between psychological and self-assessed health status and smartphone overuse among Korean college students

Hyun-Jin Kim<sup>1</sup>, Jin-Young Min<sup>1</sup>, Hye-Jin Kim<sup>2</sup>, and Kyoung-Bok Min<sup>2</sup>

<sup>1</sup>Institute of Health and Environment, Seoul National University, Seoul, Republic of Korea and <sup>2</sup>Department of Preventive Medicine, College of Medicine, Seoul National University, Seoul, Republic of Korea

## Abstract

**Background:** Several studies suggest that subjective health status is closely related to various behavioral addictions, but there are few studies on smartphone overuse.

**Aim:** This study investigated the associations between psychological and subjective health conditions and smartphone overuse in Korean college students.

**Method:** A total of 608 college students participated in this study. We investigated the perceived psychological factors, such as stress, depression symptoms and suicidal ideation. Overall health status was evaluated with self-assessed items, including usual health condition and EuroQoL-visual analog scales (EQ-VAS) score. Smartphone overuse was evaluated as the Korean Smartphone Addiction Proneness Scale.

**Results:** Students with psychotic anxiety (i.e. stress, depression and suicidal ideation) showed significant associations with smartphone overuse, indicating an approximately twofold increased risk compared to those without psychological anxiety (all  $p < 0.05$ ). Students who reported feeling that their usual health is not good were more likely to overuse smartphones than those who are in good health (OR = 1.98; 95% CI = 1.22–3.21). The EQ-VAS score, which indicates current self-assessed health status, also showed a similar result with general health status (OR = 2.14; 95% CI = 1.14–4.02).

**Conclusion:** Negative conditions in self-perceived emotional or overall health condition are associated with the increased likelihood of smartphone overuse in Korean college students.

## Keywords

Psychological conditions, subjective health status, smartphone overuse, Korean college students

## History

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## Background

Smartphones have become popular devices worldwide because of their convenience and various enhanced features. Smartphones, like powerful portable computers, offer a wide range of applications such as navigation, e-mail, web-based communication and social networks, as well as easy access to the Internet (Kwon et al., 2013). The number of smartphone users has increased rapidly, and more than 80% of the population (about 40 million people) in South Korea has a smartphone (Poushter, 2016). However, some users are addicted to or overly dependent on the smartphones, resulting in negative consequences such as sleep disturbances, dry eyes and pain in the shoulders or neck (Demirci et al., 2015; Kim & Kim, 2015; Moon et al., 2016). According to the survey on Internet overdependence of South Korea, risk groups with dependency on smartphone among smartphone users in 2015

accounted for 16.2%, up 2% from the previous year (National Information Society Agency, 2015).

In recent years, researchers have become increasingly concerned with identifying the factors that contribute to excessive or addictive smartphone use. In this regard, prior studies have suggested potential candidates, most of which were closely related to psychosocial traits, such as stress, depression, anxiety, loneliness and shyness (Bian & Leung, 2015; Chiu, 2014; Demirci et al., 2015; Long et al., 2016; Wang et al., 2015). Such negative psychological factors are also directly linked to suicidal ideation (Ayyash-Abdo, 2002; Takeuchi & Nakao, 2013). In 2015, Wu et al. demonstrated that the rates of suicidal ideation and suicide attempts in internet addicts were considerably higher than those without internet addiction (Wu et al., 2015). Similarly, thoughts related to suicide may increase the likelihood of smartphone overuse, as well as internet addiction.

Additionally, subjective health status, which is the self-assessed health, is a useful way to evaluate individuals' overall health (Poikolainen et al., 1996). This is strongly correlated with direct health scale measures, such as the Health Survey Questionnaire and the Sickness Impact Profile (Poikolainen et al., 1996). Several studies have shown that subjective health status is closely related to various behavioral

Address where the work was carried out: Department of Preventive Medicine, College of Medicine, Seoul National University, 103 Daehak-ro, Jongno-gu, Seoul, 110-799, Republic of Korea

Correspondence: Kyoung-Bok Min, Department of Preventive Medicine, College of Medicine, Seoul National University, 103 Daehak-ro, Jongno-gu, Seoul, 110-799, Republic of Korea. Tel: +82 2 740 8968. Fax: +82 2 747 4830. E-mail: [minkb@snu.ac.kr](mailto:minkb@snu.ac.kr)

addictions, including alcoholism and heroin dependence (Guallar-Castillon et al., 2001; Meshesha et al., 2013; Mikolajczyk et al., 2016; Stranges et al., 2006). Given that behavioral addictions co-occur (Grant et al., 2010; Sussman et al., 2011), individuals with a suboptimal (i.e. fair, poor or very poor) health status may be at a high risk of smartphone overuse. However, no research has reported the relationship between suicidal ideation, health status and smartphone overuse.

This study aimed to explore whether perceived psychological and subjective health status are related to smartphone overuse among Korean college students. We assessed various psychological traits such as stress, depression and suicidal ideation, in addition to health status perception, including the EuroQol-visual analog scale (EQ-VAS) score, and conducted a comprehensive association analysis to identify whether these components were associated with smartphone overuse.

## Method

### Study design

This was a cross-sectional survey design.

### Participants

A questionnaire-based online survey was conducted by a professional research agency for a period of four months from August to September of 2016. Participants in this study were randomly selected among college students in South Korea. Of these, a final total of 608 college students who owned smartphones and expressed interest in the study were included. The participants were predominantly 20 years old, and the proportion of females was higher than that of males. All participants completed the questionnaires without any missing items. The survey was conducted anonymously and did not include any personal information.

### Ethical approval

This study was approved by the Institutional Review Board of Seoul National University Hospital.

### Smartphone overuse assessment

In 2011, the National Information Society Agency of South Korea developed the Smartphone Addiction Proneness Scale (SAPS), based on the existing mobile phone and internet addiction scales (National Information Society Agency, 2011). To assess the level of smartphone usage of participants, we used the SAPS questionnaire, which consists of 15 items with a 4-point Likert scale (1 = “strongly disagree”, 2 = “disagree”, 3 = “agree”, 4 = “strongly agree”). The total score of smartphone usage was calculated as the sum of each subscale, and a higher score indicated the higher usage of a smartphone. This form can be divided into four sub-domains by unique symptoms for smartphone addiction as follows: (1) “disturbance of adaptive functions” (five items), (2) “virtual life orientation” (two items), (3) “withdrawal” (four items) and (4) “tolerance” (four items) (Kim et al., 2014). We classified the participants into three groups

according to the guidelines of the National Information Society Agency (2011): the “high risk” group (defined as participants with a total score  $\geq 44$  or participants with a “disturbance of adaptive functions” domain score  $\geq 15$ , a “withdrawal” domain score  $\geq 13$  and a “tolerance” domain score  $\geq 13$ ), “potential risk” group (defined as participants with a  $40 \leq$  total score  $\leq 43$  or participants with a “disturbance of adaptive functions” domain score  $\geq 14$ ) and “normal” group (defined as participants with a total score  $\leq 39$  or participants with a “disturbance of adaptive functions” domain score  $\leq 13$ , a “withdrawal” domain score  $\leq 12$  and a “tolerance” domain score  $\leq 12$ ). For statistical analysis, smartphone overuse was defined as a “high risk” group or a “potential risk” group. The SAPS demonstrated a high reliability with Cronbach’s alpha coefficient of 0.88 (Kim et al., 2014). The validity of SAPS was also confirmed by its correlations with internet addiction scale ( $r = 0.49$ ) (Kim et al., 2014).

### Perceived psychological and subjective health assessment

To investigate the participants’ psychological condition, we assessed stress levels, depression symptoms and suicidal ideation, respectively. To evaluate the stress level, the subject was asked to respond to the question “How much stress do you usually feel in your daily life?” They responded using a 4-point Likert scale (1 = “very much”, 2 = “much”, 3 = “a little”, 4 = “almost none”). We divided the participants into stressed (“very much” or “much”) and not stressed (“a little” or “almost none”) groups. To determine the subject’s depression symptoms, we asked them about their experience of depression for the past year, and participants responded with “yes” or “no”. Participants were also asked to respond to the question “Have you ever thought about wanting to die in the last year?” They also responded to this with “yes” or “no”. Participants were also asked to provide a self-assessed overall health status. To assess the usual health status, participants were asked to respond to the question “What do you usually think about your health?” They responded with a 5-point Likert scale (1 = “very good”, 2 = “good”, 3 = “normal”, 4 = “poor”, 5 = “very poor”). For evaluating current health condition, we used the EQ-VAS score, ranging from zero (worst health status) to 100 (best health status) (EuroQol, 1990). This variable was divided into four categories according to cut-offs (40, 60 and 80) of the EQ-VAS score.

### Other variables assessment

Demographic data such as age, sex, household income, major, residence type, alcohol drinking and smoking status were obtained from the self-assessment questionnaire. Household income was divided into three categories (<2,000,000 KRW; 2,000,000–5,000,000 KRW and >5,000,000 KRW). We classified the participants’ major into three categories (natural science, social science and arts). In addition to the participants’ smoking and drinking status, we identified whether they were living with their families.

## Data analysis

To assess the associations between psychological and subjective health status and smartphone overuse, we performed a multiple logistic regression analysis. The odds ratios (ORs) and 95% confidence intervals (CIs) for smartphone overuse were estimated. These estimates were adjusted for various covariates such as age, sex, household income, major, residence type, alcohol drinking and smoking status. Moreover, we conducted multiple linear regression analysis to evaluate the relationship between these factors and the four sub-domains of smartphone overuse. All statistical analyses were performed with SAS version 9.3 (SAS Institute, Cary, NC), and statistical significance was determined with a significance level of 0.05.

## Results

Basic characteristics of study participants are summarized in Table 1. A total of 608 college students were included in this study. The mean age was 22.8 years, and the proportion of males (30.1%) was lower than that of females (69.9%). Participants were predominantly majoring in natural science (42.1%) or social science (47.9%), and the percentage of participants who were majoring in art was the lowest (10.0%). A majority of the respondents were living with their parents or other family members (73.4%). The proportion of current smokers was low (10.2%), while the proportion of alcohol drinking was high (88.2%). Approximately 36% of the participants ( $n=222$ ) were included in the smartphone

Table 1. Basic characteristics of study population.

Characteristics	Mean (SD) or $N$ (%)
No. sample	608
Age (years)	22.8 (2.2)
Sex	
Male	183 (30.1)
Female	425 (69.9)
Major	
Natural science	256 (42.1)
Social science	291 (47.9)
Arts	61 (10.0)
Household	
<2,000,000 KRW	129 (21.2)
Income	
2,000,000–5,000,000 KRW	323 (53.1)
>5,000,000 KRW	156 (25.7)
Residence	
With family	446 (73.4)
Others	162 (26.6)
Smoking	
Current smoker	62 (10.2)
Ex- or Never smoker	546 (89.8)
Alcohol drinking	
Yes	535 (88.0)
No	73 (12.0)
Smartphone use	
High risk group	67 (11.0)
Potential risk group	155 (25.5)
Normal group	386 (63.5)
Component addiction	
Disturbance of adaptive functions	11.7 (2.9)
Virtual life orientation	3.7 (1.3)
Withdrawal	9.0 (2.6)
Tolerance	10.4 (2.5)

overuse group, and 30.2% ( $n=67$ ) of them were classified into the high-risk group of smartphone use.

Table 2 shows the association results between perceived psychological health and smartphone overuse. Stressed participants made up a higher percentage of the smartphone overuse group (61.7%), compared to that of the unstressed group (41.5%). Similar patterns of percentage were also shown in depression symptoms and suicidal ideation. In multiple logistic regression results after adjustment for covariates, these psychological traits were found to be significantly associated with the increased risk of smartphone overuse (all  $p<0.05$ ). The stressed participants were 2.2 times more likely to overuse smartphones than those who reported little stress (OR = 2.19; 95% CI = 1.55–3.10). Similarly, the ORs (95% CIs) of smartphone overuse in depression symptoms and suicidal ideation were estimated as 1.91 (1.27–2.86) and 2.2 (1.52–3.31), respectively.

We also identified the relationship between self-assessed overall health status and smartphone overuse. As shown in Table 3, participants who perceived themselves as having “poor” or “very poor” usual health status had a higher percentage of smartphone overuse (27.5%) than the normal group (16.6%). However, participants who responded to usual health status as “normal” and “good” or “very good” had a lower percentage of smartphone overuse than the normal group. The percentage of smartphone overuse (21.6%) compared to the normal group (13.2%) was higher in the group with EQ-VAS scores less than or equal to 40. In logistic regression results, the risk of smartphone overuse in the “poor” or “very poor” group was significantly higher, compared with the “good” or “very good” group (OR = 1.98; 95% CI = 1.22–3.21). Likewise, participants with EQ-VAS scores less than or equal to 40 showed an increased risk of smartphone overuse, compared with those with EQ-VAS scores greater than 80 (OR = 2.14; 95% CI = 1.14–4.02).

Linear regression results in the four sub-domains are illustrated in Table 4. Psychological health conditions, such as stress, depression symptoms and suicidal ideation were significantly associated with all four sub-domains, including “disturbance of adaptive functions”, “virtual life orientation”, “withdrawal” and “tolerance” (all  $p<0.05$ ). Similarly, most subjective health conditions were shown to be related to all four subdomains (all  $p<0.05$ ), even though association between usual health condition and the “withdrawal” subdomain was not observed ( $p=0.0816$ ).

## Discussion

Our study was conducted to evaluate the relationship between psychological or subjective health status and smartphone overuse in Korean college students. We identified that perceived psychological health, such as stress, depression symptoms and suicidal ideation were closely related to smartphone overuse (all  $p<0.05$ ). Likewise, poor subjective health status in usual health condition (OR = 1.98; 95% CI = 1.22–3.21) and EQ-VAS scores (OR = 2.14; 95% CI = 1.14–4.02) are significantly associated with an increased risk of smartphone overuse. In the sub-domain analysis, perceived psychological and subjective health status showed

Table 2. Logistic regression results for association between psychological health and smartphone overuse.

Psychological health	Smartphone overuse ( <i>n</i> = 222)	Normal ( <i>n</i> = 386)	OR	95% CI	<i>p</i> Value
	<i>N</i> (%)	<i>N</i> (%)			
Stress					
Yes	137 (61.7)	160 (41.5)	2.19	1.55–3.10	<0.0001
No	85 (38.3)	226 (58.5)	Ref (1.00)	–	
Depression/anxiety symptom					
Yes	64 (28.8)	65 (16.8)	1.91	1.27–2.86	0.0018
No	158 (71.2)	321 (83.2)	Ref (1.00)	–	
Suicidal ideation					
Yes	78 (35.1)	69 (17.9)	2.24	1.52–3.31	<0.0001
No	144 (64.9)	317 (82.1)	Ref (1.00)	–	

OR: odds ratio; CI: confidence interval.

The association results were adjusted for age, sex, major, income, residence, smoking and alcohol drinking.

Table 3. Logistic regression results for association between subjective health status and smartphone overuse.

	Smartphone overuse ( <i>n</i> = 222)	Normal ( <i>n</i> = 386)	OR	95% CI	<i>p</i> Value
	<i>N</i> (%)	<i>N</i> (%)			
General health status					
Poor or very poor	61 (27.5)	64 (16.6)	1.98	1.22–3.21	0.0080
Normal	105 (47.3)	197 (51.0)	1.14	0.76–1.71	
Good or very good	56 (25.2)	125 (32.4)	Ref (1.00)	–	
EQ-VAS score					
≤40	48 (21.6)	51 (13.2)	2.14	1.14–4.02	0.0316
40–60	71 (32.0)	144 (37.3)	1.05	0.60–1.84	
60–80	78 (35.1)	133 (34.5)	1.29	0.74–2.26	
>80	25 (11.3)	58 (15.0)	Ref (1.00)	–	

OR: odds ratio; CI: confidence interval; EQ-VAS: EuroQol-visual analogue scales.

The association results were adjusted for age, sex, major, income, residence, smoking and alcohol drinking.

Table 4. Regression results for association between psychological or subjective health and each subdomain in smartphone overuse.

	Disturbance of adaptive functions		Virtual life orientation		Withdrawal		Tolerance	
	$\beta$ (SE)	<i>p</i> Value	$\beta$ (SE)	<i>p</i> Value	$\beta$ (SE)	<i>p</i> Value	$\beta$ (SE)	<i>p</i> Value
Psychological health								
Stress	0.91 (0.23)	0.0001	0.57 (0.10)	<0.0001	0.82 (0.21)	<0.0001	0.74 (0.20)	0.0001
Depression/anxiety symptom	0.81 (0.29)	0.0052	0.51 (0.13)	<0.0001	0.62 (0.26)	0.0166	0.55 (0.24)	0.0224
Suicidal ideation	0.99 (0.27)	0.0003	0.77 (0.12)	<0.0001	1.26 (0.24)	<0.0001	0.57 (0.23)	0.0131
Subjective health status								
Usual health status	0.51 (0.17)	0.0023	0.31 (0.08)	<.0001	0.26 (0.15)	0.0816	0.49 (0.14)	0.0005
EQ-VAS score	0.32 (0.13)	0.0133	0.24 (0.06)	<.0001	0.24 (0.11)	0.0364	0.24 (0.11)	0.0245

SE: standard error; EQ-VAS: EuroQol-visual analogue scales.

The regression results were adjusted for age, sex, major, income, residence, smoking and alcohol drinking.

significant associations with all four subdomains, including “disturbance of adaptive functions”, “virtual life orientation”, “withdrawal” and “tolerance” (all  $p < 0.05$ ). Current research highlights the importance of controlling psychological and overall health status to be less dependent on smartphones.

With the rapid increase in the penetration of smartphones, maladaptive patterns of smartphone use have become an issue in South Korea. A recent Pew Research Center report on global smartphone penetration documented that South Korea has the highest penetration rate of smartphones and high-speed internet among the surveyed countries, with penetration rates of 88% and 94%, respectively (Poushter, 2016). In 2015, a domestic survey was carried out in South Korea to identify

the dysfunctions of informatization caused by the rapid increase in smartphone use (National Information Society Agency, 2015). According to this data, approximately 16% of smartphone users are strongly dependent on smartphones, and college students showed the largest increase of 4.3% over the previous year than students from other grades (National Information Society Agency, 2015). Among adults aged 20–59 years old, unemployed college students are also found to be vulnerable to smartphone dependency (National Information Society Agency, 2015). This is probably because college students have easy access to smartphones and free time compared to students in other grades and adult workers.

To date, several recent studies have shown evidence consistent with our findings on the association between

smartphone use and psychological traits, such as stress, anxiety and depression (Chiu, 2014; Demirci et al., 2015; Long et al., 2016; Wang et al., 2015). In 2015, Demirci et al. emphasized the importance of smartphone addiction management in students with depression and anxiety, showing the significant positive correlations between depression or anxiety levels and Smartphone Addiction Scale scores among Turkish college students (Demirci et al., 2015). One recent study investigated the potential risk components for problematic smartphone use (PSU) in a large-scale sample of Chinese undergraduate students and reported high perceived stress, severity of emotional symptoms and perfectionism-related traits as predictors for PSU (Long et al., 2016). The positive correlation between stress and PSU was also found in another study (Wang et al., 2015). Additionally, Chiu et al.'s study identified that college students' various life stresses, including family stress and emotional stress, are closely related to smartphone addiction (Chiu, 2014).

In particular, stress has been known to increase vulnerability to addiction as well as contributing to the development of addiction (Sinha, 2008). The relationship between psychological symptoms, such as stress, and addictive behaviors are not yet clearly known, but may be explained by several plausible hypotheses. Stress influences the catecholamine regulation of prefrontal circuits, thereby impairing self-control and impulse control (Hassanbeigi et al., 2013). Stress-induced elevation of glucocorticoids also enhances glutamate activity in the ventral tegmental area and, in turn, activates the dopamine neurons (Saal et al., 2003; Sinha, 2008). Increased expression levels of brain derived neurotrophic factor (BDNF) protein in the mesolimbic structure, including the nucleus accumbens (NAc), ventral tegmental area (VTA) and amygdala, also contribute to impulsive behaviors, such as drug seeking (Lakshminarasimhan & Chattarji, 2012; Sinha, 2008). Moreover, many minor stress events are associated with the likelihood of experiencing a greater number of cravings (Ames & Roitzsch, 2000).

In addition to psychological factors, we have identified, for the first time, the significant association between self-assessed health and smartphone overuse. Previous studies on subjective health status and addictive behaviors have been conducted primarily in relation to alcoholism (Guallar-Castillon et al., 2001; Mikolajczyk et al., 2016; Stranges et al., 2006). In 2006, Stranges et al. investigated the association between subjective health status and alcohol-drinking patterns and found that intoxication patterns of drinking were associated with poorer subjective health status compared to regular or moderate consumption (Stranges et al., 2006). Another recent study discovered that poor self-rated health status was associated with an increased risk of problematic drinking, rather than high frequency of drinking (Mikolajczyk et al., 2016). Guallar-Castillón et al. reported the negative relationship between suboptimal subjective health (i.e. fair, poor or very poor) and alcohol consumption, such as wine and beer, among Spaniards, but suggested that the results could differ in Mediterranean countries (Guallar-Castillon et al., 2001). Although there was no evidence consistent with our association results between subjective health status and smartphone addiction, the above evidence may support our results to some extent, considering that multiple types of addictive behaviors may occur together

(Grant et al., 2010; Sussman et al., 2011). However, additional studies are needed to determine this.

Unlike previous studies, this study analyzed the associations with the four sub-domains, which are symptoms of smartphone addiction. Consequently, psychological and subjective health factors were significantly associated with all subdomains, not specific subdomains. In 2014, Kim et al. emphasized the necessity for research related to symptoms of smartphone addiction on mental health (Kim et al., 2014). Because previous studies have focused only on the total scale of smartphone addiction rather than symptoms, this approach to subdomains is important and can also be applied to studies of other risk factors related to smartphone addiction.

To the best of our knowledge, this is the first study to confirm that individuals with unstable mental health, such as stress, depression and suicidal ideation, and poor overall health status are more likely to rely on smartphones. However, several limitations should be considered. First, we used a cross-sectional study design to investigate the relationship between psychological or subjective health conditions and smartphone overuse, for which it is difficult to assess a causal relationship. Second, this is the result of an online survey of some college students, and therefore, significant results from current studies cannot be generalized to participants of all ages. Third, the participants' psychological and overall health conditions were measured with self-administered questionnaires. The use of self-assessed health status in epidemiologic surveys is common, but responses obtained using this approach may be unreliable (Crossley & Kennedy, 2002). Lastly, the participants' stress and depression status were briefly assessed as one item, with a four-point Likert scale and dichotomous variables, respectively.

## Conclusion

In conclusion, we examined the relationship between psychological factors or subjective health status and smartphone overuse among Korean college students. Our findings indicated that psychological and subjective health status is significantly associated with the four symptoms of smartphone addiction as well as smartphone overuse. The current study emphasizes the importance of controlling psychological health and subjective health conditions to prevent smartphone overuse in Korean college students.

## Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article. This work was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (grant no. 2015R1D1A1A01059048 and 2015R1D1A1A01057619). This work was also supported by the Education and Research Encouragement Fund of Seoul National University Hospital (2017).

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