The Relationship Between Types of Smartphone Use, Digital Literacy, and Smartphone Addiction in the Elderly

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Objective  There is limited understanding of which specific factors relate to smartphone addiction in the elderly. The aim of this study was to examine the relationship between types of smartphone use, digital literacy, and smartphone addiction in the elderly.

Methods  It used data from a survey on smartphone overdependence by the South Korea National Information Society Agency in 2019. Participants were 3,121 older people (1,627 males, 1,494 females; mean age=63.83 [standard deviation=2.88 years]). We conducted hierarchical multiple regression analysis.

Results  The results of a hierarchical multiple regression analysis indicated that smartphone usage time was positively related to smartphone addiction. Entertainment-seeking and life service types of smartphone use, and digital literacy were positively associated with smartphone addiction. Conversely, smartphone use for information-seeking and communication-seeking was negatively related to smartphone addiction.

Conclusion  This study suggests that it is necessary to understand different types of smartphone uses in the elderly and to educate the elderly on digital literacy to prevent smartphone addiction. In future studies, it will be necessary to re-confirm the relationship between smartphone usage type, digital literacy, and smartphone addiction in the elderly (including participants in their 70s or older).

Keywords  Types of smartphone use; Digital literacy; Smartphone addiction; Elderly.

INTRODUCTION

Smartphones have become part of modern people’s daily lives based on portability, instantaneousness, and convenience.¹ According to the Pew Research Center,² South Korea’s smartphone penetration rate ranked first in 27 countries surveyed at 95% in 2019. As the use of smartphones increases, negative outcomes such as physical and psychological problems reveal, and smartphone addiction is becoming a social issue.³⁻⁸ Smartphone addiction is defined as excessive use of smartphones despite the negative effects of smartphones, which are more important than other activities in one’s daily life.³⁻⁴ According to a survey by the National Information Society Agency (NIA),⁹ the percentage of risk group of smartphone addiction in South Korea was 20% as of 2019 and is increasing annually.

Most of the prior research on smartphone addiction is focused on exploring the variables related to smartphone addiction for children, adolescents, and college students. On the other hand, studies on adults are very insufficient, and there are few studies on the elderly in particular. This may be due to the idea that the problem of smartphone use will not be serious in the case of the elderly and that they will not have difficulty controlling smartphone use. However, a recent survey by the NIA⁹ suggests that smartphone addiction among the elderly can become a social problem. In particular, the risk group of smartphone addiction in people in their 60s was 17.5%, a significant increase compared to 16.8% in 2020. Considering that the total smartphone addiction risk group was 24.2% in 2021, this is a high score. Likewise, the elderly cannot be free from smartphone addiction. In particular, at the age of 60s, the use of smartphones may increase due to the reduction of social roles and weakening of offline relationships, which can lead to smartphone addiction. Despite the fact that the
proportion of the elderly's smartphone addiction risk group cannot be overlooked, little is known about the characteristics of the elderly's smartphone addiction.

The type (or purpose) of smartphone use is considered one of the key factors on smartphone addiction. According to the uses and gratifications theory, individuals actively use media to satisfy their specific needs. Type of smartphone use depends on individual characteristics, which may affect their smartphone addiction. Although the types of smartphone use vary among researchers, they can generally be classified as information seeking, entertainment seeking, and communication seeking. In addition, recent research suggests life service has arisen as another type of smartphone use.

The use of smartphones to search for and use information may increase the habitual use of smartphones, which may lead to addiction. However, other studies argue that using smartphones for information seeking is negatively related to smartphone addiction. For example, using a smartphone to search for health information can improve life satisfaction. Previous studies have suggested that excessive use of smartphones for entertainment seeking, including online games, watching videos, listening to music, and reading e-books, can increase smartphone use. The communication type of smartphone usage type includes messenger, E-mail, and SNS use. People use smartphones to communicate with others, which may strengthen offline social relationships. However, a number of studies have shown no significant correlation between smartphone use for communication and smartphone addiction.

Recently, life service has become an area of attention as digital consumption, financial transactions, and big data increase. Jang argued that smartphone addiction increases as the elderly use smartphones for life services such as financial transactions and online transactions. Compared to previous research, which focused on limited areas of life service, this study included a variety of areas of life service such as purchasing goods/services, selling, financing, life management, and health care.

With smartphones replacing the functions of traditional personal computers, digital literacy has become increasingly important. Digital literacy refers to an individual’s ability to acquire and utilize information online using digital devices. Digital media is a necessity for everyone in a digital society, regardless of age or sex, but digital literacy research is important because the results of digital device use vary depending on how digital media is used. Digital literacy is associated with age and socioeconomic level, and higher digital literacy may relate to increased smartphone use. Recent studies on the relationship between digital literacy and smartphone addiction have been mixed. Some studies indicate that digital literacy is not related to smartphone addiction, while others argue that digital literacy is positively related to smartphone addiction. In this study, we assume that digital literacy has a positive effect on smartphone addiction in older adults. The higher the digital literacy level of the elderly individual, the more likely the individual is to participate in a variety of online activities, which can lead to the excessive use of digital devices.

Among socio-demographic variables, sex, age, and income are related to smartphone addiction. While some studies have shown an association between sex and smartphone addiction, other studies have found they are not related. Past studies have argued that smartphone addiction decreases with age. However, the relationship between age and smartphone addiction has not been sufficiently verified in the elderly. Few studies have identified the relationship between monthly income and smartphone addiction. Smartphone usage time is closely related to smartphone addiction. Several studies have shown that smartphone use time is positively associated with smartphone addiction.

Meanwhile, research on smartphone addiction that has been conducted so far has mainly focused on adolescents and college students, and there were only a few studies on the factors affecting smartphone addiction in the elderly. Based on past studies, smartphone addiction needs to comprehensively consider sociodemographic characteristics, smartphone usage time, and smartphone usage types. This study is a preliminary study of the elderly in their 60s and aims to comprehensively examine the variables that were important in previous studies of adolescents and university students. It is also necessary to examine how digital literacy, which can be considered particularly important for the elderly, is related to smartphone addiction. In other words, since the use of smartphones by the elderly is increasing recently, which can lead to smartphone addiction, this study, which comprehensively identifies the variables of their smartphone addiction, is expected to have significance.

This study, therefore, examined the relevance of specific types of smartphone use, digital literacy, and smartphone addiction after controlling for sociodemographic variables and smartphone usage time. This study is based on the following hypotheses: first, smartphone usage time is positively related to smartphone addiction. Second, types of smartphone use (information seeking, entertainment seeking, and life service) are positively associated with smartphone addiction. Third, digital literacy is positively related to smartphone addiction.

**METHODS**

**Participants and survey**

This study uses data from a survey on smartphone overde-
pendence conducted by the NIA in 2019. The survey is administered to 28,592 people aged 3–69 years in 17 areas nationwide from August to October 2019. The sampling process is as follows: first, 17 areas are stratified by sampling. Second, a proportion of the systematic sampling method is used to select the enumeration district. Third, households are selected using systematic sampling methods, and NIA surveys participants that used the internet through smartphones at least once within the last month of the household member. The sampling error is 0.58%p at the 95% confidence level. The survey is conducted by trained interviewers who visited the selected sample households and directly recorded participants’ answers on questionnaires during their one-on-one interviews with participants. In this study, 3,121 people aged between 60 to 69 years participated in the survey used for the data analysis. The average age is 63.83 years, with a standard deviation (SD) of 2.88, with 1,627 males (52.1%) and 1,494 females (47.9%).

This study used public data that can use freely, so approval from IRB is not essential.

Measures

Demographic variables

Sex is coded into two categories, with 1 for males and 2 for females. Monthly income is measured on a six-point scale (less than 2 million won=1, 2–4 million won=2, 4–6 million won=3, 6–8 million won=4, 8–10 million won= 5, over 10 million won=6).

Smartphone usage time

Smartphone usage time is measured using a single item on a five-point scale to indicate the average amount of hours for which people use their smartphones daily while working, studying, and doing household chores (less than 1 hour=1, less than 1–2 hours=2, less than 2–3 hours=3, less than 3–4 hours=4, more than 4 hours=5).

Types of smartphone use

To assess smartphone usage types, respondents were asked how frequently they used 20 different smartphone functions, using a 5-point Likert-type scale ranging from 1=almost never to 5=very often. The higher the total score, the higher the degree of smartphone use for each type. Exploratory factor analysis was performed to verify the factor structure of smartphone usage types. In this study, Kaiser-Meyer-Olkin (KMO) measure (0.901) and Bartlett’s sphericity test (p<0.001) mean that the data used in this study are suitable for factor analysis. Exploratory factor analysis with oblimin rotation identified four sub-factors, explaining 52.70% of the variance including life service (6 items; α=0.78), information seeking (6 items; α=0.85), entertainment seeking (4 items; α=0.62), and communication seeking (4 items; α=0.52). In this study, the Cronbach’s alpha value of types of smartphone use is 0.89 (Table 1).

Digital literacy

To measure digital literacy, six items on the 4-point Likert type-scale developed by the NIA are used, and the higher the total score, the higher the digital literacy level. The items are as follows: “I can find the information and content I need online,” “I can determine if the information I get online is reliable,” “I can recognize and participate in social issues online,” “I can create and edit digital content,” “I am aware of issues regarding privacy online,” “I use online information to conduct academic and career-related activities.” In this study, the Cronbach’s alpha value of digital literacy is 0.85.

Smartphone addiction

We use the smartphone overdependence scale (S-scale), developed by the NIA, to measure smartphone addiction.

Table 1. Exploratory factor analysis (N=3,121)

| Smartphone usage type | Factors |
|-----------------------|---------|
|                       | 1       | 2       | 3       | 4       |
| Life management       | 0.991   |         |         |         |
| Health care           | 0.547   |         |         |         |
| Purchasing goods/services | 0.484   |         |         |         |
| Financing             | 0.465   |         |         |         |
| Education             | 0.429   |         |         |         |
| Selling goods/services | 0.313   |         |         |         |
| Product/service search | 0.819   |         |         |         |
| Interest (hobby) search | 0.818   |         |         |         |
| Other common web surfing | 0.694   |         |         |         |
| Academic and business search | 0.653   |         |         |         |
| Transportation/location search | 0.619 |         |         |         |
| News viewing          | 0.582   |         |         |         |
| E-books               | 0.658   |         |         |         |
| Radio and podcasts    | 0.580   |         |         |         |
| Music                 | 0.386   |         |         |         |
| TV, videos, movie     | 0.357   |         |         |         |
| Gaming                | 0.275   |         |         |         |
| Messenger             | 0.384   |         |         |         |
| E-mail                | 0.293   |         |         |         |
| SNS                   | 0.216   |         |         |         |
| **Eigenvalues**       | 6.690   | 2.011   | 1.286   | 1.082   |
| **Variance explained (%)** | 31.855  | 9.575   | 6.123   | 5.150   |
| **Cronbach’s α**      | 0.781   | 0.852   | 0.621   | 0.522   |

1, life service; 2, information seeking; 3, entertainment seeking; 4, communication seeking
This scale includes 10 items, which measured self-control failure, salience, and serious consequences (of smartphone addiction). The inventory consists of a four-point Likert type-scale (disagree completely=1, agree completely=4), with a total score of 40 points; a higher score indicates a higher level of smartphone addiction. Smartphone addiction risk groups are classified as high-risk groups with a total score of 28 or more, potential risk groups with a total score of 27 to 24 or more, and general user groups in other cases. Among them, the high-risk group and the potential-risk group are divided into the smartphone addiction risk group. The specific items are as follows: “Every time I try to reduce my smartphone usage time, I fail,” “It is hard to concentrate on other things when I have a smartphone around me,” and “I once had a health problem because of using a smartphone.” The Cronbach’s alpha value for smartphone addiction is 0.89.

Statistical analysis
The data are analyzed using SPSS Statistics 23.0 (IBM Co., Armonk, NY, USA). A descriptive statistical analysis is conducted to identify the characteristics of sociodemographic variables (sex, age, and monthly income). Pearson’s correlation is used to determine the correlation between the relevant variables. Next, we conduct a hierarchical multiple regression analysis to identify the associations between types of smartphone use, digital literacy, and smartphone addiction. In the first stage, sociodemographic variables (sex, age, monthly income) and smartphone usage time are included. In the second stage, types of smartphone use (life service, information seeking, entertainment seeking, and communication seeking) are included. In the third stage, digital literacy is included.

RESULTS

Socio-demographic characteristics
Of the total 3,121 participants, 1,627 (52.1%) were males and 1,494 (47.9%) were females, and the average age was 63.83 years (SD=2.88). Participants’ monthly income was distributed in the following way: 512 people (16.4%) earned under 2 million won; 1,128 people (36.1%) earned between 2–4 million won; 889 people (28.5%) earned between 4–6 million won; 429 people (13.7%) earned 6–8 million won; 131 people (4.2%) earned 8–10 million won; and 32 people (1.0%) earned over 10 million won. There were 2,666 (85.4%) participants in the general user group, 373 (12.0%) in the potential risk group, and 82 (2.6%) in the risk group. A total of 14.6% of the smartphone addiction risk group. With regard to the smartphone usage time, 1,798 people reported an hour or less use, 905 people reported 1–2 hours, 297 people reported 2–3 hours, 93 people reported 3–4 hours, and 28 people reported over 4 hours. A descriptive statistical analysis of the relevant variables is presented in Table 2.

Table 2. Sociodemographic characteristics (N=3,121)

| Variable                      | Value       |
|-------------------------------|-------------|
| Sex                           |             |
| Male                          | 1,627 (52.1)|
| Female                        | 1,494 (47.9)|
| Age (yr)                      | 63.83±2.88  |
| Monthly income (million won)  |             |
| <2                            | 512 (16.4)  |
| ≥2 to <4                      | 1,128 (36.1)|
| ≥4 to <6                      | 889 (28.5)  |
| ≥6 to <8                      | 429 (13.7)  |
| ≥8 to <10                     | 131 (4.2)   |
| ≥10                           | 32 (1.0)    |
| Years of education            |             |
| Below elementary school       | 150 (4.8)   |
| Middle school graduate        | 692 (22.2)  |
| High school graduate          | 1,839 (58.9)|
| College graduate              | 431 (13.8)  |
| Above graduate school         | 9 (0.3)     |
| Types of jobs                 |             |
| Manager                       | 51 (1.6)    |
| Expert workers                | 48 (1.5)    |
| Office workers                | 160 (5.1)   |
| Service workers               | 259 (8.3)   |
| Salesmen                      | 386 (12.4)  |
| Agriculture, forestry, and fisheries | 146 (4.7)|
| Craft and trades workers      | 294 (9.4)   |
| Plant, machine operators      | 108 (3.5)   |
| Elementary occupations        | 442 (14.2)  |
| Housewife                     | 972 (31.1)  |
| Out of work                   | 255 (8.2)   |
| Addiction group               |             |
| General user group            | 2,666 (85.4)|
| Potential risk group          | 373 (12.0)  |
| Risk group                    | 82 (2.6)    |
| Times of smartphone usage (hr)|             |
| <1                            | 1,798 (57.6)|
| ≥1 to <2                      | 905 (29.0)  |
| ≥2 to <3                      | 297 (9.5)   |
| ≥3 to <4                      | 93 (3.0)    |
| ≥4                            | 28 (0.9)    |

Values are presented as number (%) or mean±standard deviation
Correlation

Pearson’s correlation was conducted to verify the correlation between variables, and the results are presented in Table 3. Smartphone usage time was found to have a positive correlation with the type of smartphone use (life service, information seeking, entertainment seeking, and communication seeking), digital literacy, and smartphone addiction. Type of smartphone use (life service, information seeking, entertainment seeking, communication seeking) and digital literacy had a positive correlation with smartphone addiction. Finally, digital literacy positively correlated with smartphone addiction.

Next, the normality test for the analyzed data of this study was reviewed through skewness and kurtosis. If skewness is an absolute value of 3 or more and kurtosis is an absolute value of 7 or more, it is judged that there is a problem with the normality of the data. As a result of reviewing the normality of the analyzed data in this study, it was found that there was no problem with skewness and kurtosis in the test of normality.

Hierarchical multiple regression

A hierarchical multiple regression analysis was conducted to examine the independent influence of demographic variables, smartphone usage time, smartphone usage type, and digital literacy on smartphone addiction. In addition, Durbin–Watson coefficients were derived to verify multicollinearity between variables. As a result of the analysis, the Durbin–Watson coefficient of the final model was 1.305, which did not exceed 2, confirming that the problem of multicollinearity did not occur. The total explanatory power (R²) of the variables of the regression model was 36.1%, and the F value of the regression model was 42.36, which was significant at the level of significance probability p<0.001.

The results in Table 4 indicated that smartphone usage time,
digital literacy, as well as the type of smartphone used for life service, information, entertainment, and communication, had a significant impact on smartphone addiction. On the other hand, sociodemographic variables (sex, age, monthly income, years of education, and types of jobs) did not influence smartphone addiction. Smartphone usage time was positively associated with smartphone addiction ($\beta=0.151, p<0.001$). In other words, the more time spent on a smartphone, the greater the likelihood of smartphone addiction. The use of smartphones for life service ($\beta=0.166, p<0.001$) and entertainment seeking ($\beta=0.076, p<0.001$) were positively related to smartphone addiction. However, information seeking ($\beta=-0.044, p<0.05$) and communication type ($\beta=0.056, p<0.05$) were negatively associated with smartphone addiction. Among the smartphone usage types, the explanatory amount of the life service type was the largest and followed by entertainment and communication. Finally, the analysis found that higher digital literacy levels in the elderly were linked to higher levels of smartphone addiction ($\beta=0.134, p<0.001$).

**DISCUSSION**

This study verified how types of smartphone usage and digital literacy are related to smartphone addiction in the elderly after controlling for sociodemographics and time spent using smartphones. The main results and discussions of this study are as follows.

First, this study, consistent with prior research on the elderly, did not find an association between sex and smartphone addiction. In addition, even though previous studies on college students have shown that smartphone addiction decreases as age increases, no significant relationship between age and smartphone addiction was found in this study. This result may be related to the fact that this study targeted only elderly participants in their 60s. Although few studies have provided evidence indicating a link between income and smartphone addiction, that relationship was not significant in this study. Yet, similar to previous studies on adolescents and college students, smartphone use time was positively associated with smartphone addiction in this study. These results indicate that, regardless of age, the average time spent using a smartphone is an important predictor of smartphone addiction.

Second, much like prior research on adolescents, smartphone use for information seeking was negatively related to smartphone addiction. These results may be related to the kind of informative content that the elderly seek while using their smartphones. Typically, seniors search and use information related to health and the economy through smartphones, and these activities may contribute to improving their overall life satisfaction. The use of smartphones for entertainment seeking was also found to have a positive impact on smartphone addiction. These results suggest that excessive smartphone use for entertainment-seeking increases addiction to smartphones not only for adolescents and early adults but also for the elderly. On the other hand, our results were contrary to a prior study that found that using smartphones for communication were positively correlated with smartphone addiction. Previous research suggests that using a smartphone for communication may strengthen social connections with family and friends, which may improve psychological well-being. That is, people use smartphones to communicate with others, which may strengthen offline social bonding.

One notable result is that using smartphones for life services had a significant impact on the elderly’s addiction to smartphones. In a study of adults in their 20s, mobile shopping was significantly related to smartphone addiction, but a study on all ages showed that smartphone use for life services did not significantly impact smartphone addiction. The results of this study are similar to those of Jang, who verified a significant positive relationship between life service type and smartphone addiction in the elderly. This study suggests that excessive use of smartphones for life services may increase the risk of elderly addiction to smartphones and more research on this topic is needed in the future.

Third, digital literacy may be an important predictor of elderly addiction to smartphones. The results of this study are similar to those of past studies on adolescents and early adults, and suggest that digital literacy is likely to be positively related to smartphone addiction among the elderly. As the level of digital literacy increases, people spend more time online and participate in more diverse activities. In particular, smartphone addiction has a significant positive relation with smartphone usage time, and digital literacy is more likely to increase proficiency and may lead to smartphone addiction because digital literacy is related to media usage proficiency. The elderly who participate in these diverse activities online will spend more time using their smartphones, which may problems such as physical problems. In previous studies, the relationship between digital literacy and smartphone addiction is not clearly revealed. Future study needs to examine in detail how digital literacy affects the lives of the elderly.

The main contributions of this study are as follows: first, this study confirmed through a national sample the relationship between the types of smartphone use and smartphone addiction in the elderly. Second, this study clarified the role of digital literacy in smartphone addiction in the elderly. This study has the following implications. The degree of smartphone addiction may vary as a type of smartphone use; therefore, it is necessary to identify the main types of smartphone use in individuals and to provide education on smartphone use in different age groups.
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use to prevent smartphone addiction. In addition, it is necessary to educate older people on digital literacy to protect them from smartphone addiction.

This study has the following limitations: first, this research was only conducted on a sample of people in their 60s. In future research, it is necessary to further verify the relationship between types of smartphone use, digital literacy, and smartphone addiction, in participants in their 70s and older participants. Second, since this study used a cross-sectional design, it is difficult to infer the causal relationship between variables.

Availability of Data and Material
The data that support the findings of this study are openly available in [National Information Society Agency] at [https://www.nia.or.kr/site/nia_kor/main.do], reference number [9].

Conflicts of Interest
The authors have no potential conflicts of interest to disclose.

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Conceptualization: Ji-Hyeon Jeong, Sung-Man Bae. Formal analysis: Ji-Hyeon Jeong. Investigation: Ji-Hyeon Jeong. Methodology: Ji-Hyeon Jeong, Sung-Man Bae. Project administration: Ji-Hyeon Jeong, Sung-Man Bae. Resources: Ji-Hyeon Jeong. Software: Ji-Hyeon Jeong. Supervision: Sung-Man Bae. Validation: Sung-Man Bae. Visualization: Ji-Hyeon Jeong. Writing—original draft: Ji-Hyeon Jeong. Writing—review & editing: Sung-Man Bae.

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