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Relationship between types of smartphone use among adolescents and smartphone addiction: focusing on gender differences

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Abstract

Background: With the increasing prevalence of smartphone ownership among adolescents in South Korea, understanding usage patterns and their consequences has become a priority. This study aimed to examine smartphone usage patterns and their association with smartphone addiction, with a specific focus on gender differences. **Methods**: Data were derived from the 2022 Korean Children and Youth Panel Survey (KCYPS), which included 4524 adolescents. Latent profile analysis was used to identify distinct smartphone usage patterns based on the frequency of use across various activities. Multiple regression analysis was performed to assess the relationship between these usage patterns and smartphone addiction levels. **Results**: Four distinct smartphone usage profiles were identified for both genders. For males, these profiles included the "High Usage Group", "Family & Friends Focused-Group", "Moderate Usage Group" and "Family & Friends Focused-Low Usage Group". Both male and female adolescents were predominantly categorized in the "Moderate" and "High Usage Groups". Among males, those in the "High Usage Group" exhibited significantly higher levels of smartphone addiction compared to those in the "Family & Friends Focused-Group" and "Family & Friends Focused-Low Usage Group", potentially due to excessive use of social networking, gaming and video-watching applications. Female adolescents in the "High Usage Group" demonstrated higher addiction levels compared to the "Family & Friends Focused-Group" and "Moderate Usage Group", which may be associated with reduced engagement in intimate peer relationships and emotional sharing in groups with less frequent smartphone use. **Conclusions**: These findings indicate the necessity for gender-specific interventions to address smartphone addiction among adolescents, emphasizing the importance of developing targeted strategies for addiction prevention and policy formulation.

Keywords

Smartphone addiction; Adolescent behavior; Usage patterns; Gender differences

1. Introduction

With advancements in communication technology and the increasing versatility of smartphones, smartphone ownership rates have risen steadily. According to the Pew Research Center, smartphone ownership in South Korea reached 95% in 2018, the highest among the 27 countries surveyed [1]. As of 2023, this rate is projected to reach 97%, indicating near-universal smartphone ownership among the population [2]. In addition, 94.5% of teenagers consider smartphones as being essential to their daily lives, using them not only for communication through calls and text messages but also for educational purposes, gaming, music and social interactions via social networks [3, 4]. The high rate of smartphone ownership and the diverse uses among adolescents increase the risk of smartphone addiction, as this demographic demonstrates substantial dependence on smartphones across multiple aspects of their lives [4–6]. Smartphone addiction is characterized by the excessive use of smartphones to the extent that it becomes the most important activity in an individual's daily routine, leading to diminished self-regulation and the inability to cease usage despite negative consequences [7].

Compared to other forms of media addiction, smartphone addiction can be more severe due to the portability of smartphones and the unrestricted access they provide to various content at any time and place [4]. Upon recognizing this issue, the South Korean government established the "1st Basic Plan for Prevention and Resolution of Smartphone and Internet Over-reliance" in 2010 and is currently promoting the 5th Plan (2022–2026). These governmental efforts have led to ongoing research into smartphone addiction among adolescents [8–11]. In this regard, a recent analysis of research trends in digital

addiction, including smartphone addiction, revealed that early studies predominantly focused on risk factors related to adults and gender. However, over time, research has shifted towards exploring adolescent addictive behaviors and the unique factors contributing to smartphone addiction in this age group [12]. Given that smartphone addiction during adolescence can negatively impact academic performance and overall well-being, it is essential to investigate the factors influencing this phenomenon, including the surrounding environment [13].

Gender is recognized as a significant factor influencing smartphone addiction. Numerous studies have reported that females have higher levels of smartphone dependency compared to males [14]. Specifically, investigations conducted among middle and high school students have demonstrated a higher dependency rate among female students than their male counterparts [15–17]. However, contrasting evidence exists as some studies have reported greater smartphone dependency among male students [18], while others have found no significant gender differences [19, 20]. These discrepancies indicate the importance of examining gender differences to better understand and address smartphone addiction in adolescents. Gender-related behavioral tendencies may contribute to these differences. Moreover, males are often described as goal-oriented and driven by extrinsic motivation, while females tend to prioritize maintaining relationships and sharing emotions, which are associated with higher intrinsic motivation [4, 21].

It is reasonable to anticipate differences in smartphone usage patterns based on gender. Previous studies have shown that female students primarily use smartphones for communication, such as messaging applications, while male students use them more frequently for gaming, highlighting distinct usage patterns [22–25]. In addition to gender, factors such as age and residential area have been identified as significant contributors to smartphone addiction. Age-related trends in smartphone addiction have been widely discussed, though findings remain inconsistent. Several studies have reported that smartphone addiction increases with age. For instance, the 2023 smartphone overdependence survey conducted in Korea indicated that middle school students are at a higher risk of smartphone addiction than high school students [7]. Conversely, other studies, including those by Lee and Yang [26] and Gezgin [27], have found that the risk of smartphone addiction escalates as adolescents grow older. Residential areas have also been identified as a key factor influencing smartphone addiction. While some studies have reported higher addiction rates among adolescents in urban areas compared to those in rural regions [28, 29], contrasting findings have been observed. In this regard, Lee and Kim [30] and Lee et al. [31] revealed that adolescents residing in small- to medium-sized cities and rural areas have higher smartphone addiction rates compared to those in large cities.

In addition, the type of smartphone use is an important predictive factor influencing smartphone addiction. In a study by Lee and Yang [26], gaming and entertainment were identified as significant contributors to smartphone dependency among male students, while taking pictures and watching videos were key factors for female students. Similarly, Kim et al. [4] found that entertainment-related smartphone use significantly impacted smartphone addiction, whereas information-seeking and communication-related usage were not significant predictors. Additionally, a study on Swiss adolescents revealed that text messaging, instant messaging and social media use were important variables contributing to smartphone addiction [32].

Previous studies have provided insights into the potential relationship between smartphone usage types and smartphone addiction by gender. However, empirical verification of these relationships remains insufficient. Additionally, most prior research has employed variable-centered analysis methods that primarily focus on overall smartphone usage levels. While these methods offer a general understanding, they do not account for the heterogeneity among smartphone users, which limits their ability to generate practical and actionable recommendations [33, 34]. To address these limitations, this study adopts a subject-centered analysis approach using latent profile analysis (LPA) to classify subgroups within the population based on their smartphone usage patterns, which enables the identification of distinct usage types and facilitates the examination of their relationship with smartphone addiction, with a specific focus on gender differences. Unlike prior research, this approach provides empirical validation of gender-specific variations in smartphone usage and their association with addiction. By analyzing and understanding these gender differences, this study aims to support the development of tailored prevention and intervention programs. Moreover, incorporating gender-specific characteristics and needs into these programs has the potential to enhance their effectiveness in addressing smartphone addiction and represents a more practical and impactful strategy for mitigating the problem of smartphone addiction among adolescents.

As a result, we intend to extract smartphone usage types and examine the relationship between these extracted types and smartphone addiction, which distinguishes this study from previous research by confirming gender differences in usage.

Overall, we explored the smartphone usage types of adolescents through latent profile analysis, a subject-centered analysis method that accounts for heterogeneity among research subjects by examining the relationship between the characteristics of smartphone usage types by gender and smartphone addiction [35]. This study is expected to expand the understanding of smartphone addiction among adolescents and provide foundational data for formulating policies and practical measures to prevent addiction. The specific research questions of our present study that we aim to elucidate are as follows: First, is there a difference in smartphone usage and smartphone addiction among adolescents based on gender? Second, what are the smartphone usage types of male and female adolescents? Third, do the smartphone usage types of male and female adolescents affect smartphone addiction?

2. Materials and methods

2.1 Data

This study analyzed data from the Korean Children and Youth Panel Survey (KCYPS), conducted by the Korea Youth Policy Institute. The KCYPS is a nationally representative survey designed to comprehensively understand the growth and development trajectories of children and adolescents in Korea,

providing foundational data for developing child and youth-related policies. As of 2018, the KCYPS included a total of 5197 participants, comprising 2607 4th-grade elementary school students and 2590 1st-grade middle school students. The sampling frame was based on the 2017 Basic Education Statistics provided by the Korean Ministry of Education. A multi-stage stratified cluster sampling technique was employed to select participants, and data were collected through individual interviews conducted using tablet computers. We utilized data from the 5th wave of the survey, conducted in 2022, which included 2311 2nd-grade middle school students and 2252 2nd-grade high school students. After excluding cases with missing values in the main variables, the final dataset comprised 4524 adolescents, including 2334 male students and 2190 female students.

2.2 Variables

2.2.1 Independent variables: types of smartphone usage

The independent variable in this study was defined as the frequency of smartphone usage, categorized based on specific activities. A scale initially developed by Bae *et al.* [36] and later revised by the Korea Youth Policy Institute was employed. The original scale demonstrated good reliability, with a Cronbach's alpha of 0.842. The frequency of smartphone use was measured using 12 items, including activities such as calling family, texting family, calling friends, texting friends, using social networks, playing games, taking photos and videos, watching television (TV) and videos, listening to music, searching for information, viewing documents, and studying or working. Responses were recorded on a 4-point scale (1 = never used, 2 = rarely used, 3 = occasionally used, 4 = frequently used), with higher scores indicating more frequent smartphone usage. In this study, the Cronbach's alpha for this variable was 0.781, indicating good internal consistency.

2.2.2 Dependent variable: smartphone addiction

The dependent variable in this study was smartphone addiction, assessed using the Smartphone Addiction Proneness Scale (SAPS) developed by Kim D *et al.* [37]. The SAPS was incorporated into the Korean Children and Youth Panel Survey and demonstrated high reliability (Cronbach's alpha = 0.880) and construct validity, evidenced by its correlation with the Internet Addiction Scale, KS-II (Korean Scale for Internet Addiction-II) ($r = 0.49$). The SAPS comprises 15 items rated on a 4-point scale (1 = not at all, 2 = not much, 3 = somewhat, 4 = very much). Three items—"Smartphone use does not interfere with what I am doing (studying)", "I do not feel anxious without my smartphone" and "I do not spend much time using my smartphone"—were reverse-coded. The overall smartphone addiction score was calculated as the average of all 15 items, with higher scores indicating greater levels of smartphone addiction. In this study, the Cronbach's alpha for this variable was 0.854, confirming its reliability.

2.2.3 Group variables and control variables: gender, age, residential area

The group variable in this study was gender, coded as male (0) and female (1). Control variables included age, represented as a dummy variable (middle school student = 0, high school student = 1), and residential area, also represented as a dummy variable (urban = 0, rural = 1).

2.3 Statistical analysis

Data analysis was conducted using SPSS 29.0 (SPSS Inc., Chicago, IL, USA) and Mplus 8.0 (Muthén & Muthén, Los Angeles, CA, USA), with the following procedures applied: First, frequency analysis was performed to describe the demographic characteristics of the research subjects. Second, an independent sample *t*-test was used to examine gender-based differences in the main study variables. Third, LPA was conducted to identify smartphone usage patterns by gender. LPA, a subtype of latent class analysis (LCA), is a multivariate analysis method suited for cross-sectional studies [38]. This approach identifies subgroups of individuals with similar response patterns to measured variables, enabling the categorization of distinct groups based on their characteristics [39]. Moreover, LPA was used to classify smartphone usage types among the participants.

The model fit for the LPA was evaluated using several indices, including the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Sample-Size Adjusted BIC (SABIC), Entropy, and the Bootstrap Likelihood Ratio Test (BLRT). A satisfactory model fit is indicated by smaller values of AIC, BIC and SABIC, an Entropy value closer to 1, and a significant *p*-value for BLRT [40]. Additionally, to ensure meaningful group comparisons, each identified subgroup was required to represent more than 5% of the total sample [41]. Fourth, chi-square analysis was employed to examine differences in sociodemographic characteristics across smartphone usage types. Fifth, multiple regression analysis was conducted to explore the relationship between gender, smartphone usage types, and smartphone addiction.

3. Results

3.1 Demographic characteristics and characteristics of major variables

The demographic characteristics of the study participants are presented in Table 1. Among male students, 1193 (51.1%) were middle school students, and 1141 (48.9%) were high school students. Among female students, 1147 (52.4%) were middle school students, and 1043 (47.6%) were high school students. Regarding residential areas, 1979 male students (84.8%) and 1835 female students (83.8%) resided in urban areas, while 355 male students (15.2%) and 355 female students (16.2%) lived in rural areas.

To assess gender differences in the major variables, an independent samples *t*-test was conducted, and the results are presented in Table 2. Statistically significant differences based on gender were observed in most smartphone activities, except for watching TV and videos. Specifically, significant

TABLE 1. Demographic characteristics and characteristics of major variables (N = 4524).

Variable	Categories	Male (n = 2334)		Female (n = 2190)	
		n	%	n	%
Age					
	Middle School	1193	51.1	1147	52.4
	High School	1141	48.9	1043	47.6
Residential Area					
	Urban	1979	84.8	1835	83.8
	Rural	355	15.2	355	16.2

TABLE 2. Differences in the characteristics of the main variables by gender (N = 4524).

Variables	Male (n = 2334)		Female (n = 2190)		t (sig.)
	M	SD	M	SD	
Smartphone Usage					
Calling family	3.31	0.66	3.42	0.63	−5.400***
Texting family	3.24	0.68	3.36	0.67	−6.136***
Calling friends	3.30	0.72	3.38	0.72	−3.776***
Texting friends	3.56	0.64	3.65	0.60	−4.458***
Using social networks	2.83	1.06	3.19	0.95	−12.015***
Playing games	3.19	0.89	2.57	0.99	21.921***
Taking photos and videos	2.99	0.77	3.35	0.68	−16.688***
watching TV and videos	3.39	0.80	3.38	0.82	0.421
Listening to music	3.30	0.80	3.47	0.71	−7.795***
Searching for information	3.11	0.80	3.21	0.79	−3.796***
Viewing documents	2.80	0.98	2.86	0.95	−2.108*
Studying or working	2.77	0.86	2.89	0.87	−4.556***
Smartphone addiction	2.18	0.45	2.19	0.43	−1.076

*$p < 0.05$, ***$p < 0.001$. sig.: significance; M: Mean; SD: Standard Deviation; TV: Television.*

differences were found for talking with family ($p < 0.001$), texting with family ($p < 0.001$), talking with friends ($p < 0.001$), texting with friends ($p < 0.001$), using social networks ($p < 0.001$), playing games ($p < 0.001$), taking photos and videos ($p < 0.001$), listening to music ($p < 0.001$), searching for information ($p < 0.001$), viewing documents ($p < 0.001$), and studying or working ($p < 0.001$). Female students reported significantly higher usage frequencies for activities such as talking with family, texting with family, talking with friends, texting with friends, using social networks, taking photos and videos, listening to music, searching for information, viewing documents, and studying or working compared to male students. In contrast, male students demonstrated significantly higher frequencies of using smartphones for playing games compared to female students. However, no significant gender differences were found in smartphone addiction levels.

3.2 Types of smartphone usage by gender

The p-values of AIC, BIC, SABIC, Entropy and BLRT were used to determine the number of smartphone usage types by gender. The latent profile analysis fit statistics are presented

in Table 3. For male students, AIC, BIC and SABIC values decreased as the number of types increased, with the lowest values observed for five types. However, the entropy value for the four types was 0.905, higher than that for other models. Additionally, the p-values for BLRT were significant at the $p < 0.001$ level for models with 2, 3, 4 and 5 types. The five-type model, however, included a subgroup representing less than 5% of the total cases. Based on these findings and comprehensive consideration of model fit criteria, the four-type model was determined to be the most suitable for males and was adopted as the final model. For female students, AIC, BIC and SABIC values similarly decreased with an increasing number of types but began to increase in the five-type model, with the lowest values observed in the four-type model. The entropy value for the four types was 0.972, higher than for other models, and the p-values for BLRT were significant at the $p < 0.001$ level for models with 2, 3, 4 and 5 types. However, the five-type model also included a subgroup representing less than 5% of the total cases. Thus, the four-type model was selected as the most appropriate for females as the final model.

The gender-specific smartphone usage types identified

through latent profile analysis are illustrated in Figs. 1,2. Since the patterns were largely similar for males and females, the groups were given identical names. The first type, the "High Usage Group", displayed high usage levels across all smartphone functions, which was the largest group among males, comprising 851 individuals (36.5%), and the second largest among females, with 885 individuals (40.4%).

The second type was designated as the "Family & Friends

TABLE 3. Analysis of Latent profile fit.

Gender	Class	Model fit					Groups
		AIC	BIC	SABIC	Entropy	BLRT *p*-value	n (%)
Male							
	1	66,797.016	66,935.144	66,858.891	-	-	-
	2	63,857.675	64,070.623	63,953.077	0.732	<0.001	1053 (45.1), 1281 (54.9)
	3	62,759.289	63,047.055	62,888.196	0.859	<0.001	843 (36.1), 617 (26.4), 873 (37.5)
	4	57,986.139	58,348.726	58,148.562	0.905	<0.001	142 (6.1), 711 (30.5), 851 (36.5), 630 (26.9)
	5	57,504.580	57,941.986	57,700.519	0.893	<0.001	142 (6.1), 99 (4.2), 711 (30.5), 531 (22.7), 851 (36.5)
Female							
	1	61,007.482	61,144.082	61,067.830	-	-	-
	2	57,803.908	58,014.499	57,896.945	0.807	<0.001	737 (33.7), 1453 (66.3)
	3	56,569.285	56,853.868	56,695.011	0.852	<0.001	634 (29.0), 526 (24.0), 1030 (47.0)
	4	50,811.869	51,170.443	50,970.283	0.972	<0.001	153 (7.0), 184 (8.4), 968 (44.2), 885 (40.4)
	5	51,175.038	51,607.604	51,366.141	0.889	<0.001	524 (23.9), 104 (4.8), 489 (22.3), 188 (8.6), 885 (40.4)

AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion; BLRT: Bootstrap Likelihood Ratio Test; SSABIC: Sample-Size Adjusted BIC.
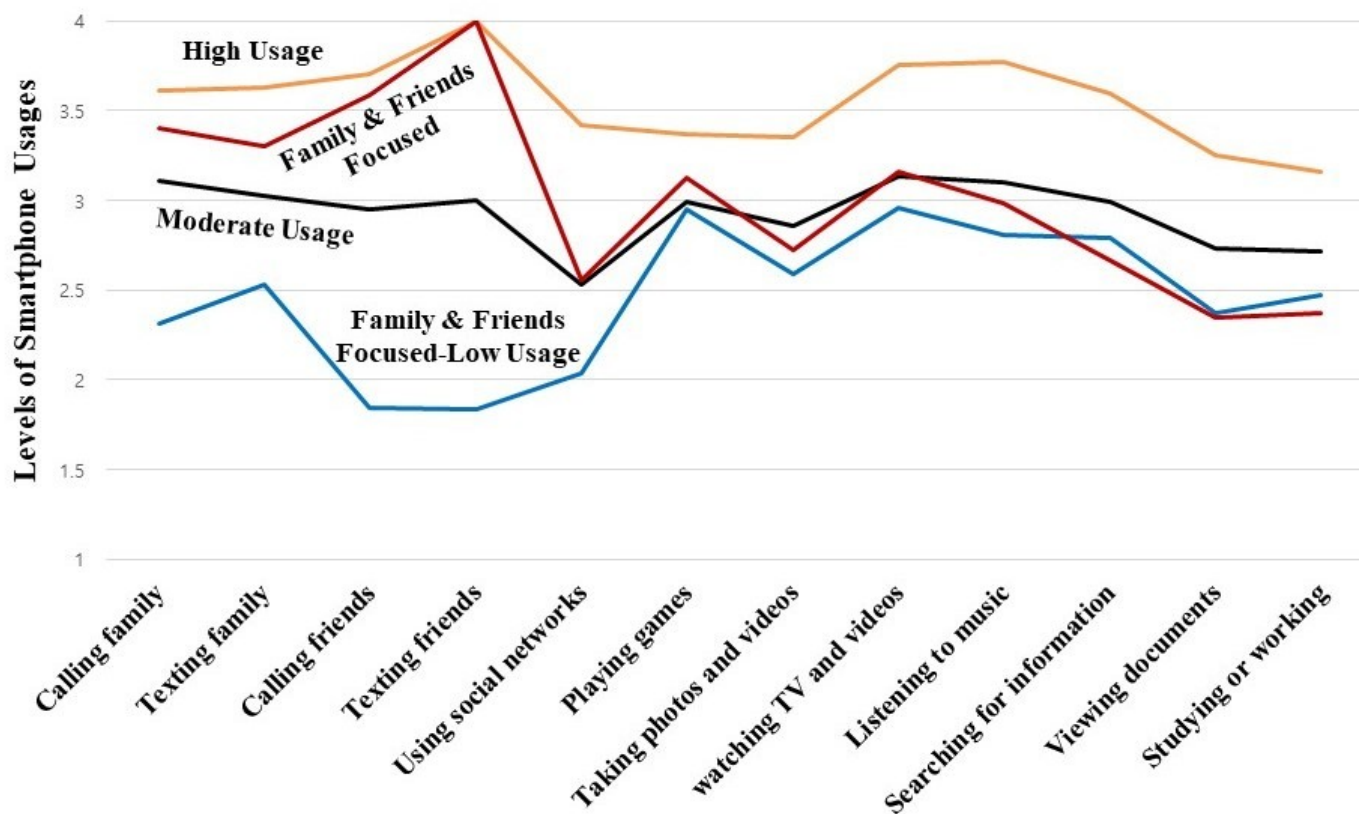

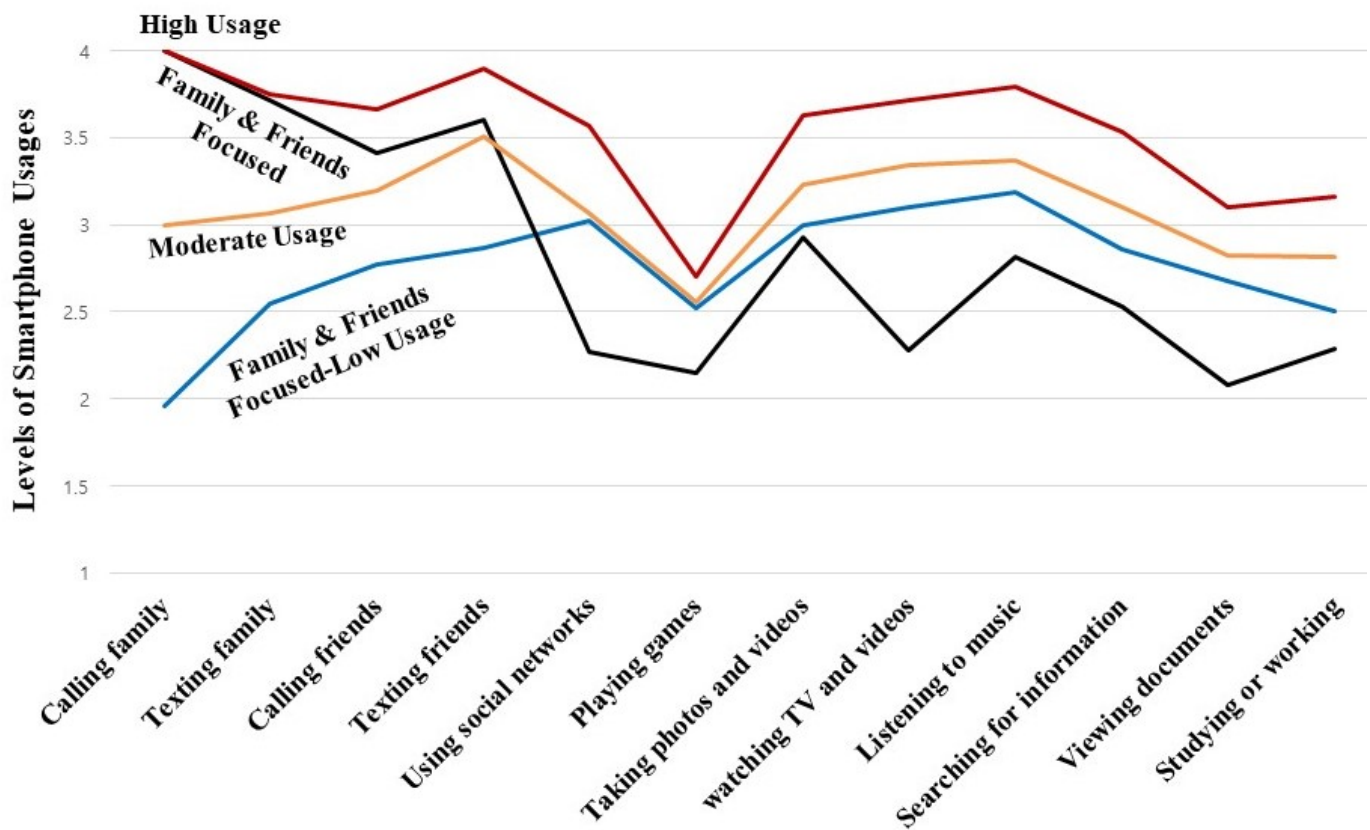**FIGURE 1. Estimation of male smartphone usage patterns.** TV: Television.

F I G U R E 2. Estimation of female smartphone usage patterns. TV: Television.

Focused" group, characterized by higher usage of calls and text messaging with family and friends compared to other smartphone functions. This group included 630 males (26.9%) and 184 females (8.4%), indicating a larger representation among males than females. Interestingly, within this group, male students primarily contacted friends more frequently than family, whereas female students exhibited the opposite pattern, prioritizing communication with family over friends. Additionally, a notable characteristic of the female "Family & Friends Focused" group was their relatively lower usage of all other smartphone functions compared to the other identified groups.

The third type was designated as the "Moderate Usage Group" due to their balanced use of all available smartphone functions at an average level. This group represented the second largest proportion among males, with 711 individuals (30.5%), and the largest proportion among females, with 968 individuals (44.2%). The fourth type was identified as the "Family & Friends Focused-Low Usage Group", characterized by minimal use of calls and text messages with family and friends compared to other functions. This group constituted the smallest proportion for both genders, including 142 males (6.1%) and 153 females (7.0%).

The chi-square analysis was performed to assess differences in demographic characteristics by smartphone usage type (Table 4). For male students, the results indicated significant differences in age across smartphone usage types ($\chi^2 = 35.443$, $p < 0.001$). The proportion of middle school students was higher than that of high school students in the "Family &

Friends Focused" and "Family & Friends Focused-Low Usage" groups. Conversely, high school students were more prevalent in the "High Usage" and "Moderate Usage" groups. However, no significant differences in residential areas were observed across smartphone usage types for male students.

For female students, significant differences were found in both age ($\chi^2 = 21.233$, $p < 0.001$) and residential area ($\chi^2 = 8.410$, $p < 0.05$) across smartphone usage types. In terms of age, the proportions of middle and high school students were similar in the "High Usage", "Moderate Usage" and "Family & Friends Focused-Low Usage" groups. However, the "Family & Friends Focused" group had a higher proportion of middle school students compared to high school students.

Regarding residential areas, all smartphone usage types were predominantly urban, with lower representation in rural areas. Notably, the "Family & Friends Focused-Low Usage" group had a higher proportion of students from rural areas (22.9%) compared to other groups, while the "Family & Friends Focused" group had a lower proportion from rural areas (11.4%) than other groups.

3.3 Relationship between gender, smartphone usage type, and smartphone addiction

Multiple regression analysis was conducted to determine the relationship between gender, smartphone usage type, and smartphone addiction (Table 5). For male students, the explanatory power of the control and independent variables on smartphone addiction was 11.4% ($R^2 = 0.114$), and the

TABLE 4. Analysis of Latent profile fit.

Variable	Categories	Types of Smartphone Usage								χ^2
		High Usage		Family & Friends Focused		Moderate Usage		Family & Friends Focused-Low Usage		
		n	%	n	%	n	%	n	%	
Males										
Age	Middle School students	357	42.0	358	56.8	346	48.7	80	56.3	35.443***
	High School students	494	58.0	272	43.2	365	51.3	62	43.7	
Residential Area	Urban	741	87.1	518	82.2	598	84.1	122	85.9	7.060
	Rural	110	12.9	112	17.8	113	15.9	20	14.1	
Females										
Age	Middle School students	465	52.5	125	67.9	479	49.5	78	51.0	21.233***
	High School students	420	47.5	59	32.1	489	50.5	75	49.0	
Residential Area	Urban	738	83.4	163	88.6	816	84.3	118	77.1	8.410*
	Rural	147	16.6	21	11.4	152	15.7	35	22.9	

*$p < 0.05$, ***$p < 0.001$.*

TABLE 5. Relationship between gender, smartphone usage type, and smartphone addiction.

Variables	Males		Females	
	Coef.	S.E.	Coef.	S.E.
Control variables				
Age (ref. middle school students)	0.003	0.019	−0.019	0.018
Area of living (ref. Urban)	0.010	0.026	0.009	0.013
Smartphone Usage types				
Family & Friends Focused (ref. High Usage)	−0.150***	0.024	−0.200***	0.035
Moderate Usage (ref. High Usage)	−0.030	0.023	0.050*	0.020
Family & Friends Focused-Low Usage (ref. High Usage)	−0.180***	0.041	0.144***	0.038
Constant	2.203	0.019	2.171	0.028

*$p < 0.05$, ***$p < 0.001$. S.E.: Standard Error; Ref.: Reference; Coef.: Coefficient.*

research model was considered appropriate ($F = 13.584$, $p < 0.001$). Among the control variables, neither age nor residential area had a significant effect on smartphone addiction (Fig. 3). Regarding the independent variables, the "High Usage" group was used as the reference, and dummy variables were created for the "Family & Friends Focused", "Moderate Usage" and "Family & Friends Focused-Low Usage" groups. The analysis revealed that both the "Family & Friends Focused" group (Coef. $= −0.150$, $p < 0.001$) and the "Family & Friends Focused-Low Usage" group (Coef. $= −0.180$, $p < 0.001$) had significant effects on smartphone addiction. Specifically, smartphone addiction levels were higher in the "High Usage" group compared to the "Family & Friends Focused" and "Family & Friends Focused-Low Usage" groups. However, the "Moderate Usage" group did not show a significant difference in smartphone addiction compared to the "High Usage" group. These results contradict the expectation that the "High Usage" group would exhibit

higher addiction levels than the "Moderate Usage" group.

In the model analyzing female students, the explanatory power of the control and independent variables on smartphone addiction was 13.2% ($R^2 = 0.132$), and the research model was statistically significant ($F = 15.603$, $p < 0.001$). Among the control variables, neither age nor residential area showed a significant effect on smartphone addiction. For the independent variables, the "High Usage" group was used as the reference category, with dummy variables created for the "Family & Friends Focused", "Moderate Usage" and "Family & Friends Focused-Low Usage" groups. The results revealed significant effects of all three groups on smartphone addiction. The "Family & Friends Focused" group demonstrated a negative association with smartphone addiction (Coef. $= −0.200$, $p < 0.001$), indicating lower levels of addiction compared to the "High Usage" group. Conversely, both the "Moderate Usage" group (Coef. $= 0.050$, $p < 0.05$) and the "Family & Friends Focused-Low Usage" group (Coef. $= 0.144$, $p <$
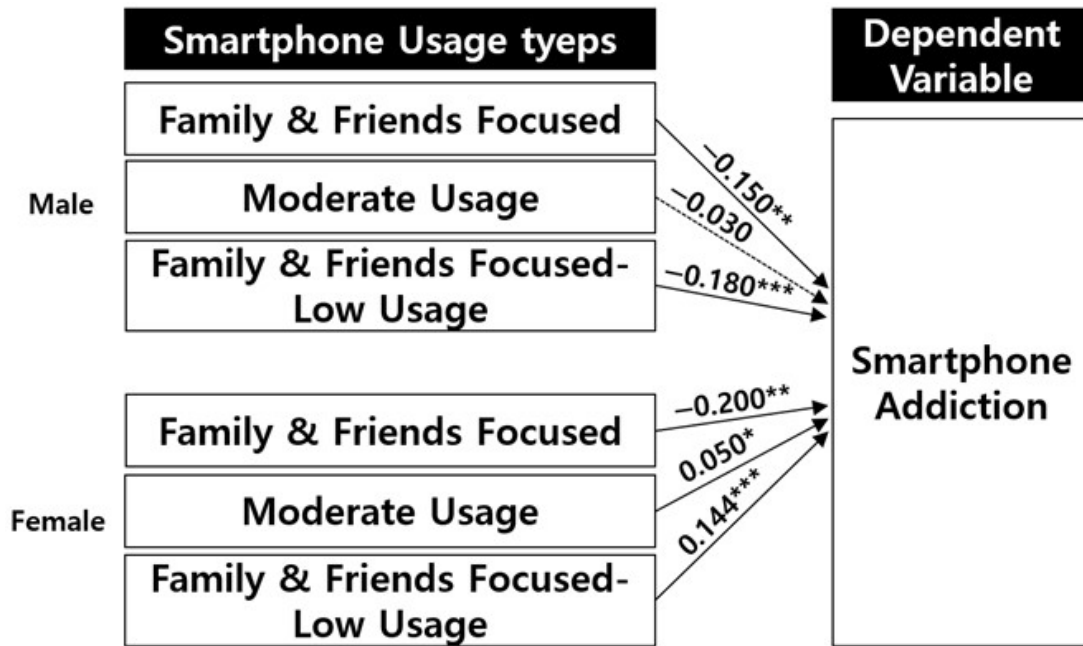
FIGURE 3. Relationship between smartphone use type by gender and smartphone addiction (unstandardized coefficient). *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

0.001) exhibited positive associations, indicating higher levels of addiction compared to the "High Usage" group. Overall, smartphone addiction among female students was lower in the "Family & Friends Focused" group compared to the "High Usage" group, while it was higher in both the "Moderate Usage" and "Family & Friends Focused-Low Usage" groups relative to the "High Usage" group.

4. Discussion

This study investigated the smartphone usage patterns of adolescents through latent profile analysis and examined the relationship between gender-specific usage patterns and smartphone addiction.

First, the analysis of smartphone usage frequencies revealed statistically significant gender differences in activities such as calling family, texting family, calling friends, texting friends, using social networks, playing games, taking pictures and videos, listening to music, searching for information, viewing documents, and studying or working. Male students were found to have significantly higher frequencies of gaming compared to female students. Conversely, female students reported significantly higher frequencies of activities such as calling family, texting family, calling friends, texting friends, using social networks, taking pictures and videos, listening to music, searching for information, viewing documents, and studying or working. This pronounced gender difference in smartphone usage is consistent with findings from Mo and Moon [42], who analyzed 2012 panel data from middle school students as they also demonstrated that female students engaged more frequently in activities related to communication and social interaction, such as calling and texting family and friends, as well as using social networks. The higher frequency of communication-related smartphone use among female students may reflect their greater emphasis on maintaining social

relationships and sharing emotions compared to male students [42]. On the other hand, male students were more likely to use smartphones for entertainment purposes, particularly gaming, rather than for communication.

Secondly, latent profile analysis of adolescents' smartphone usage patterns identified four distinct types for both male and female students: High Usage, Family & Friends Focused, Moderate Usage and Family & Friends Focused-Low Usage groups. Among female students, the "Moderate Usage" group, which utilizes all available smartphone functions at an average level, accounted for the largest proportion (44.2%), followed by the "High Usage" group, which engages in all functions at a high level (40.4%). Similarly, for male students, the "High Usage" group represented the largest proportion (36.5%), followed by the "Moderate Usage" group (30.5%). When comparing the combined proportions of these two groups ("High Usage" and "Moderate Usage") by gender, the ratio was significantly higher among female students (84.6%) compared to male students (67.0%). These findings suggest that female students utilize a broader range of smartphone functions at higher and more balanced levels than male students, aligning with prior research indicating that smartphones may serve as a more female-friendly medium and provide diverse functionalities that appeal to communication, social networking and multitasking preferences often associated with female users [4].

Third, the analysis of the relationship between gender-specific smartphone usage types and smartphone addiction revealed that male students in the "High Usage" group exhibited higher levels of smartphone addiction compared to those in the "Family & Friends Focused" and "Family & Friends Focused-Low Usage" groups. To understand these findings, we need to assess the differences in smartphone usage patterns among these groups. The "High Usage" group demonstrated a higher frequency of activities such as using

social networks, playing games, and watching TV and videos compared to the "Family & Friends Focused" and "Family & Friends Focused-Low Usage" groups. Kim, Lee and Moon [4] suggest that excessive smartphone use, along with heightened exposure to specific types of content, is strongly associated with smartphone addiction. In particular, the use of social networks and games has been shown to have a positive correlation with smartphone overdependence [43]. Furthermore, studies indicate that male students are more vulnerable to game addiction, which may contribute to their higher levels of smartphone addiction [23]. Additionally, during adolescence, the natural intensification of sexual curiosity may lead to an increased likelihood of watching adult videos. Research has shown that male students tend to view pornography more frequently than female students [44]. Although it is challenging to confirm whether the videos viewed by these students specifically included adult content, this potential association warrants consideration. Taken together, these findings suggest that for male students in the "High Usage" group, excessive engagement and immersion in specific smartphone activities, including social network use, gaming, and video watching, may significantly contribute to elevated levels of smartphone addiction.

Meanwhile, for female students, smartphone addiction was found to be higher in the "High Usage" group compared to the "Family & Friends Focused" group, higher in the "Moderate Usage" group compared to the "High Usage" group, and higher in the "Family & Friends Focused-Low Usage" group compared to the "High Usage" group. The "Family & Friends Focused" group is characterized by significantly lower use of all smartphone functions except for communication activities, such as calls and text messages with family and friends. Therefore, it is understandable that smartphone addiction levels are higher in the "High Usage" group, which engages in a broader range of smartphone functions compared to the "Family & Friends Focused" group. Interestingly, this study also revealed that smartphone addiction was higher in the "Moderate Usage" and "Family & Friends Focused-Low Usage" groups than in the "High Usage" group.

To better understand this phenomenon, it is important to examine the differences between these types and the characteristics of smartphone usage among female students. Compared to the "High Usage" group, the "Moderate Usage" and "Family & Friends Focused-Low Usage" groups exhibit relatively lower frequencies of smartphone use for calls or texts with family or friends, as well as for social network activities. As discussed earlier, female students tend to place significant importance on maintaining social relationships and sharing emotions. Consequently, smartphone use often serves as a tool for sustaining relationships with peers through communication. In the "Moderate Usage" and "Family & Friends Focused-Low Usage" groups, where communication and emotional sharing are relatively lower, it is likely that these students experience weaker peer relationships compared to those in the "High Usage" group. Previous studies have identified peer relationships as a critical factor influencing smartphone addiction [45]. Adolescents who face significant stress in peer relationships are more prone to smartphone addiction [4], while positive attachment relationships with peers have been shown to buffer the negative effects of adolescent depression on smartphone addiction [46]. For female students in the "Moderate Usage" and "Family & Friends Focused-Low Usage" groups, relatively low levels of close peer relationships may lead to feelings of alienation and loneliness. These emotional states could, in turn, contribute to higher levels of smartphone addiction as students potentially use their devices as a coping mechanism to mitigate these negative feelings.

5. Conclusions

Based on the findings of this study, the following recommendations could be proposed: First, excessive use and immersion in specific content such as social networks, games, television and video watching were found to be associated with smartphone addiction in male students. Therefore, it is recommended to develop and implement alternative activity programs to provide male students with engaging options beyond playing smartphone games or watching videos. Experts in youth smartphone addiction have highlighted the scarcity of alternative recreational activities for adolescents, contributing to a cycle of excessive smartphone use [47]. Thus, creating play spaces near schools and academies and offering diverse experiential activities can help reduce reliance on smartphones. Furthermore, government regulation of the covert distribution of pornography on platforms frequently used by adolescents, such as Telegram and social media, is essential. Schools should also provide comprehensive sex education and raise awareness about the negative effects of watching pornography.

Secondly, for female students, smartphone addiction was associated with limited opportunities to communicate or share emotions, such as talking on the phone, texting friends or using social media. Parents and teachers should be attentive to whether children or students are frequently using smartphones in isolation, either at home or school, as this may indicate feelings of loneliness or difficulty in forming peer relationships. In such cases, it is important to provide educational and counseling interventions to help these students develop friendships and rebuild connections with their classmates. By supporting the formation of positive peer attachment relationships, efforts can be made to prevent adolescents from becoming overly immersed in cyberspace.

Lastly, the limitations of this study are as follows. First, there is a possibility of measurement error due to social desirability bias. Adolescents who participated in the survey may not have accurately reported their frequency of smartphone use or levels of addiction for each usage type. Secondly, this study relied on secondary data, which imposed limitations on variable selection. The final analysis included 4524 adolescents, which may restrict the generalizability of the findings. Specifically, only variables related to smartphone use and addiction, as defined in the Korean Children and Youth Panel Survey, could be analyzed. Future research utilizing primary data collection with appropriate and tailored scales may produce clearer and more precise results. Third, since this study used cross-sectional data, it was limited to analyzing and verifying correlations between adolescent smartphone usage types and smartphone addiction. To address this limitation, future studies should employ longitudinal designs to explore

causal relationships between smartphone usage patterns and addiction. Fourth, this study did not comprehensively examine the underlying reasons for adolescents' immersion in specific content or their peer relationships. To gain deeper insights, future research should incorporate qualitative approaches, such as interviews and behavioral observations, to better understand these multifaceted factors. Despite these limitations, this study is significant as it examined the relationship between adolescents' smartphone usage patterns and smartphone addiction by gender. The findings suggest that excessive use and immersion in specific content are associated with smartphone addiction in male students, while low levels of close peer relationships are linked to addiction in female students. These results provide valuable insights for developing targeted interventions to address smartphone addiction among adolescents.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available publicly online at: https://www.nypi.re.kr/archive/board?menuId=MENU00329.

AUTHOR CONTRIBUTIONS

SC and SL—designed the research study; wrote first draft; reviewed the manuscript. HJW—performed the research and analyzed the data. KHJ—authored the discussion and the conclusion section of the manuscript. YHK—contributed to drafting and revising the introduction. All authors contributed to editorial changes in the manuscript, and all authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All methods were performed in accordance with the Declaration of Helsinki. This report was exempted from approval by the institutional review boards (IRB) of the Clinical Research Ethics Committee of Jeonbuk National University. Every participant gave a written consent prior to their participation in the study.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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