ORIGINAL ARTICLE

Association between excessive smartphone use and perceived health consequences among rural university students in Northern Thailand

Nattapon Pansakun[1*], Supakan Kantow[2], Tatsanee Chaiya[3], Punyisa Pudpong[2], Kamon Charoenthararak[4]

[1] Department of Health Promotion, School of Public Health, University of Phayao, Thailand
[2] Department of Occupational Health and Safety, School of Public Health, University of Phayao, Thailand
[3] Division of Central Administration, Maejo University, Thailand
[4] Inpatient Department, Pakkhat Hospital, Bueng Kan, Thailand

Corresponding Author: Nattapon Pansakun **Email:** nattapon.pa@up.ac.th

Received: 16 October 2022 **Revised:** 26 December 2022 **Accepted:** 13 January 2023 **Available online:** May 2023
DOI: 10.55131/jphd/2023/210203

ABSTRACT

Mobile phone usage has increased dramatically in recent years. University students, in particular, are among the most prolific smartphone users. This research aimed to determine the association between excessive smartphone use and perceived health consequences of such use among rural university students majoring in various fields. The cross-sectional design was used to conduct the study among first-year undergraduate students recruited using the convenient sampling procedure. The questionnaire consisted of three sections: participants' demographics, excessive smartphone use, and perceptions of health consequences. Data were analyzed using bivariate and multiple linear regression analysis. A total of 590 responses completed the questionnaire. The results showed that 79.2% of the participants were female and the mean age was 18.8 ± 0.6 years. The original sample comprised students belonging to Humanities and Social Sciences; HSS (59.3%), Science and Technology; ST (25.3%), and Health Sciences; HS (15.4%) fields. The level of excessive smartphone use of these students was moderate (49.3%), high (49.0%), and low (1.7%). Over half of them demonstrated the perceived health consequences at a moderate level (76.1%) and a high level (22.0%); only a minority indicated a low level (1.9%). Linear regression analysis showed that excessive smartphone use was positively and significantly associated with the perceptions of health consequences among rural university students (p-value < 0.001). Other variables such as body mass index, father's occupation, and fields of study were related to the perceived health consequences among rural university students (p-value < 0.05). According to the outcomes of this research, it is recommended that intervention be made to encourage and support appropriate smartphone usage behaviors.

Key words:
behavior; smartphone addiction; smartphone; students; university

Citation:
Nattapon Pansakun, Supakan Kantow, Tatsanee Chaiya, Punyisa Pudpong, Kamon Charoenthararak. Association between excessive smartphone use and perceived health consequences among rural university students in Northern Thailand. J Public Hlth Dev. 2023;21(1):27-39
(https://doi.org/10.55131/jphd/2023/210203)

INTRODUCTION

Mobile phones have become increasingly ubiquitous and essential, with individuals all throughout the world embracing their potential with enthusiasm.[1] The proliferation of mobile phones and their use as a crucial means of communication has played a major role in helping people overcome the difficulties of daily life. From organizing everyday tasks to maintaining contact with work colleagues, friends, and family,[2-4] the functions of mobile phones have widened and transformed into smartphones.[3] The term smartphone generally refers to mobile phones with more sophisticated connection and computational capabilities than regular mobile phones.[5,6] With these advanced functionalities, there is no limit to the applications that can be created for smartphones. Their usage appears in many fields: entertainment (e.g., gaming, online browsing, and streaming material), communication (e.g., interacting with others through social networking apps, checking one's email, instant messaging, and voice-over-internet protocol calling), and knowledge searching (e.g., finding local and destination information, accessing indispensable research material or other information related to academic pursuits and professions).[5-7]

Although smartphones offer many benefits, they can also lead to excessive use.[8-10] Excessive smartphone use as a new concept aroused wide interest.[11,12] Excessive smartphone use refers to a state of obsession when the individual behavior is out of control due to the overuse of mobile phones, leading to significant impairments in physical state, psychological state, and social function.[13] Various terms have been used to describe different patterns of smartphone overuse. These include, for example, "smartphone addiction," "excessive smartphone use," "problematic smartphone use," and "smartphone overuse."[14] Although most research in the field declares that smartphones are addictive or takes the existence of smartphone addiction for granted, their review did not find sufficient support from the addiction perspective to confirm the existence of smartphone addiction at this time. Addiction is a disorder with severe effects on physical and psychological health. Excessive use, impulse control problems, and negative consequences may present as addiction, but that does not mean they should be considered an addiction.[15] For the sake of simplicity, we have adopted the term "excessive smartphone use" in this study to refer to the complete range of problematic or maladaptive smartphone use patterns.

A growing amount of literature has indicated that adolescents and young adults spend too much time on their smartphones and feel obsessed with them.[5, 8] In 2021, China had the most smartphone users worldwide, followed by India.[16] Meanwhile, based on a survey from Thailand's statistics on information and communication technology, Thai people, especially young people, tend to use smartphones earlier than other demographic groups; 98.4 percent of those aged 15-24 years old use smartphones, 97.3 percent of those aged 25-34 years old use smartphone, and 90.6 percent of those aged 35-49 use smartphones.[17]

Rapid smartphone advancements have led university students to adopt electronic devices as an essential part of their lifetimes because of their advanced features. Most university students use their smartphones for recreational, social, and educational purposes.[18] Therefore, university students are more vulnerable to excessive smartphone use.[19,20] They use them almost all the time[10] (i.e., it's the first thing they check in the morning and just before bed), which is a sign of excessive smartphone use.[21] In addition, overwhelming evidence shows that smartphones, in particular excessive use, may have various adverse consequences on health and life

performance[22, 23] leading to headaches, fatigue,[3, 24, 25] sleep disturbances,[3,10,24,25] neck disorders,[26] insomnia,[3] stress,[25,27] anxiety,[4,13,14] depression,[10,13,14,25,28] psychological issues,[11,19,20] nomophobia,[21,29] decreased academic success,[5, 22] and diminished social participation in real life.[3]

Previous studies have emphasized associations between specific socio-demographic variables and excessive smartphone use. A few studies have examined the relationship between excessive smartphone use and perceptions of health-related effects. So far, little is known about the extent of the relationship between excessive smartphone use and university students' field of study. Although many research groups have studied smartphone use among university students, the study of smartphone use among university students in rural areas of Thailand, where the students might have less access to smartphones than those in urban areas, is scant. This study aimed to investigate smartphone use behavior and its association with perceptions of the health-related effects among rural university students in Phayao Province, Northern Thailand.

METHODS

Study Design and Sample Size

A cross-sectional design was used to conduct the study among first-year undergraduate students recruited using the convenient sampling procedure at University of Phayao, Northern Thailand. For this study, individuals were randomly selected from two different multidisciplinary buildings.

The population was indefinite, and the researcher did not have access to the exact population due to the first-year undergraduate students in all fields; therefore, Cochran's formula was applied to estimate the sample size.[30] The formula was $n/k \geq 30$, where n is the number of samples used in the research per one variable[31] (k, which is nine), which yielded a sample size of 270 (n = 30 x 9). Assuming a dropout rate of 10%, we determined that 297 participants would be sufficient for this study. Therefore, the total number of participants in this study from two multidisciplinary buildings was 594.

The inclusion criteria required the participants to be first-year undergraduate students with a smartphone, access to the internet (at least one hour during the day), and a willingness to participate in this study. Subsequently, participants were recruited from each multidisciplinary building until the desired sample size was achieved. The Phayao Human Ethics Committee approved the study. Participants were recruited following a lecture break. They were first informed of the study's objectives and assured confidentiality of their data gathered between the May and July 2019 academic year. The average time for completing the questionnaire was approximately 10-20 minutes. Participants with more than 50% missing data were excluded from the analyses.

Instrumentation

A self-administered questionnaire developed and created by the researchers was based on a survey of relevant literature and similar studies.[3,5,6,32,33] The questionnaire consisted of three different sections. The first section comprised 10 items describing the demographic characteristics of the participants, including fields of study, gender, age, body mass index (BMI), underlying diseases, father's occupation, mother's occupation, financial status (financial support from parents), smartphone experience, and internet usage patterns. The second section comprised 15 items covering smartphone use in entertainment, education, and finance. These items were used to measure the

potentially excessive smartphone use of the participants. The final section of the study comprised 27 items covering four dimensions of health consequences, e.g., physical health consequences, mental health consequences, social health consequences, and spiritual health consequences. These items were used to evaluate participants' perceived health consequences of smartphone use.

The second and third sections assessed the frequency of behaviors and the respondents' perceived health consequences in the previous two weeks on a four-point Likert scale ranging from 1 = not at any time, 2 = occasionally, 3 = frequently, to 4 = continuously. The total scores were calculated by summing item scores for each section. Excessive smartphone use was classified using the summed score: 1.00-2.00 = low use, 2.01-3.00 = moderate use, and 3.01-4.00 = high use. The perceived health consequences of smartphone use were categorized using the summed score as follows: 1.00-2.00 = low health consequences, 2.01-3.00 = moderate health consequences, and 3.01-4.00 = high health consequences. Three experts from the School of Medicine and the School of Public Health reviewed and scored the questionnaire items to assess the content validity using the index of item-objective congruence (IOC). The questionnaire's internal consistency as the indicator of reliability was measured employing Cronbach's alpha coefficient derived from data of 30 pilot students not included in the main sample. The reliability coefficient for the entire excessive smartphone use questionnaire was 0.79 and ranged from 0.62-0.76 in terms of dimensions. The reliability of the entire questionnaire measuring perceived health consequences was 0.88 and ranged from 0.78 to 0.86 in terms of dimensions.

Statistical Analyses

Data collected from the study were organized and analyzed using the IBM SPSS Statistics software version 27.0. Cronbach's alpha coefficients were calculated to establish reliability. Socio-demographic characteristics, excessive smartphone use, and perceived health consequences were analyzed using descriptive statistics. The factors and excessive smartphone use associated with perceived health consequences were examined using univariate analysis. Additionally, a simple linear regression was undertaken to identify predictors of the perceived health consequences, and variables with p-value < 0.15 were then entered into the multiple linear regression. Using the Enter method, statistically significant variables at the 0.05 level were entered into the final model.

RESULTS

The study included 594 undergraduate participants. Four students were excluded because of incomplete data. Thus, the final study included 590 participants who were classified into three different fields of study: HSS (n = 350; 59.3%), ST (n = 149; 25.3%), and HS (n = 91; 15.4%). Furthermore, 79.2% were females, and 20.8% were males. The mean age was 18.8 ± 0.6 years, and the participants' average smartphone experience was 6.3 ± 1.73 years (Table 1).

Table 1 Demographic characteristics of groups by fields of study.

Variables	Overall n = 590	Fields of study n (%) HS n = 91	ST n = 149	HSS n = 350
Gender				
Female	123 (20.8)	31 (34.1)	35 (23.5)	57 (16.3)
Male	467 (79.2)	60 (65.9)	114 (76.5)	293 (83.7)
Age (years)				
18	170 (28.8)	24 (26.4)	47 (31.5)	99 (28.3)
19	344 (58.3)	59 (64.8)	97 (65.1)	188 (53.7)
20	76 (12.9)	8 (8.8)	5 (3.4)	63 (18.0)
Mean = 18.8, SD = 0.62, Max = 20, Min = 18				
BMI (kg/m^2)				
Underweight (<18.5)	146 (24.7)	12 (13.2)	36 (24.2)	98 (28.0)
Normal (18.5-22.9)	332 (56.3)	40 (44.0)	81 (54.4)	211 (60.3)
Overweight (23.0-24.9)	50 (8.5)	17 (18.6)	11 (7.4)	22 (6.3)
Obese (>24.9)	62 (10.5)	22 (24.2)	21 (14.0)	19 (5.4)
Mean = 20.7, SD = 3.40, Max = 38.1, Min = 16.0				
Underlying disease				
No	554 (93.9)	85 (93.4)	133 (89.3)	336 (96.0)
Yes	36 (6.1)	6 (6.6)	16 (10.7)	14 (4.0)
Father's occupation				
General worker	147 (24.9)	27 (29.6)	40 (26.8)	80 (22.9)
Agriculturist	141 (23.9)	24 (26.4)	34 (22.8)	83 (23.7)
Merchant/business owner	86 (14.6)	10 (11.0)	15 (10.1)	61 (17.4)
Government employee	165 (28.0)	21 (23.1)	43 (28.9)	101 (28.9)
Others (farmer, carpenter, mason)	51 (8.6)	9 (9.9)	17 (11.4)	25 (7.1)
Mother's occupation				
General worker	136 (23.1)	22 (24.2)	34 (22.8)	80 (22.9)
Agriculturist	136 (23.1)	19 (20.9)	33 (22.1)	84 (24.0)
Merchant/business owner	121 (20.5)	21 (23.1)	26 (17.4)	74 (21.1)
Government employee	146 (24.7)	18 (19.8)	37 (24.8)	91 (26.0)
Others (farmer, shopkeeper, seamstress)	51 (8.6)	11 (12.0)	19 (12.9)	21 (6.0)
Financial status (Baht/month)				
<3,000 ($ 94)	112 (19.0)	23 (25.3)	31 (20.8)	58 (16.6)
3,000-5,000 ($ 94-156)	268 (45.4)	43 (47.3)	63 (42.3)	162 (46.3)
>5,001 ($ 156)	210 (35.6)	25 (27.4)	55 (36.9)	130 (37.1)
Mean = 5,278.1 SD = 5,159.92 Max = 15,000 Min = 1,500				
Smartphone experience (years)				
<5	184 (31.2)	35 (38.5)	46 (30.9)	103 (29.4)
5-10	398 (67.5)	55 (60.4)	102 (68.5)	241 (68.9)
>10	8 (1.3)	1 (1.1)	1 (0.6)	6 (1.7)
Mean = 6.3, SD = 1.73, Max = 11, Min = 3				
Internet usage patterns				
H/3G/4G	316 (53.6)	52 (57.1)	74 (49.7)	190 (54.3)
WiFi	274 (46.4)	39 (42.9)	75 (50.3)	160 (45.7)

Note. HS: Health Sciences; ST: Science and Technology; HSS: Humanities and Social Sciences

Table 2 reveals that most participants reported either moderate (49.3%) or high (49.0%) overall smartphone use. The highest mean scores of excessive smartphone use were found in the HSS field (2.86 ± 0.36). Regarding the perceived health consequences, the results indicated that 76.1% of the participants were classified as having moderate levels. Moreover, participants in the field of HSS had the highest mean score, followed by ST and HS groups, respectively.

Interestingly, the highest mean scores emerged for excessive smartphone use and perceived health consequences across all dimensions in the HSS fields.

Table 2 Descriptive analysis of excessive smartphone use and perceived health consequences.

Variables	Overall n = 590	Fields of study n (%) HS n = 91	ST n = 149	HSS n = 350
Excessive smartphone use				
Low level	10 (1.7)	5 (5.5)	5 (3.4)	0 (0.0)
Moderate level	291 (49.3)	52 (57.1)	81 (54.4)	158 (45.1)
High level	289 (49.0)	34 (37.4)	63 (42.2)	192 (54.9)
Mean (SD)	2.73 (0.36)	2.62 (0.35)	2.62 (0.31)	2.81 (0.36)
Min-Max	1.77-3.75	1.77-3.47	1.88-3.42	1.86-3.75
Perceived health consequences				
Low level	11 (1.9)	4 (4.4)	3 (2.0)	4 (1.1)
Moderate level	449 (76.1)	73 (80.2)	127 (85.2)	249 (71.1)
High level	130 (22.0)	14 (15.4)	19 (12.8)	97 (27.8)
Mean (SD)	2.97 (0.36)	2.85 (0.47)	2.90 (0.48)	3.03 (0.39)
Min-Max	1.64-4.00	1.64-4.00	1.88-4.00	2.08-4.00

Note. HS: Health Sciences; ST: Science and Technology; HSS: Humanities and Social Sciences

Linear regression was used to identify excessive smartphone use and other variables associated with perceived health consequences. In the bivariate analysis, 11 variables were statistically significantly associated with perceived health consequences at less than the 0.15 level (Table 3). In the final model, the results revealed that four variables – body mass index, the father's occupation, the field of study, and excessive smartphone use – were significantly related to perceived health consequences (p-value < 0.05) (Table 4).

Table 3 Relationship between predictors and perceived health consequences from excessive smartphone use among fields of study by simple linear regression.

Variables	B	SE	Beta	p-value	95% CI
Gender	0.072	0.037	0.080	**0.052**	**-0.001, 0.145**
Age (years)					
18	-0.094	0.050	-0.116	**0.063**	**-0.193, 0.005**
19	-0.137	0.046	-0.185	**0.003**	**-0.228, -0.047**
20	Ref.				
BMI (kg/m^2)					
Underweight	0.020	0.036	0.023	0.589	-0.051, 0.090
Normal	Ref.				
Overweight	-0.058	0.055	-0.044	0.291	-0.166, 0.050
Obese	-0.170	0.050	-0.142	**0.001**	**-0.269, -0.071**
Underlying disease	-0.097	0.063	-0.063	**0.124**	**-0.221, 0.027**
Father's Occupation					
General worker	0.173	0.059	0.204	**0.003**	**0.058, 0.288**
Agriculturist	0.141	0.059	0.164	**0.017**	**0.025, 0.257**
Merchant/business owner	0.198	0.064	0.191	**0.002**	**0.073, 0.323**
Government employee	0.262	0.058	0.321	**< 0.001**	**0.148, 0.375**
Others	Ref.				

Variables	B	SE	Beta	p-value	95% CI
Mother's Occupation					
General worker	0.178	0.060	0.205	**0.003**	**0.062, 0.295**
Agriculturist	0.132	0.060	0.152	**0.027**	**0.015, 0.249**
Merchant/business owner	0.186	0.061	0.205	**0.002**	**0.067, 0.305**
Government employee	0.234	0.059	0.276	**< 0.001**	**0.118, 0.350**
Others	Ref.				
Financial status (Baht/month)	0.018	0.007	0.107	**0.009**	**0.004, 0.032**
Smartphone experience (years)	0.017	0.009	0.081	**0.049**	**0.000, 0.034**
Internet usage patterns	-0.095	0.030	-0.130	**0.002**	**-0.154, -0.036**
Excessive smartphone use (scores)	0.276	0.033	0.330	**< 0.001**	**0.212, 0.340**
Field of Study					
Health Sciences	Ref.				
Science and Technology	-0.001	0.047	-0.001	0.980	-0.094, 0.092
Humanities and Social Sciences	0.185	0.042	0.248	**< 0.001**	**0.103, 0.267**

Note. Bold texts: p-value < 0.15; Financial status (1,000 Bath/unit)

There was an inversely significant relationship between the obese group (BMI > 24.9 kg/m^2) and the perceived health consequences (β = -0.105, p-value < 0.05), with the perceived health consequences score being significantly lower in the obese group than in the normal group (BMI > 24.9 kg/m^2). The perceived health consequences score was significantly higher in two occupations associated with the father – government employee (p-value < 0.001) and general worker (p-value < 0.05). The model predicted that perceived health consequences were 0.088 points higher in the HSS group than in the HS group (p-value < 0.05). Moreover, increasing each excessive smartphone use score increased the perceived health consequences score by about 0.262 points (β = 0.314, p-value < 0.001) (Table 4).

When classified by field of study, the multiple linear regression analysis revealed that the excessive smartphone use score was significantly associated with perceived health consequences in all fields of study, as shown in Table 5. In the ST and HSS groups, excessive smartphone use and the father's occupation were significantly associated with perceived health consequences. Furthermore, the standardized coefficients between the excessive smartphone use and perceived health consequences scores were found to be highest in the HS field (0.485), followed by ST (0.378) and the HSS (0.228)

Table 4 Relationship between predictors and perceived health consequences from excessive smartphone use among fields of study by multiple linear regression.

Variables	B	SE	Beta	p-value	95% CI
Constant	1.781	0.147		**< 0.001**	**1.492, 2.071**
BMI (kg/m^2)					
Underweight	-0.017	0.034	-0.020	0.619	-0.084, 0.050
Normal	Ref.				
Overweight	-0.030	0.052	-0.023	0.564	-0.132, 0.072
Obese	-0.105	0.048	-0.088	**0.030**	**-0.199, -0.010**
Father's Occupation					
General worker	0.132	0.059	0.156	**0.025**	**0.016, 0.248**
Agriculturist	0.107	0.067	0.125	0.111	-0.025, 0.239
Merchant/business owner	0.118	0.067	0.113	0.077	-0.013, 0.248
Government employee	0.215	0.061	0.246	**< 0.001**	**0.096, 0.334**
Others	Ref.				
Excessive smartphone use (scores)	0.262	0.034	0.314	**< 0.001**	**0.196, 0.328**
Field of Study					
Health Sciences	Ref.				
Science and Technology	-0.034	0.045	-0.040	0.454	-0.123, 0.055
Humanities and Social Sciences	0.088	0.042	0.118	**0.037**	**0.005, 0.171**

Note. Bold texts: p-value < 0.05

Table 5 Relationship between excessive smartphone use and perceived health consequences from smartphone usage among groups by fields of study, multiple linear regression.

FS	Variables	B	SE	Beta	p-value	95% CI
HS	**Constant**	1.836	0.315		**< 0.001**	**1.208, 2.463**
	Financial status (Baht/month)	-0.065	0.018	-0.391	**0.001**	**-0.101, -0.028**
	Excessive smartphone use (scores)	0.364	0.078	0.485	**< 0.001**	**0.209, 0.520**
ST	**Constant**	1.735	0.277		**< 0.001**	**1.187, 2.2825**
	BMI (kg/m^2)					
	Underweight	-0.003	0.063	-0.003	0.967	-0.127, 0.121
	Normal	Ref.				
	Overweight	-0.077	0.097	-0.063	0.431	-0.269, 0.115
	Obese	-0.214	0.076	-0.234	**0.006**	**-0.365, -0.063**
	Father's Occupation					
	General worker	0.249	0.099	0.346	**0.014**	**0.052, 0.445**
	Agriculturist	0.226	0.113	0.298	**0.047**	**0.003, 0.450**
	Merchant/business owner	0.147	0.113	0.165	0.124	-0.048, 0.397
	Government employee	0.215	0.097	0.307	**0.028**	**0.024, 0.407**
	Others	Ref.				
	Excessive smartphone use (scores)	0.250	0.058	0.378	**< 0.001**	**0.135, 0.365**
HSS	**Constant**	1.783	0.228		**< 0.001**	**1.335, 2.231**
	Gender	0.121	0.052	0.121	**0.021**	**0.018, 0.224**
	Father's Occupation					
	General worker	0.084	0.086	0.096	0.326	-0.084, 0.252
	Agriculturist	0.050	0.092	0.058	0.583	-0.130, 0.231
	Merchant/business owner	0.062	0.094	0.063	0.514	-0.124, 0.247
	Government employee	0.225	0.090	0.277	**0.012**	**0.049, 0.402**
	Others	Ref.				
	Excessive smartphone use (scores)	0.212	0.048	0.228	**< 0.001**	**0.117, 0.308**

Note. FS: Fields of Study; HS: Health Sciences; ST: Science and Technology; HSS: Humanities and Social Sciences; Bold texts: p-value < 0.05; Financial status (1,000 Bath/unit)

DISCUSSION

This study focused on factors and excessive smartphone use associated with perceived health consequences among rural university students majoring in various fields. Scholars must understand the different health promotion and prevention practices in diverse study areas. Nearly all participants in this study exhibited moderate or high excessive smartphone use. Likewise, in a previous study conducted in Chiangmai (Northern Thailand), 45.8% of the students were categorized as excessive smartphone users.[19] Based on a review of the positive and negative effects of smartphone use on students, smartphones in the 21st century are seen as an essential part of university students' everyday lives because of their advanced features. Most students utilize smartphones for entertainment, social, and educational purposes.[18]

In particular, 54.9% of the students in the HSS group scored high on smartphone use. Furthermore, the HSS group had a greater proportion of users utilizing smartphones excessively compared to other groups. A previous study conducted in China also found that undergraduates in the humanities were more likely to use smartphones inappropriately, suggesting that undergraduates who were planning to major in the humanities while in high school are at greater risk of experiencing such adverse effects.[34] Indeed, a literature review revealed that only a few studies had examined the link between addiction and a student's field of study, supporting the findings of this study. Some of these studies have discovered that humanities students are more addicted to smartphones than physical science students.[32] In a study conducted by Long et al.[34], majoring in science vs. humanities was a significant predictor of problematic smartphone use in the final model (OR = 2.14, p-value < 0.001). Moreover, Zarei et al.[33] found that 90.2% of medical sciences students were not addicted to their smartphones and that only 9.8% were addicted to the internet. Specifically, when considering sub-elements, including entertainment, educational, and financial use, the findings indicated that students in the HSS field are more likely to use smartphones to accomplish various daily tasks than students in other fields. However, this finding calls for further investigation.

Over three-quarters of all participants were classified as having moderate perceived health consequences. Specifically, 27.7% of students in the HSS field reported the highest perceived health consequences from smartphone use compared to other groups. Moreover, the multiple linear regression analysis revealed that excessive smartphone use was significantly associated with perceived health consequences in all fields of study. This means that students with a higher score on excessive smartphone use are likely to experience perceived health consequences. A previous study in Turkey has shown that 71.2% of students declared having health problems related to smartphone usage. Insomnia and fatigue were revealed as the most common health complaint related to smartphone use.[3]

Furthermore, the mean scores for all perceived health consequence dimensions – physical, mental, social, and spiritual health – were the highest in the HSS group. The model predicted that perceived health consequences were 0.088 points higher in the HSS group than in the HS group (p-value < 0.05). One of the crucial reasons for the low mean perceived health consequences score in the HS and ST groups could be strong knowledge of the fundamentals of health and science among these students, enabling them to appraise potential harms and protect themselves by

taking actions, such as controlling excessive smartphone use, assessing initial health problems, and switching to other activities. Regarding the physical health dimension, this study's findings, together with those of a Thailand study,[26] suggest that university student smartphone users utilize a smartphone 3.55 ± 2.66 hours per day, a habit that leads to musculoskeletal disorders. The neck was the most painful body region after using smartphones for more than 12 months (32.50%). One common neck disorder was a flexed-neck posture (OR = 2.44, 95% CI = 1.21-4.90). Moreover, a study conducted in Korea[36] found that participants who were addicted to smartphones were more likely to have experienced accidents (OR = 1.90, 95% CI = 1.26-2.86), which included falling from a height, slipping (OR = 2.08, 95% CI = 1.10-3.91), or experiencing bumps and collisions (OR = 1.83, 95% CI = 1.16-2.87). Likewise, a growing body of evidence demonstrates excessive smartphone use or addiction is negatively associated with mental health problems among college students,[11, 19, 20] including depression,[10, 13, 14, 25, 28] anxiety,[4, 13, 14] stress,[25, 27] and nomophobia.[21, 29] On the other hand, normal smartphone use was negatively associated with mental health problems, indicating that reduced smartphone use can minimize such health problems. For instance, appropriate amounts of time spent on a smartphone were positively related to life satisfaction.[20, 22]

In addition, we found that other factors – such as financial status, body mass index, father's occupation, and gender – were significantly associated with perceived health consequences in different fields of study. This finding is similar to the results of other researchers. Coban et al.[35] demonstrated that smartphone addiction doubles the risk of obesity in university students. Consistent with the work of Zencirci et al.[3] and Long et al.[34] one risk factor for problematic smartphone use was better financial status of the family. However, it is unclear in this study why students whose fathers were government employees tended to have higher scores on perceived health consequences than those with fathers employed in other fields.

The results of this study should be considered in light of several limitations. First, because of a cross-sectional study design, causation could not be inferred. Second, our assessments of smartphone use and perceived health consequences were developed by researchers based on relevant literature and similar studies. Therefore, our findings cannot be compared with other smartphone addictions recorded using standard assessment forms. However, our assessments were valid and reliable. Finally, participants in the current study were from University of Phayao in the northern part of Thailand's rural area, which limits the generalizability of the results to other regions; therefore, large-scale studies with nationally representative samples are thus highly recommended in the future. Moreover, the participants were limited to undergraduate students. In this regard, undergraduate students are more vulnerable to excessive smartphone use and smartphone addiction. However, other vulnerable groups should also be recruited in future research studies.

CONCLUSION

Research on excessive smartphone use and perceived health consequences among rural university students in various fields of study in Thailand is still limited, as can be seen from past studies that have focused on the prevalence and the psychological and physical effects of smartphone use, time spent on smartphones, and activities conducted on smartphones. However, students' culture and use patterns in rural areas might differ from urban areas according to the study field. This research provides the first insights into the HSS graduates in rural

areas. Other fields of study might find different associations between excessive smartphone use by students and their perceived health consequences. According to the outcomes of this research, it is recommended that intervention be made to encourage and support appropriate smartphone usage behaviors. Strategies designed to promote and support appropriate smartphone use should be thoroughly investigated.

ACKNOWLEDGMENTS

The authors would like to acknowledge and express sincere appreciation to the various departments of the University of Phayao for their contributions to this study. We would especially like to thank the participants in this study for their time.

REFERENCES

1. Deloitte. Global mobile consumer trends [Internet]. 2017 [cited 2021 Jul 30]. Available from: https://www2.deloitte.com/global/en/pages/technology-media-and-telecommunications/articles/gx-global-mobile-consumer-trends.html.
2. Derks D, Bakker AB, Gorgievski M. Private smartphone use during worktime: A diary study on the unexplored costs of integrating the work and family domains. Comput Hum Behav Rep. 2021;114:106530. doi: 10.1016/j.chb.2020.106530.
3. Zencirci SA, Aygar H, Göktaş S, Önsüz MF, Alaiye M, Metintaş S. Evaluation of smartphone addiction and related factors among university students. Int J Res Med Sci. 2018;6(7):2210. doi: 10.18203/2320-6012.ijrms20182805.
4. Liu QQ, Yang XJ, Hu YT, Zhang CY, Nie YG. How and when is family dysfunction associated with adolescent mobile phone addiction? Testing a moderated mediation model. Child Youth Serv Rev. 2020;111:104827. doi: 10.1016/j.childyouth.2020.104827.
5. Boumosleh J, Jaalouk D. Smartphone addiction among university students and its relationship with academic performance. Glob J Health Sci. 2018;10(1):48-59.
6. Dikeç G, Kebapçı A. Smartphone addiction level among a group of university students. Bağımlılık Dergisi. 2018;19(1):1-9.
7. Narkprasit C. Innovative mobile technology application to enhance healthcare and quality of life for senior citizens in Bangkok, Thailand. J Public Hlth Dev. 2020;18(1):1-8.
8. Carbonell X, Chamarro A, Oberst U, Rodrigo B, Prades M. Problematic use of the internet and smartphones in university students: 2006–2017. Int J Environ Res Public Health. 2018;15(3):475. doi: 10.3390/ijerph15030475.
9. Lopez-Fernandez O, Kuss DJ, Romo L, Morvan Y, Kern L, Graziani P, et al. Self-reported dependence on mobile phones in young adults: A European cross-cultural empirical survey. J Behav Addict. 2017;6(2):168-77. doi: 10.1556/2006.6.2017.020.
10. Ng KC, Wu LH, Lam HY, Lam LK, Nip PY, Ng CM, et al. The relationships between mobile phone use and depressive symptoms, bodily pain, and daytime sleepiness in Hong Kong secondary school students. Addict Behav. 2020;101:105975. doi: 10.1016/j.addbeh.2019.04.033
11. Elhai, JD, Levine JC, Hall BJ. The relationship between anxiety symptom severity and problematic smartphone use: A review of the literature and conceptual frameworks. J Anxiety

Disord. 2019;62:45-52. doi: 10.1016/ j.janxdis.2018.11.005.
12. Elhai, JD, Yang H, Montag C. Cognitive-and emotion-related dysfunctional coping processes: transdiagnostic mechanisms explaining depression and anxiety's relations with problematic smartphone use. Curr Addict Rep. 2019;6.4:410-7. doi: 10.1007/s40429-019-00260-4
13. Kim YJ, Jang HM, Lee Y, Lee D, Kim DJ. Effects of internet and smartphone addictions on depression and anxiety based on propensity score matching analysis. Int J Environ Res Public Health. 2018;15(5):859. doi: 10.3390/ ijerph15050859
14. Elhai JD, Dvorak RD, Levine JC, Hall BJ. Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology. J Affect Disord. 2017;207:251-9. doi: 10.1016/ j.jad.2016.08.030.
15. Panova T, Carbonell X. Is smartphone addiction really an addiction?. J Behav Addict. 2018;7(2):252-9. doi: 10.1556/ 2006.7.2018.49
16. O'Dea S. Smartphone users by country worldwide [Internet]. 2021 [Cited 2021 Jul 30]. Available from: https://www. statista.com/statistics/748053/worldwi de-top-countries-smartphone-users/.
17. Office TNS. The 2020 Establishment Survey on the Use of Information and Communication Technology (Annually) [Internet]. 2020. [Cited 2021 Jul 29]. Available from: http://www.nso.go.th/sites/2014/Pages/ mass_media/info_mass1.aspx.
18. Singh MKK, Samah NA. Impact of smartphone: A review on positive and negative effects on students. Asian Soc Sci. 2018;14(11):83-9.
19. Tangmunkongvorakul A, Musumari PM, Thongpibul K, Srithanaviboonchai K, Techasrivichien T, Suguimoto SP, et al. Association of excessive smartphone use with psychological well-being among university students in Chiang Mai, Thailand. PLOS ONE. 2019;14(1):e0210294. doi: 10.1371/ journal.pone.0210294.
20. Kil N, Kim J, McDaniel JT, Kim J, Kensinger K. Examining associations between smartphone use, smartphone addiction, and mental health outcomes: A cross-sectional study of college students. Health Promot Perspect. 2021;11(1):36. doi: 10.34172/ hpp. 2021.06.
21. Argumosa-Villar L, Boada-Grau J, Vigil-Colet A. Exploratory investigation of theoretical predictors of nomophobia using the Mobile Phone Involvement Questionnaire (MPIQ). J Adolesc. 2017;56:127-35. doi: 10.1016/j.adolescence.2017.02.003.
22. Yang Z, Asbury K, Griffiths MD. An exploration of problematic smartphone use among Chinese university students: Associations with academic anxiety, academic procrastination, self-regulation and subjective wellbeing. Int J Ment Health Addict. 2019;17(3):596-614. doi: 10.1007/s11469-018-9961-1.
23. Mei S, Hu Y, Wu X, Cao R, Kong Y, Zhang L, et al. Health risks of mobile phone addiction among college students in China. Int J Ment Health Addict. 2022;1-16. doi: 10.1007/s11469-021-00744-3.
24. Pimpak T, Yoobua C, Limpiteeprakan P. Sleep quality among students at a high school in Sisaket Province, Thailand. J Public Hlth Dev. 2018; 16(1):63-74.
25. Kang Y, Liu S, Yang L, Xu B, Lin L, Xie L, et al. Testing the bidirectional associations of mobile phone addiction behaviors with mental distress, sleep disturbances, and sleep patterns: a one-year prospective study among Chinese college students. Front. 2020;11:634. doi: 10.3389/fpsyt.2020.00634.
26. Namwongsa S, Puntumetakul R, Neubert MS, Boucaut R. Factors associated with neck disorders among

university student smartphone users. Work. 2018;61(3):367-78. doi: 10.3233/Wor-182819.
27. Gligor Ș, Mozoș I. Indicators of smartphone addiction and stress score in university students. Wien Klin Wochenschr. 2019;131(5):120-5. doi: 10.1007/s00508-018-1373-5.
28. Ithnain N, Ghazali SE, Jaafar N. Relationship between smartphone addiction with anxiety and depression among undergraduate students in Malaysia. Int J Health Sci. 2018;8:163-71.
29. Servidio R. Self-control and problematic smartphone use among Italian University students: The mediating role of the fear of missing out and of smartphone use patterns. Curr Psychol. 2019:1-11. doi: 10.1007/s12144-019-00373-z.
30. Cochran WG. Sample Techniques. New York: McGraw-Hill Book; 1985. p. 31.
31. Kerlinger FN, Pedhazur EJ. Multiple Regresssion in Bahavioral Research. New York: Holt, Rinchart and Winton; 1973.
32. Al-Barashdi HS, Bouazza A, Jabur NH. Smartphone addiction among university undergraduates: a literature review. J Sci Res Rep. 2015:210-25.
33. Zarei S, Azodi P, Fatahi T, Azodi F, Mahmoodi M, Jahanpour F. Relationship between internet addiction and identity styles in bushehr university of medical sciences students. J Educ Community Health. 2021;8(1):29-33. doi: 10.52547/jech.8.1.29
34. Long J, Liu TQ, Liao YH, Qi C, He HY, Chen SB, et al. Prevalence and correlates of problematic smartphone use in a large random sample of Chinese undergraduates. BMC psychiatry. 2016;16(1):1-12. doi: 10.1186/s12888-016-1083-3
35. Coban, Deniz Adnan. Investigation of the relationship between smartphone addiction and overweight on university students. 2019;26(10):2172-6.
36. Kim HJ, Min JY, Kim HJ, Min KB. Accident risk associated with smartphone addiction: A study on university students in Korea. J Behav Addict. 2017;6(4):699-707. doi: 10.1556/2006.6.2017.070