



# Effects of internet addiction and smartphone addiction on the sleep quality of students of the Faculty of Public Health, University of Medicine and Pharmacy at Ho Chi Minh City in 2023

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## Abstract

**Introduction:** Internet addiction and smartphone addiction are global dilemmas. Excessive misuse of smartphones or the internet can adversely affect users' health, psychological, spiritual, and quality of life. On the other hand, sleep has been considered one of the factors that make people's lives and spirits the most comfortable. However, smartphone and internet addiction can adversely affect users' sleep, especially in adolescents who are easily tempted and love to learn. Therefore, this study was conducted to determine the influence of smartphone and internet addiction on students' sleep quality.

**Methods:** This was a cross-sectional study conducted on students in the field of public health. The data were collected through a set of self-filling questionnaires with three scales to assess: Smartphone Addiction Scale-Short Version (SAS-SV), Internet Addiction Test (IAT), and Pittsburgh Sleep Quality Index (PSQI).

**Results:** The results recorded 718 students participating in the study, with 67.1% female students. Students with smartphone addiction accounted for 47.4%, and internet addiction accounted for 54.9%, including 95.7% of students with mild to moderate addiction. Students with internet addiction had 1.72 times poorer sleep quality than students who were not addicted to the internet (95% confidence interval (CI): 1.36–2.17). There was no association between smartphone addiction and students's sleep quality ( $p=0.391$ ).

**Conclusions:** Students need to be informed to better understand the harmful effects of internet addiction to improve sleep quality.

**Keywords:** internet addiction disorder; smartphone addiction; sleep quality; cross-sectional studies; students

## 1. INTRODUCTION

The internet and smartphones are two of the most popular and strongly developing electronic technology industries

in Vietnam and globally. According to Internet World Stars News statistics for 2021, there were more than 5 billion internet users, accounting for 65.6% of the world's population [1]. In addition, a smartphone is a mobile device capable of

Received: Sep 14, 2023 / Revised: Jul 18, 2024 / Accepted: Jul 22, 2024

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accessing the internet in any environment and at any time. According to Statista's 2021 data, about 6.4 billion people were using smartphones, and it is estimated that by 2026, this number could reach 7.5 billion people [2]. With the strong development of smartphones and the internet, it is inevitable that people will have a high demand for these technologies. However, overuse of the internet or smartphones can lead to internet or smartphone addiction, which adversely affects user's health [3,4], including mental disorders, depression, or the overall well-being, especially in relation to sleep [4,5].

Nowadays, the use of the internet and smartphones has become commonplace among teenagers and young adults [6,7]. According to some figures in Turkey, 96.7% of people aged 16–24 used smartphones, and 95.7% reported using the internet [8]. Many studies have also shown the relationship between internet addiction and/or smartphone addiction and their effects on sleep as well as the quality of sleep in teenagers [9–11].

In Vietnam, there have not been many studies investigating how the link between smartphone addiction and internet addiction affects sleep quality; only a few studies have shown a separate link between smartphone addiction or internet addiction and quality of sleep [12,13]. While sleep is one of the basic human activities that can affect the quality of life, its importance is often overlooked.

Students in the Faculty of Public Health at the University of Medicine and Pharmacy at Ho Chi Minh City regularly use the internet to search for documents and stay updated on current news. In addition to mobile devices, smartphones are an indispensable tool for students engaged in learning and clinical practice. Therefore, these students may be particularly susceptible to the negative effects of internet and smartphone addiction on sleep quality.

For these reasons, the team carried out the topic "Effects of internet addiction and smartphone addiction on the sleep quality of students of the Faculty of Public Health, University of Medicine and Pharmacy at Ho Chi Minh City in 2023" with the goal of determining internet addiction, smartphone addiction, and poor sleep quality in students of the Faculty of Public Health and the associations between internet addiction, smartphone addiction, and sleep quality in students. The results from the study will provide information to have a

basis for developing solutions to help students use the internet or smartphone more appropriately, improve the quality of sleep for students, and improve student health.

## 2. METHODS

### 2.1. Study design & setting

A cross-sectional study was conducted between March 2023 and June 2023 among a sample of full-time students enrolled in the first to sixth years at the Faculty of Public Health, University of Medicine and Pharmacy at Ho Chi Minh City.

The study used a self-administered questionnaire that included individual characteristics and three main components of characteristics and scales for surveying Smartphone Addiction Scale-Short Version (SAS-SV) with 10 questions, Internet Addiction Test (IAT) with 20 questions, and Pittsburgh Sleep Quality Index (PSQI) with 19 questions for data collection.

### 2.2. Participants

The sample size estimation in this study was conducted using a formula that estimates a proportion of the population:

$$n \geq \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

To ensure a 95% confidence interval ( $\alpha=0.05$ ) in the estimation of the percentage ( $p$ ) of students with poor sleep quality [14] at 47.9% with a margin of error ( $d$ ) of 5%, a minimum sample size ( $n$ ) of 384 students was determined.

The study used a whole sample selection technique to select students enrolled in the Faculty of Public Health who were at least 18 years old. Students who used smartphones and the internet and agreed to participate in the study were selected for the research sample; in addition, students who did not complete the SAS-SV, IAT, or PSQI scales were excluded from the study.

Students were selected according to the entry and exit criteria to limit selection bias. All students who met the selection criteria for the study completed a survey using a pre-prepared self-administered questionnaire.

### 2.3. Variables

Variables investigated in the study include background variables: age, gender (male or female), major (Preventive Medicine, Nutrition, or Public Health), year of study (from the first year to the sixth year), academic ability (from weak to excellent), current residence (family, motel, or dormitory), and smartphone usage characteristics, and internet usage characteristics. Independent variables were smartphone addiction, internet addiction. While the outcome variable was students' sleep quality.

#### 2.3.1. Smartphone addiction scale – short version (SAS-SV)

The study used the SAS-SV scale of Min Kwon (2013) to consider whether or not to be addicted to smartphones [15]. The total scale score ranged from 10 to 60 points, with a cut point of 31 points for men and 33 points for women. Smartphone addiction was identified as follows:

*Smartphone addiction:* total SAS-SV score  $\geq 31$  in men and  $\geq 33$  in women.

*No smartphone addiction:* total SAS-SV score  $< 31$  in men and  $< 33$  in women.

The scale has been translated into Vietnamese by the author group.

#### 2.3.2. Internet addiction test (IAT)

Internet addiction has been assessed on an IAT scale of 20 questions [16]. The score of each statement ranged from 1 to 5, corresponding to the following frequency categories: never, rarely, occasionally, often, always. Internet addiction has been identified as follows:

*Internet addiction:* total IAT score  $\geq 50$  points.

*No internet addiction:* total IAT score  $< 50$  points.

Level of internet addiction:

*No addiction:* total IAT score  $< 50$ .

*Lightness-medium level:* total IAT score from 50 to 79.

*Heavy level:* total IAT score  $\geq 80$  points.

#### 2.3.3. Pittsburgh sleep quality index (PSQI)

The quality of sleep has been assessed by the PSQI scale. The Vietnamese version of the PSQI scale was translated by

author To Minh Ngoc and assessed as having a high level of reliability, with no issues or disagreements reported when used on patients in Vietnam [17]. The scale consisted of 19 questions organized into seven components. Each component had levels of 0–3 points. The general sleep quality score of seven components, ranging from 0 to 21 points. The quality of sleep was assessed as follows:

*Poor sleep quality:* total PSQI score  $\geq 5$  points.

*Good sleep quality:* total PSQI score  $< 5$  points.

The PSQI scale has been translated by Suzhou et al. and found to be reliable and valid.

The questionnaire was built with a clear, well-informed structure that was targeted, easy to understand, and easy to answer. The collected information was retested and cleaned to limit information bias.

### 2.4. Bias

The IAT scale is used to assess internet addiction; however, the scale only generally determines whether students are addicted to the internet, without distinguishing between different types of internet addiction.

The IAT and SAS-SV scales are translated from English to Vietnamese, so there may be some misunderstandings in the questions. However, when conducting the survey, the research team clearly explained to the participants.

### 2.5. Statistical method

Categorical variables are presented using frequency and percentage (%). The Wilson score interval method was used to calculate the 95% confidence interval (CI) for the variables “Smartphone addiction” and “Internet addiction”. Continuous variables are presented as mean  $\pm$  SD. The Chi-square test or Fisher's exact test was used to determine the relationship between background variables, independent variables, and outcome variables. Fisher's exact test serves as an alternative when the expected frequency in more than 20% of cells is less than 5, or when any cell has an expected frequency of less than 1.

The study used the prevalence ratio (PR) with a 95% CI to evaluate the association between background variables, independent variables, and outcome variables. Regarding the

analysis of the PSQI score, a Poisson multivariate regression model was used to control for confounding factors in the study due to its suitability for modeling count data, especially when the data are non-negative integers and the variance is approximately equal to the mean. Potential confounding factors considered in the model are grouped as follows: Background variables: age, gender (male or female), major (Preventive Medicine, Nutrition, or Public Health), year of study (from first to sixth year), academic performance (from weak to excellent), current residence (family, rental, or dormitory), characteristics of smartphone usage, and characteristics of internet usage. Independent variables: smartphone addiction, internet addiction. Outcome variable: students' sleep quality.

## 2.6. Ethical considerations

The research was conducted entirely with the voluntary participation of students. All personal information and data collected were encrypted, kept confidential, and used solely for scientific research purposes. Students participating in the research were provided with comprehensive information about the content, purpose, benefits, and risks of the study. Before participating, students were given full contact information for the researcher to address any questions or complaints during their participation. The study did not record full names, contact details, or identifying information unless the student provided explicit consent. Students had the option to refuse to answer any questions or to withdraw from the study at any time during the questionnaire. Completing the questionnaire took approximately 10–15 minutes.

The study protocol was approved in terms of medical ethics by the ethics committee in biomedical research, University of Medicine and Pharmacy at Ho Chi Minh City, No. 309/HDDD-DHYD, signed on March 14, 2022.

## 2.7. CROSS checklist adherence

This study adhered to the CROSS (Checklist for Reporting of Survey Studies) checklist in order to ensure the development of a comprehensive manuscript that facilitates a thorough understanding and critical evaluation by readers [18].

## 3. RESULTS

In 2023, the total enrollment of the Faculty of Public Health was 1,116 students. At the time of data collection, 844 students were present, of whom 94 declined to participate in the study, leaving 750 who agreed to participate in the survey. After collecting 750 survey responses, 32 students were excluded from the research due to incomplete responses to the SAS-SV, IAT, and PSQI scales. Ultimately, 718 students remained in the study sample for analysis. The response rate was approximately 88.9%.

### 3.1. Personal characteristics of students

The average age of students participating in the study was  $21.3 \pm 2.0$  years old, of which 32.9% were male and 67.1% were female. Preventive Medicine has the highest percentage of students participating in research, while Public Health made up the lowest. In addition, there was no significant difference in the academic year of the students participating in the study; however, the 5th and 6th years were only in Preventive Medicine, which accounted for the lowest rate in the study. Students with good academic standing had the highest rate of 52.8%. Additionally, 47.5% of students lived with their families, and students living in hostels accounted for 42.1% (Table 1).

### 3.2. Characteristics of using the smartphone

The students participating in the study had an average smartphone use time of  $7.4 \pm 2.6$  years. Most students used smartphones to access social networks for learning purposes, exercise, and entertainment. Students with an average smartphone use time of 5 hours or more per day accounted for 78.3%. Most students used smartphones after waking up, of whom 89.6% had 30 minutes of use or less. In addition, 94.6% of students who used smartphones before sleeping for a duration of more than 30 minutes accounted for the highest percentage (Table 2).

According to the SAS-SV scale, the research results showed that out of 718 students participating in the survey, there were 340 students were identified as having smartphone addiction, accounting for 47.4% with a 95% CI of

**Table 1. Personal characteristics of students (n=718)**

Personal characteristics	Frequency	Percentage (%)
Age <sup>1)</sup>	21.3±2.0	
Gender		
Male	236	32.9
Female	482	67.1
Majors		
Preventive medicine	435	60.6
Nutrition	168	23.4
Public health	115	16.0
School year		
Freshman	166	23.1
2 <sup>nd</sup> year	129	18.0
3 <sup>rd</sup> year	148	20.6
4 <sup>th</sup> year	133	18.5
5 <sup>th</sup> year	70	8.8
6 <sup>th</sup> year	72	10.0
Academic ability		
Excellent	19	2.7
Good	98	13.6
Rather	379	52.8
Medium	193	26.9
Weak	29	4.0
Current residence		
Family	341	47.5
Motel	302	42.1
Dormitory	66	9.2
Other	9	1.2

<sup>1)</sup> Mean±SD.

0.44–0.51 (Table 2).

### 3.3. Characteristics of using the internet

Research results showed that students spent an average of 6.8±3.5 hours per day using the internet, mainly for studying, accessing social networks, and serving entertainment needs. The majority of students used mobile phones (97.2%) and personal computers (74.6%) to access the internet (Table 3).

Out of a total of 718 students participating in the study, 54.9% of students had internet addiction according to the IAT scale, with a 95% CI of 0.51–0.59, of which students with mild–moderate addiction accounted for the highest percentage (95.7%) and 4.3% had severe internet addiction (Table 3).

**Table 2. Smartphone usage characteristics and smartphone addiction rate (n=718)**

Variables	Frequency	Percentage (%)	
Smartphone usage time (year) <sup>1)</sup>	7.4±2.6		
Purpose of use			
Social network	686	95.5	
Study	677	94.3	
Entertainment	671	93.5	
Basic calling, texting	641	89.3	
Average smartphone usage in a day (hr)			
<5 hr	156	21.7	
≥5 hr	562	78.3	
Use smartphone after waking up (yes)	713	99.3	
Average use time after waking up			
≤30 min	536	89.6	
>30 min	62	10.4	
Use smartphone before sleeping (yes)	678	94.6	
Average time used before sleeping			
≤30 min	316	46.6	
>30 min	362	53.4	
Variables	Frequency	Ratio (%)	CI 95%
Smartphone addiction			
No	378	52.6	
Yes	340	47.4	44–51

<sup>1)</sup> Mean±SD.  
CI, confidence interval.

### 3.4. Sleep quality status according to the Pittsburgh Sleep Quality Index (PSQI) scale

The average score of students’ sleep quality according to the PSQI scale was 5.2±2.9 points; the percentage of students with poor sleep quality was still relatively high (39.7% with a 95% CI: 0.36–0.43; Table 4).

### 3.5. Relationship between smartphone addiction, internet addiction, and sleep quality

Using a Poisson multivariable regression model to control for personal characteristics, smartphone addiction, and internet addiction, the results showed that there was a significant association between internet addiction and poor sleep quality. Accordingly, students with internet addiction were 1.72-times more likely to have poor sleep quality compared to students

**Table 3.** Features of using the internet and internet addiction rate (n=718)

Variables	Frequency	Percentage (%)	
Internet usage time per day (hr/day) <sup>1)</sup>		6.8±3.5	
Purpose of using the internet			
Social network	690	96.1	
Study	699	97.4	
Entertainment	677	94.3	
Basic calling, texting	583	81.2	
Internet facilities			
Mobile phone	698	97.2	
Personal computer	536	74.6	
Tablet	181	25.2	
Fixed computer at home	50	7.0	
Computer at a paid internet access point	35	4.9	
Variables	Frequency	Percentage (%)	CI 95%
Internet addiction			
No	324	45.1	51–59
Yes	394	54.9	
Internet addiction level			
Light-Medium	377	95.7	
Heavy	17	4.3	

<sup>1)</sup> Mean±SD.

CI, confidence interval.

**Table 4.** Sleep quality status according to the PSQI scale (n=718)

Variables	Frequency	Percentage (%)	CI 95%
Sleep quality			
Sleep quality score		5.2±2.9 <sup>1)</sup>	
Poor sleep quality	433	60.3	0.36–0.43
Good sleep quality	285	39.7	

<sup>1)</sup> Mean±SD.

PSQI, Pittsburgh Sleep Quality Index; CI, confidence interval.

without internet addiction ( $p < 0.001$ , 95% CI: 1.36–2.17). In addition, the results also recorded that the 2nd year students were 43% less likely to have poor sleep quality compared to the 1st year students ( $p = 0.002$ , 95% CI: 0.40–0.81). Smartphone addiction was not associated with the poor sleep quality of students ( $p > 0.05$ ) (Table 5).

When considering the interaction and confounding of smartphone addiction and internet addiction on sleep quality, the results showed that smartphone addiction was not interactive and was not a confounding factor in the relationship

**Table 5.** Poisson multivariate regression model of personal characteristics, smartphone addiction, and internet addiction with sleep quality

Variables	PR	CI 95%	p-value
Smartphone addiction			
No	1		
Yes	1.10	0.89–1.35	0.381
Internet addiction			
No	1		
Yes	1.72	1.36–2.17	<0.001
Majors			
Preventive medicine	1		
Public health	1.08	0.83–1.40	0.564
Nutrition	0.91	0.72–1.16	0.457
School year			
Freshman	1		
2 <sup>nd</sup> year	0.57	0.40–0.81	0.002
3 <sup>rd</sup> year	0.89	0.69–1.15	0.381
4 <sup>th</sup> year	0.94	0.72–1.23	0.665
5 <sup>th</sup> year	0.72	0.49–1.05	0.085
6 <sup>th</sup> year	0.98	0.73–1.33	0.920
Academic ability			
Excellent-good	1		
Rather	0.91	0.72–1.15	0.434
Medium-weak	0.91	0.69–1.19	0.476
Current residence			
Family	1		
Without family	0.96	0.81–1.16	0.706

PR, prevalence ratio; CI, confidence interval.

between internet addiction and sleep quality of students ( $p = 0.125$ , crude PR value=1.84, PR M-H value=1.72, difference between crude PR and adjusted PR=6.4% (<10%)) (Table 6).

However, internet addiction was noted in the study as a confounding factor in the association between smartphone addiction (crude PR value=1.44, PR M-H value=1.08, crude PR and adjusted PR=33.3% (>10%)) and students's sleep quality, but there was no interaction with smartphone addiction ( $p = 0.126$ ) (Table 7).

## 4. DISCUSSION

### 4.1. Personal characteristics

The study was conducted on Public Health students at the

**Table 6.** The relationship between smartphone addiction and smartphone use characteristics of students

Variables	Smartphone addiction		p-value	PR (CI 95%)
	Yes	No		
Smartphone usage time (year) <sup>1)</sup>	7.5±2.6	7.2±2.5	0.140	1.02 (0.99–1.05)
Purpose of use				
Social network				
No	14 (43.7)	18 (56.3)		1
Yes	326 (47.5)	360 (52.5)	0.676	1.09 (0.73–1.62)
Study				
No	23 (56.1)	18 (43.9)		1
Yes	317 (46.8)	360 (53.2)	0.248	0.83 (0.63–1.11)
Entertainment				
No	25 (53.2)	22 (46.8)		1
Yes	315 (46.9)	356 (53.1)	0.407	0.88 (0.67–1.17)
Basic calling, texting				
No	37 (48.1)	40 (51.9)		1
Yes	303 (47.3)	338 (52.8)	0.897	0.98 (0.77–1.26)
Average smartphone usage in a day (hr)				
<5 hr	52 (33.3)	104 (66.7)	<0.001	1
≥5 hr	288 (51.3)	274 (48.7)		1.54 (1.21–1.95)
Use smartphone after waking up				
No	2 (40.0)	3 (60.0)	0.550	1
Yes	338 (47.4)	375 (52.6)		1.18 (0.40–3.48)
Average use time after waking up				
≤30 min	259 (48.3)	277 (51.7)	0.090	1
>30 min	37 (59.7)	25 (40.3)		1.24 (0.99–1.54)
Use smartphone before sleeping				
No	10 (25.6)	29 (74.4)	0.005	1
Yes	329 (48.5)	349 (51.5)		1.89 (1.10–3.25)
Average time used before sleeping				
≤30 min	127 (40.2)	189 (59.8)	<0.001	1
>30 min	203 (56.1)	159 (43.9)		1.40 (1.19–1.64)

<sup>1)</sup> Mean±SD.

PR, prevalence ratio; CI, confidence interval.

University of Medicine and Pharmacy at Ho Chi Minh City, and the results indicated that the average age of the students in the study (21.3 years old) was consistent with the average age of students at the University of Medicine and Pharmacy at Ho Chi Minh City. The proportion of female students in the study was 67.1%, which is similar to the ratio of male and female Public Health students at the University of Medicine and Pharmacy at Ho Chi Minh City. Moreover, most students participating in the study were Preventive Medicine students, accounting for 60.6%; in addition, there was not much difference in the rate of student participation in the

study in academic years (Table 1). The study found that students with good academics accounted for a high percentage, indicating that their academic performance was quite good. Most students were not dependent on their families; this is suitable for the lifestyle of students in various provinces who lived in dormitories or boarding rooms.

#### 4.2. Characteristics of using the smartphone

The average time that a student used a smartphone was high, at 7.4 years. With the development of technology, the time students have spent using phones is quite reasonable.

**Table 7. The relationship between internet addiction and internet use characteristics of students**

Variables	Internet addiction frequency (%)		p-value	PR (CI 95%)
	Yes	No		
Internet usage time per day (hr/day) <sup>1)</sup>	7.1±3.5	6.6±3.5	0.036	1.02 (1.01–1.04)
Purpose				
Social network				
No	8 (28.6)	20 (71.4)	0.004	1
Yes	386 (55.9)	304 (44.1)		
Study				
No	11 (57.9)	8 (42.1)	0.789	1
Yes	383 (54.8)	316 (45.2)		
Entertainment				
No	17 (41.5)	24 (58.5)	0.076	1
Yes	377 (55.7)	300 (44.3)		
Basic calling, texting				
No	71 (52.6)	64 (47.4)	0.554	1
Yes	323 (55.4)	260 (44.6)		
Internet facilities				
Mobile phone				
No	8 (40.0)	12 (60.0)	0.175	1
Yes	386 (55.3)	304 (44.7)		
Personal computer				
No	80 (44.2)	101 (55.8)	0.001	1
Yes	314 (58.5)	223 (41.5)		
Tablet				
No	290 (54.1)	246 (45.9)	0.447	1
Yes	104 (57.1)	78 (42.9)		
Fixed computer at home				
No	365 (54.6)	303 (45.4)	0.645	1.06 (0.83–1.36)
Yes	29 (58.0)	21 (42.0)		
Computer at a paid internet access point				
No	373 (54.6)	310 (45.4)	0.532	1.10 (0.83–1.45)
Yes	21 (60.0)	14 (40.0)		

<sup>1)</sup> Mean±SD.

PR, prevalence ratio; CI, confidence interval.

They mainly used smartphones to access social networks, for learning, and for entertainment. The features integrated into smartphones are convenient for them anywhere, anytime, so students prefer to choose smartphones to fulfill these needs.

On average, students using smartphones daily for 5 hours or more accounted for a high percentage (78.3%), which is higher than the study of Matar [19] in Lebanon at 49.0%. In addition, the majority of students using the phone after waking up and having a use time of 30 minutes or less made up a significant percentage, which was higher than the research

of Thao [20], with 37.6% of students using their phones between 5 to 30 minutes after waking up. Furthermore, the study also found that the percentage of students using smartphones before sleeping for more than 30 minutes was noticeable, which was quite similar to the research results of Thao [20], with the rate of using smartphones over 30 minutes accounting for 46.3%.

### 4.3. Characteristics of using the internet

The average time that students used the internet daily was



about 6.8 hours, which was lower than the time students used smartphones in each day. Additionally, this result was higher than the previous result in the research of Thao [21] in 2016 at the University of Medicine and Pharmacy at Ho Chi Minh City, with the main purpose of learning, entertainment, and accessing social networking sites. The means of access were mainly mobile phones and personal computers. This result was similar to the study of Kolaib [22] in 2019, showing that 95.8% of students used mobile phones to access the internet, as well as the results of the authors Hieu [23] and Kha [24] in Phu Yen, Vietnam, which also reported similar findings.

#### **4.4. Smartphone addiction rate**

The research results showed that the percentage of students with smartphone addiction was relatively high (47.4%). This rate was quite similar to the study on smartphone addiction in India [25], which was 44.7% and higher than the percentage of students addicted to mobile phones in the study in Turkey [3] (34.6%) and of the author Thanh's study [13] (33.3%). This difference may be due to the advancement of science and technology, the introduction of new phone lines, and improved features, leading to an increased usage rate, which could contribute to a rise in the prevalence of smartphone addiction. Therefore, students need to have reasonable smartphone usage time and manage their time effectively to limit smartphone addiction and improve their health.

#### **4.5. Internet addiction**

A remarkable record was that the rate of internet addiction among students is quite high compared to previous studies conducted on the same subject, such as the study by author Ngoc [26] at Hai Phong Medical University, where the rate of internet addiction was 38.5%; at the University of Medicine and Pharmacy at Ho Chi Minh City in 2015, by author Thanh [27], the rate was 13.9%; and in the study by Thao [21] in 2016 was 17.2%. The high rate of internet addiction can be attributed to the increasing development of the internet, the rising demand for information, and the updating of news by users. In addition, the research results showed that most students had a mild to moderate addiction to the internet, so it is necessary to implement interventions such as managing

and regulating internet access time to limit excessive use, which can lead to addiction and adversely affecting students' health.

#### **4.6. Sleep quality status**

According to the PSQI scale, the average score of students' sleep quality was 5.2 points; this score is lower than the study of author Thao [20] (5.58 points). Additionally, students with poor sleep quality accounted for a low percentage (39.7%), which indicates that students' sleep quality is improving. However, there were still some problems that prevented students' sleep, and this rate is lower than the poor sleep rate of Thao [20] (44.79%); this difference may be due to the different survey times of the studies. Furthermore, this rate is also lower than studies in India [28] (63.39%) by author Ozcan [29] (52.4%). This finding shows that the sleep quality of the students in the study was quite good, but there were still problems that were not resolved, so students need to have a reasonable evening routine to improve their sleep.

#### **4.7. Relationship between smartphone addiction, internet addiction, and sleep quality**

The study also recorded an interesting result: internet addiction is a confounding factor in the association between smartphone addiction and students' sleep quality.

After controlling for potential confounding factors, the study found that internet addiction was indeed associated with students' sleep quality, while smartphone addiction was not, indicating that students with internet addiction had worse sleep quality than students without internet addiction. This is also consistent with reports that the mechanism through which internet addiction cause sleep disturbance is long-term exposure to light emitted by electronic devices, leading to inhibition of melatonin hormone secretion, a hormone that plays an important role in sleep, thereby disrupting the human circadian clock [30]. In addition, the brain is overexcited by using the internet for a long time, which can lead to a series of sleep problems such as difficulty falling asleep, waking up easily, and poor sleep quality [31]. Moreover, the results also showed that second-year students were associated with poor sleep quality. This result is quite similar

to the results of a study by author Acikgoz [32] conducted in Turkey that found that internet addiction and smartphone addiction are related to students' sleep quality. However, the difference in the association between smartphone addiction and sleep quality in the two studies may be caused by the different sample sizes and population characteristics in each country. Another reason could be the difference in smartphones usage habits, as well as the time and purpose of using a smartphone.

Besides the results obtained, the study also has some limitations. First, the data collected were from self-completed questionnaires completed by students, which can lead to information errors due to recall. Second, the SAS-SV and IAT scale questionnaires were self-translated by the authors, so there might be some questions that students may misunderstand. Third, the IAT scale only generally assesses whether a person is addicted to the internet or not; it cannot differentiate between addiction to a smartphone and that to a desktop or other tools.

## 5. CONCLUSION

In summary, the study recorded that the prevalence of smartphone addiction and internet addiction among students of the Faculty of Public Health at the University of Medicine and Pharmacy at Ho Chi Minh City was quite high. In addition, the study found an association between internet addiction and the sleep quality of students but did not find an association between smartphone addiction and the sleep quality of students. With this result, the research team hopes that the school and students will gain a more comprehensive view of student's smartphone addiction as well as internet addiction so that measures can be taken to avoid affecting the mental and physical health of students.

### Acknowledgements

The research team would like to sincerely thank the Faculty of Public Health at the University of Medicine and Pharmacy at Ho Chi Minh City for facilitating and helping the study be carried out and collecting adequate data.

### Funding sources

The research received funding from the potential project of the University of Medicine and Pharmacy at Ho Chi Minh City digital contract 186/2022/HD - DHYD led by Msc. Quang Minh Lam.

### Conflict of interest

No potential conflict of interest relevant to this article was reported.

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### Availability of data and material

Upon reasonable request, the datasets of this study can be available from the corresponding author.

### Ethics approval

The study protocol was approved in terms of medical ethics by the ethics committee in biomedical research, University of Medicine and Pharmacy at Ho Chi Minh City, No. 309/

HDDD-DHYD, signed on March 14, 2022.

## REFERENCES

1. Internet World Stats News. Internet 2021 usage in Asia 2021 [Internet]. 2021 [cited 2024 Aug 4]. <https://www.statista.com/statistics/265153/number-of-internet-users-in-the-asia-pacific-region/>
2. Statista. Number of smartphone mobile network subscriptions worldwide from 2016 to 2023, with forecasts from 2023 to 2028 [Internet]. 2023 [cited 2024 Aug 4]. <https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/#statisticContainer>
3. Pawlikowski M, Altstötter-Gleich C, Brand M. Validation and psychometric properties of a short version of Young's Internet Addiction Test. *Comput Hum Behav*. 2013;29(3):1212-23.
4. Wang W, Du X, Guo Y, Li W, Zhang S, Guo L, et al. Association between problematic Internet use and behavioral/emotional problems among Chinese adolescents: the mediating role of sleep disorders. *PeerJ*. 2021;9:e10839.
5. Lin PH, Lee YC, Chen KL, Hsieh PL, Yang SY, Lin YL. The relationship between sleep quality and Internet addiction among female college students. *Front Neurosci*. 2019;13:599.
6. Choi SW, Kim DJ, Choi JS, Ahn H, Choi EJ, Song WY, et al. Comparison of risk and protective factors associated with smartphone addiction and Internet addiction. *J Behav Addict*. 2015;4(4):308-14.
7. Lee H, Kim JW, Choi TY. Risk factors for smartphone addiction in Korean adolescents: smartphone use patterns. *J Korean Med Sci*. 2017;32(10):1674-9.
8. Turkish Statistical Institute. Turkish Statistical Institute survey on information and communication technology (ICT) usage in households and by individuals, 2021 [Internet]. 2021 [cited 2024 Aug 4]. [https://data.tuik.gov.tr/Bulten/Index?p=Survey-on-Information-and-Communication-Technology-\(ICT\)-Usage-in-Households-and-by-Individuals-2021-37437](https://data.tuik.gov.tr/Bulten/Index?p=Survey-on-Information-and-Communication-Technology-(ICT)-Usage-in-Households-and-by-Individuals-2021-37437)
9. Bruni O, Sette S, Fontanesi L, Baiocco R, Laghi F, Baumgartner E. Technology use and sleep quality in preadolescence and adolescence. *J Clin Sleep Med*. 2015;11(12):1433-41.
10. Huang Q, Li Y, Huang S, Qi J, Shao T, Chen X, et al. Smartphone use and sleep quality in Chinese college students: a preliminary study. *Front Psychiatry*. 2020;11:352.
11. Xie X, Dong Y, Wang J. Sleep quality as a mediator of problematic smartphone use and clinical health symptoms. *J Behav Addict*. 2018;7(2):466-72.
12. Tam NM, Nhan NPT, Hang NTT. The relationship between smart phone usage and sleep disturbances and psychological distress among students. *Hue J Med Pharm*. 2017;7(4):125-30. <https://www.doi.org/10.34071/jmp.2017.4.19>
13. Thanh TXB. The prevalence of smartphone addiction and the association between smartphone addiction and depression among students of the Faculty of Public Health, University of Medicine and Pharmacy, Ho Chi Minh City [Doctor of Preventive Medicine thesis]. Ho Chi Minh City: University of Medicine and Pharmacy; 2012.
14. Quynh TNT, Loan KX, Thuy MTT. Sleep quality and related factors in students majoring in preventive medicine, Ho Chi Minh City University of Pharmacy. *J Med Ho Chi Minh City*. 2016;20(1):261-7.
15. Kwon M, Kim DJ, Cho H, Yang S. The smartphone addiction scale: development and validation of a short version for adolescents. *PLOS ONE*. 2013;8(12):e83558.
16. Rezaul Karim AKM, Nigar N. The Internet addiction test: assessing its psychometric properties in Bangladeshi culture. *Asian J Psychiatry*. 2014;10:75-83.
17. Ngoc TM. Pittsburgh sleep quality scale Vietnamese version. *J Med Ho Chi Minh City*. 2014;18(6):664-8.
18. Sharma A, Minh Duc NT, Luu Lam Thang T, Nam NH, Ng SJ, Abbas KS, et al. A consensus-based checklist for reporting of survey studies (CROSS). *J Gen Intern Med*. 2021;36(10):3179-87.
19. Matar Boumosleh J, Jaalouk D. Depression, anxiety, and smartphone addiction in university students- a cross sectional study. *PLOS ONE*. 2017;12(8):e0182239.
20. Thao VT. The relationship between smartphone use and sleep quality among students of the Faculty of Public Health at Ho Chi Minh City University of Medicine and

- Pharmacy [Bachelor of Public Health Graduate thesis]. Ho Chi Minh City: University of Medicine and Pharmacy; 2017.
21. Thao DTT. Internet addiction prevalence and association with depression among students of the Faculty of Public Health of Ho Chi Minh City of Medicine and Pharmacy in 2016 [Bachelor's thesis in Public Health]. Ho Chi Minh City: University of Medicine and Pharmacy; 2016.
  22. Kolaib AMA, Alhazmi AHH, Kulaib MMA. Prevalence of Internet addiction and its associated factors among medical students at Taiba University, Saudi Arabia. *J Fam Med Prim Care*. 2020;9(9):4797-800.
  23. Hieu DTL. Internet addiction prevalence and association between Internet addiction and depression among high school students in Le Loi, Dong Xuan district, Phu Yen province in 2019 [Doctor of Preventive Medicine Graduation thesis]. Ho Chi Minh City: University of Medicine and Pharmacy; 2019.
  24. Kha PQ. Internet addiction rate and related factors among students of Nguyen Hong Son Secondary School, Song Cau town, Phu Yen province, in 2018 [Graduate thesis of Doctor of Preventive Medicine]. Ho Chi Minh City: University of Medicine and Pharmacy; 2018.
  25. Kumar VA, Chandrasekaran V, Brahadeeswari H. Prevalence of smartphone addiction and its effects on sleep quality: a cross-sectional study among medical students. *Ind Psychiatry J*. 2019;28(1):82-5.
  26. Ngoc NTM, Thao NHP, Linh LT, Hai PT, Thao NTT. Internet addiction and some related factors among general medical students at Hai Phong University of Medicine and Pharmacy in 2019. *J Prev Med*. 2019;29(9):165.
  27. Thanh NV. The prevalence of Internet addiction and the association of Internet addiction with sleep quality among students of the Faculty of Public Health of Ho Chi Minh City University of Medicine and Pharmacy in 2015 [Bachelor's degree in Public Health]. Ho Chi Minh City: University of Medicine and Pharmacy Ho Chi Minh City; 2015.
  28. Chatterjee S, Kar SK. Smartphone addiction and quality of sleep among Indian medical students. *Psychiatry*. 2021;84(2):182-91.
  29. Ozcan B, Acimis NM. Sleep quality in Pamukkale University students and its relationship with smartphone addiction. *Pak J Med Sci*. 2021;37(1):206-11.
  30. Gandhi AV, Mosser EA, Oikonomou G, Prober DA. Melatonin is required for the circadian regulation of sleep. *Neuron*. 2015;85(6):1193-9.
  31. Guerrini Usubini A, Terrone G, Varallo G, Cattivelli R, Plazzi G, Castelnovo G, et al. The mediating role of emotion dysregulation and problematic Internet use in the relationship between negative affect and excessive daytime sleepiness: a structural equation model. *Nat Sci Sleep*. 2022;14:291-302.
  32. Acikgoz A, Acikgoz B, Acikgoz O. The effect of Internet addiction and smartphone addiction on sleep quality among Turkish adolescents. *PeerJ*. 2022;10:e12876.