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Original article

Association between sleep quality and internet addiction in high school students

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Abstract: ***Background:*** Internet addiction and poor sleep quality are two types of common mental health disorders among high school students. This study was conducted to determine the prevalence of poor sleep quality and its association with internet addiction in high school students. ***Methods:*** A cross-sectional study was conducted on 820 high school students in Dong Hoa town, Phu Yen province in April 2021. The students were requested to fill out a structured questionnaire. internet addiction was evaluated by the short version Internet Addiction Test (s-IAT). The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality. ***Results:*** The prevalence of poor sleep quality was 33.5% among high school students. The proportion of students with internet addiction evaluated by the s-IAT was 21%. The association between internet addiction and poor sleep quality remained statistically significant with p<0,001 (OR=2.98, 95% CI: 2.05-4.34) after adjusting for potential confounding variables. ***Conclusion:*** The proportions of internet addiction and poor sleep quality were high and there was an association between them. Students should not use the internet after 9 pm and should spend at least 8 hours each night on sleep.

Keywords: Internet addiction; sleep quality; high school students.

1. INTRODUCTION

Given the growth of internet access, the prevalence of internet addiction has been increasing [1]. The percentage of internet utilization in young people, ranging from 15 to 24 years old, was the highest among all age groups in 2017 [2]. According to a report by the World Health Organization, excessive internet usage in adolescents has become a public health problem [1]. A meta-analysis of 24 articles about internet addiction from 7 countries in Southeast Asia indicated that the prevalence of internet addiction was 20.0% (with p<0.05 and 95% CI: 14.5 - 27.0) [3]. In Vietnam, the rates of internet addiction in teenagers from several studies vary, ranging from 21.0% to over 59.0% [4-6]. In terms of the factors associated with sleep quality, internet addiction is one of the most common factors [7]. The Centers for Disease Control and Prevention (CDC) in the USA recommends that adolescents from the age of 13 to 18 should spend 8 to 10 hours each day on sleep [8]. In Vietnam, some studies demonstrated that more than half of students had poor mental health and slept less than 8 hours a day [9] [10]. Internet addiction and poor sleep quality are two types of common mental health disorders that cause negative implications for high school students such as poor life satisfaction, inferior academic performance, anxiety, and depression [11].

Several studies around the world have reported an association between internet addiction and sleep quality in adolescents [7, 12, 13]. In Vietnam, a survey conducted on 566 students in the Northern provinces (2017) also

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demonstrated the association between two factors [5]. However, the association between sleep quality and internet addiction was not comprehensively evaluated in that study, as a standard scale was not used to assess sleep quality.

Dong Hoa town of Phu Yen province has been in a growing socio-economic development in recent years [14]. There has not been any research about internet addiction and sleep quality in the locality. Therefore, this study was carried out on students from all high schools in Dong Hoa town to ascertain the prevalence of poor sleep quality and its association with internet addiction. The study used two standardized scales for Vietnamese (PSQI and s-IAT) to assess internet addiction and sleep quality [15] [16]. The results of this study would serve as a useful source that helps schools management committee and parents properly acknowledge the circumstance of internet addiction and sleep quality, thereby offering opportune prevention and intervention measures.

2. MATERIALS AND METHOD

2.1. Study design and participants

Cross-sectional study.

Study subjects

The study was conducted on 820 students in April 2021 at three high schools in Dong Hoa town, Phu Yen province. The estimated sample size of the study was 820 students. The study employed single-stage cluster sampling according to the systematic random method and the cluster unit was one class. The average number of students in a class was 42 students, therefore, the number of clusters was calculated as 20 clusters. After data cleaning, there were 768 valid questionnaires included in analyses among 819 students recruited into the study, accounting for 93%. There were 5% of the students and parents who refused to participate in the study and 2% of the students did not complete the questionnaire, the response rate was similar to that of the previous study with the same cluster sampling method in students [4].

2.2. Inclusion and exclusion criteria

Inclusion criteria

Students from 10th, 11th, 12th grades of three selected high schools were present at the time of the study.

Exclusion criteria

Students who were absent at the time of the survey, even at our second return. Students did not complete over 80% of the questionnaire.

2.3. Defining and measuring variables

The study used a structured questionnaire which was a pre-designed set of self-completed questions, including information of personal characteristics, academic environment, living habits, internet usage practices, internet addiction test and sleep quality scale.

We measured internet addiction using the short version Internet Addiction Test (s-IAT) that was validated by Pawlikowski [17]. We used the Vietnamese version of the s-IAT which has been used in previous studies [5, 16]. The s-IAT consists of 12 questions to be rated on a 5-point Likert scale ranging from 1 to 5 and the total score of 36 points or more was identified as internet addiction.

We assessed sleep quality of the participants by the Pittsburgh Sleep Quality Index (PSQI) scale [18]. The PSQI (Pittsburgh Sleep Quality Index) was used to assess sleep quality, which consisted of 19 items. The scale that scores from 0 to 21 has been widely used to evaluate sleep quality and the total PSQI score above 5 corresponded to poor sleep quality. The PSQI scale has shown excellent validity and acceptable reproducibility in adolescents in previous studies [7, 9].

2.4. Data collection

We contacted the school administration and asked for permission to conduct the study. After that, we asked homeroom teachers to leave classrooms when we were collecting data at the beginning of class, at break time, and at the time of side activities. The teachers should stay outside during the collection time to avoid bias about school information in the questionnaire.

2.5. Controlling bias

The questionnaire was designed with a clear, compact, and concise questions. Before the survey, researchers and collaborators imparted detailed instructions about how to fill out the questionnaire to students, and then all queries from students were answered carefully. The collaborators were trained prior to conducting formal research so that a consensus on content for dissemination and responses to students' questions could be reached. During the survey, students were reminded to avoid exchanges and discussions. In addition, in terms of the questionnaire, a trial survey prior to the formal one was conducted to adjust the obscure content, confusing words and arrangements which could lead to collect incorrect information.

2.6. Statistical analysis

Descriptive statistics (mean, frequency, and percentage) were used to measure variables including socio-demographic characteristics, academic environment, lifestyle practices, internet addiction, sleep quality. The Chi-square test or the Fisher test was used to ascertain the associations between internet addiction and sleep quality or between these variables and potentially confounding variables. The strength of association was determined by odds ratio (OR) with 95% CI. The associations were considered statistically significant when p value < 0.05. In univariate analysis, variables that (1) were associated with the exposure and (2) the outcome and (3) were not an intermediary step in the causal pathway between the exposure and the outcome would be stratified to determine whether they were true confounding variables.

The purpose of the stratification method is to determine the confounding and interacting variables. In this method, first step is to compute the crude OR. Then the OR at each stratum is estimated and compared with each other. If there is a difference between the strata, the p-value between the strata will be <0.05 and vice versa. If there is a difference between the strata, the stratified variable is considered interactive one. The next step, the adjusted OR is calculated. To determine whether the stratified variable is confounding, comparison between the crude OR and the adjusted OR is performed. If

the difference between crude and adjusted OR is >10%, the stratified variable is considered a confounding variable. Both confounding and interaction variables were included in the multivariate model.

3. RESULTS

Demographic characteristics

Among the 768 students, the number of females was 424 (55.2%) and males 344 (44.8%). The percentages of students in each grade are the same (grade 10, 31.0%; grade 11, 34.5%; grade 12, 34.5%). The baseline frequencies of participants' the socio-demographic characteristics of participants shown in Table 1. The research identified that 21.0% of participant had internet addiction and 33.5% had poor sleep quality. Of these, the female student had the highest rate of internet addiction than male students ($p<0.05$), similar to poor sleep quality, the rate among female students is higher than that of male students ($p<0.05$). For participants with internet addiction and poor sleep quality, most of them had extra classes, were dissatisfied, had academic pressure, used the Internet longer than 1 hour after 9pm, used social media ($p<0.05$). In both groups in terms of internet addiction and sleep quality, there were no significant differences in the result of characteristics including academic performance, conduct, living with someone, and family financial status.

Table 1. Socio-demographic characteristics of the participants (n=768)

Characteristics		**Frequency**	**Percentage**
Gender	Female	424	55.2
	Male	344	44.8
Grade level	12^{th} grade	238	31.0
	11^{th} grade	265	34.5
	10^{th} grade	265	34.5
Academic performance	Very good	142	18.5
	Good	424	55.2
	Average	184	24.0
	Below average	18	2.3
First semester conduct	Very good	656	85.4
	Good	91	11.9
	Average and below average	21	2.7
Living with someone	Parents	672	87.5
	A parent	69	9.0
	Other	27	3.5
Family financial status	Well off/ Affluent	30	3.9
	Barely sufficient/ Normal	656	85.4
	Destitute	82	10.7

Table 2. Internet addiction and Sleep quality (n=768)

Variables		**Frequency**	**Percentage**	**95% CI**
Internet addiction	Yes	161	21.0	18.0 - 24.0
	No	607	79.0	
Sleep quality	Poor	257	33.5	30.0 – 37.0
	Good	511	66.5	

Table 3. Association between Internet addiction and sleep quality stratified by sample characteristic variables (n=768)

Control confounding variables	Difference in stratified OR (p)	Stratum-specific OR	Crude OR	Difference between stratum-specific OR and crude OR by %	Confounding/ Interaction
Gender	0.071	3.52	3.69	4.60	No
Grade level	0.820	3.73	3.69	1.08	No
Academic performance	0.436	3.59	3.69	2.71	No
Conduct	0.388	3.70	3.69	0.27	No
Living with someone	0.375	3.68	3.69	0.27	No
Family financial status	0.168	3.67	3.69	0.54	No
Having extra classes	0.570	3.59	3.69	2.71	No
School satisfaction	0.453	3.43	3.69	7.04	No
Academic pressure	0.322	3.09	3.69	16.2	**Confounding**
Using the Internet after 9pm	0.100	3.19	3.69	13.5	**Confounding**
Degree of Internet usage	0.771	3.51	3.69	4.87	No
Internet usage time	0.848	3.5	3.69	5.14	No
Degree of alcohol usage	0.392	3.57	3.69	3.25	No
Smoking	0.716	3.65	3.69	1.08	No
Social media	0.497	3.57	3.69	3.25	No
Playing games	0.361	3.68	3.69	0.27	No
Reading news	0.171	3.69	3.69	0.00	No
For learning purpose	0.523	3.74	3.69	1.35	No
Watching film	0.060	3.61	3.69	2.16	No
Shopping	0.884	3.77	3.69	2.16	No

Table 4. Multivariable model between Internet addiction and sleep quality in students (n=768)

Variables	Sleep quality			
	Crude OR (Crude 95% CI)	p value	Adjusted OR (Adjusted 95% CI)	p value
Internet addiction	3.69 (2.58-5.30)	<0.001	2.98 (2.05-4.34)	<0.001
Academic pressure	1.62 (1.39-1.89)	<0.001	1.47 (1.26-1.73)	<0.001
Using the Internet after 9pm	1.46 (1.25-1.70)	<0.001	1.23 (1.04-1.46)	0.014

As shown in Table 2, variables including academic pressure and using the internet after 9pm were confounders because these variables significantly changed the association between internet addiction and sleep quality (>10%). The two variables were included in multivariable logistic regression analyses for controlling.

After controlling confounding variables by multivariable logistic regression analyses, the results demonstrated that internet addiction was truly associated with sleep quality in students. Specifically, in the group of students with internet addiction, the odds of poor sleep quality were 2.98 times higher than the other students without internet addiction, p<0.001, 95% CI: 2.05-4.34 (Table 3).

4. DISCUSSION

The results demonstrated that internet addiction was truly associated with sleep quality in high school students. The odds of poor sleep quality were 2.98 times higher than the other students without internet addiction, p<0.001, 95% CI: 2.05-4.34. The rate of internet addiction is 21.0%, this figure is comparable to the outcome of the study using the same scale of s-IAT on 566 students in Vietnam's Northern provinces in 2017 (21.2%). Other studies in Vietnam reported higher rates of internet addiction, e.g., a study on 1492 high school students in Ho Chi Minh City in 2019 (59.0%) [4], a study on 674 secondary school students in Dong Nai province in 2018

(51.1%) [19]. The dissimilar results from these studies may stem from different instruments for assessment of internet addiction. Moreover, another rational rationale is that the specific period when each study was conducted may render the figures of internet addiction different. In terms of sleep quality, the proportion of poor sleep quality evaluated by the PSQI was 33.5%, lower than that of studies on high school students in Ho Chi Minh City in 2019 (60.5%) [9] and in Dong Nai in 2012 (50.0%). This discrepancy can be elucidated by previous research which manifested that the degree of urbanization adversely affects sleep quality. Urban problems such as noise pollution, high population density significantly engender sleep disturbance [20]. Dong Nai Province and Ho Chi Minh City are among the most urbanized metropolises in the country, which can lead to higher rates of poor sleep quality than low-urbanized localities like Phu Yen [21].

After controlling confounding factors, the results showed that the odds of poor sleep quality were 2.98 times higher among students with internet addiction compared to students without internet addiction, $p<0.001$ (95% CI: 2.05 - 4,34). Several previous studies also confirmed an association between internet addiction and sleep quality. The results after using multivariable analyses of a study on high school students in Japan (2020) indicated that internet addiction was associated with sleep quality [7] . Specifically, in the group of male students with internet addiction, the odds of poor sleep quality were 2.17 times higher than non-internet-addicted male students ($p<0.001$); among female students with internet addiction, the odds of poor sleep quality were 2.2 times higher compared to female students without internet addiction ($p<0.001$). In another study conducted on 853 secondary school students in Japan (2017) [11], the results demonstrated that among students who went to sleep late, the odds of internet addiction were 1.31 times higher than those who went to bed on time ($p<0.05$). In the group of students with irregular sleep hours sleep per night, the odds of internet addiction were 1.37 times higher than students with regular sleep hours per night ($p<0.05$). Although the above studies employed different instruments to assess internet addiction and sleep quality, the results from these studies confirmed that there was an association between internet addiction and poor sleep quality. internet addiction and poor sleep quality are among the common mental health problems in schoolchildren.

As regards the association between poor sleep quality and internet addiction, although the study used stratified analysis and multivariable model to control confounding factors, the general limitation of a cross-sectional study is that it is inexpedient to determine the temporal relationship between cause and effect. Notwithstanding, this is a prerequisite study so that many further follow-up studies can be performed in order that the cause-and-effect relationship between sleep quality and internet addiction can be established.

Conclusion

The findings from this study indicate that internet addiction and poor sleep quality are prevalent in high school students and there is an association between these two factors. Further longitudinal studies are needed to elucidate the mechanism of internet addiction and sleep quality.

ETHICAL STATEMENT

The research protocol has been approved in terms of research ethics from the Ethical Council in Biomedical Research of University of Medicine and Pharmacy in Ho Chi Minh City, No. 1000/HDDD-DHYD, signed on February 20, 2021.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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AUTHORS' CONTRIBUTION

All authors including: Vinh Ba Tran, Vinh Chi Le, Tu Tien Tue Nguyen, Tuan Nhat Pham contributed to the article. Authors Vinh Ba Tran, Tuan Nhat Pham build research ideas, research design, data analysis. Authors Vinh Chi Le and Tu Tien Tue Nguyen assisted in writing and editing the article.

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