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Impact of usage of electronic devices on sleep quality among healthcare professions students in Ajman, UAE

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ABSTRACT

Due to the advancement in technology, people are using various electronic devices. People using electronics and the internet at inappropriate times may have a harder time falling asleep and have less sleep duration, and the sharp rise in electronic device use has numerous adverse effects. This study aimed to assess the impact of the usage of electronic devices on sleep and also to determine the factors influencing sleep among healthcare professions students. A cross-sectional study was conducted using a self-administered questionnaire. The association was assessed using the Chi-square test and simple binary logistic regression to identify the factors. Of the total 446, 36.4% reported not having problems during the past month in getting to sleep within 30 minutes. Internet use at school during a typical weekday, 22.2% use 2-4 hours a day; outside of school during a typical weekday, 24.7% use >6 hours. 34.3% use the internet >6 hours outside of school on weekends. The crude OR observed was 4.1, 3.7, 3.6 and 3.9 for 1-2, 2-4, 4-6, >6 hours respectively which is statistically significant. Factors that showed statistical significance for sleep duration were nationality and internet use outside the school during a typical weekend day. For how long it takes to fall asleep, the age group was the factor that showed statistical significance.

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1. INTRODUCTION

Over the past few years, technology has advanced to a level we are now incredibly dependent on. People will use various electronic devices such as phones, tablets, laptops, and televisions in any normal lifestyle. There are an enormous number of reasons why the development of technology has benefited the human race. Arguably, the most beneficial one is the Internet. Almost every single electronic device can now connect to the internet [1] and function on it. Mobile devices and laptops can use the internet for online interactions and searching for anything online. Televisions can connect to the internet and play movies from applications such as YouTube and Netflix. Electronic devices are essential for both the younger and the older generations. Students now use tablets and laptops in schools and universities instead of notebooks. Notes can be taken down and eTextbooks are readily available online. Laptops and PCs (personal computers) are necessary for any work environment. Emails are also sent from different devices, which is essential whether you are a student or a worker [2].

With all the benefits gained from these advancements, there will always be some adverse effects, including how the blue light emitted from electronic devices can affect our sleep [3]. Exposure to blue-enriched, short-length light from cell phones, computers, or tablets is equivalent to morning sunlight [4] and should be

avoided before bedtime. In addition to other factors such as coffee consumption, exercise frequency, tobacco smoking, alcohol consumption, extended working time, and depression, electronic device use near bedtime has become one of the most prominent causes of sleep disturbance [4]. Young Vietnamese adults aged 15–19 (92%) and 20–29 (76%) were the most likely to use the internet [4]. The hours between 8 and 10 p.m. were the most common for smartphone and laptop use [4]. This suggests these electronic devices expose young adults to short-wavelength light before sleep. Electronic devices at inappropriate times can cause melatonin suppression due to the short-wavelength light emitted by the screens [4]–[6], making it harder for people to fall asleep and shorten their total sleep time [6]. These biological effects can lead to sleep deprivation and disturb the circadian rhythm, affecting performance, health, and safety [7]. Moreover, Randjelović *et al.* [8] conducted a study on medical faculty students and found that using a phone impacted subjective sleep quality and increased daytime fatigue.

Depressive symptoms and adolescent sleep durations were found to have a negative relationship [2]. Recent research has found that the light emitted by the screens of electronic devices may cause the chronotype to be delayed [2]. A person's physical and cognitive activity during the day is called chronotype. Likewise, studies have found a link between nocturnal electronic device usage and sleep deprivation among teenagers and university students. The overall use of mobile phones for five hours per day is linked to shorter sleep duration and insomnia [9]–[11]. Smartphone and other electronic gadget use among young adults has increased in recent years, and it has become a trait that affects sleep quality, mental health, and student academic achievement [3], [12], [13]. Recent research has shown that an increasing number of internet users worldwide are experiencing internet addiction, with notable issues arising among university students [1], [14]. Inadequate sleep in the evening increases daytime dysfunction and leads to weak behavior [1]. A significant number of people utilize their mobile phones as alarms in the morning as well.

The use of electronic devices is frequent among healthcare professional students, and it affects the amount of sleep a student gets and their academic performance. It is a cause for concern among the general public and academic organizations, as more effort is needed to persuade students to limit their use of electronic devices before bedtime to maintain good sleep hygiene and quality. Improved sleep quality is associated with improved physical and psychological well-being [3], [15]. Studies done in Morocco and Qatar on university students reported that good habits are strongly linked to good overall sleep quality [16], [17]. This study aimed to assess the impact of the usage of electronic devices on sleep among healthcare professions students and to determine the factors influencing sleep among healthcare professions students.

2. METHOD

This cross-sectional study involved undergraduate healthcare professions students at a Medical University. For the calculation of sample size, we assumed that 50% of the students have some impact on their sleep due to electronic devices. We used the sample size formula for cross-sectional study with binary exposure to calculate the sample size. The sample size calculated was 400 and we assumed a non-response rate of 10% and the final minimum required sample size observed was 440. The participants were asked to complete a self-administered questionnaire about the impact of electronic devices on their sleep. For sleep quality, we used the Pittsburgh Sleep Quality Index (PSQI), which is a validated questionnaire. For the different types of electronic devices that are being used among our population, we chose the ICT Familiarity Questionnaire for PISA 2015. This questionnaire is also validated. Approval was obtained from the institutional review board (IRB) of Gulf Medical University before starting data collection (Ref. no. IRB/COM/STD/76/April-2022). The objectives were explained to the participants, who had the right to withdraw. Informed consent was taken before enrolment in the study; anonymity and confidentiality were maintained. After finalizing the questionnaire, we conducted a pilot study to assess the completion time and check feasibility. We explained to the participants the objectives of the research; for those who were willing to participate, written consent was obtained. After obtaining the consent, we handed out the questionnaire. We checked the completeness of the data before collecting the questionnaire. The data obtained were entered into an Excel spreadsheet, where we converted all the responses to the short answer questions into numerical codes. We analyzed them using SPSS 28. Descriptive and inferential statistics were used to analyze the data. The association was assessed using the Chi-square test, and simple binary logistic regression was used to identify the factors associated with sleep.

3. RESULTS AND DISCUSSION

We have included 446 students in this study. Of the total, 57.2% were below the age of 20, and the remaining were above the age of 20. Regarding gender, the majority were females, around 69.4%, whereas only 30.6% were males. Concerning nationality, more than 60% were from the Eastern Mediterranean region; the lowest proportion, 4.1%, were from Europe and the Western Pacific regions. Around 76.7% of the students lived with their families and only 11.5% lived independently. Moreover, 23.5% of students took

10 to 20 minutes to fall asleep, while 20.4% took more than 30 minutes. Concerning sleep duration, more than 77% of students slept for less than or equal to seven hours, while 22.3% slept for more than seven hours.

3.1. Duration of sleep and sociodemographic factors

The association between the duration of sleep and the age group showed no statistically significant difference. Among those younger than 20, 77.1% reported sleeping for less than or equal to seven hours. Moreover, for students above the age of 20, around 78.5% of them sleep for less than or equal to seven hours. The association between the duration of sleep and body mass index (BMI) group showed no statistically significant difference. Among students who have a normal weight, around 79.8% of them sleep for less than or equal to seven hours, while the remaining 20.2% sleep for more than seven hours. About 76% of overweight students sleep for less than or equal to seven hours. Among students who are obese, 70.6% of them reported that it takes them less than or equal to seven hours to fall asleep. Similarly, the association between sleep duration and gender showed no statistically significant difference. Among males, 77.2% of students reported sleeping for less than or equal to seven hours, and around the same range in females, which is 77.9%. Likewise, 22.8% of male and 22.1% of female students sleep for more than seven hours. On the other hand, the association between the duration of sleep and the nationality group showed a statistically significant difference. The 81.3% of students from the Americas sleep for less than or equal to seven hours, while only 11.1% of students from Europe and Western Pacific regions sleep for more than seven hours. The 71.9% of students from the Eastern Mediterranean and 95% from Africa sleep for less than or equal to seven hours. Therefore, we observed that each nationality and their sleep duration differ, which is statistically significant. The details are provided in Table 1.

Table 1. Association between duration of sleep and sociodemographic factors

Variable	Group	Duration of sleep				p
		<=7		>7		
		No.	%	No.	%	
Age Group	<20	195	77.1	58	22.9	NS
	>=20	150	78.5	41	21.5	
BMI Group	Underweight	117	77.0	35	23.0	NS
	Normal	150	79.8	38	20.2	
	Overweight	51	76.1	16	23.9	
	Obese	24	70.6	10	29.4	
Gender	Male	105	77.2	31	22.8	NS
	Female	239	77.9	68	22.1	
Nationality Group	Americas	26	81.3	6	18.8	<0.01
	Africa	19	95.0	1	5.0	
	South-East Asia	90	84.9	16	15.1	
	Eastern Mediterranean	189	71.9	74	28.1	
	Europe and Western Pacific	16	88.9	2	11.1	

Among students who are normal weight, overweight, and obese, 79.8%, 76.1%, and 70.6% sleep for less than or equal to seven hours, respectively. A study by Hameed *et al.* [18] found that among students who were overweight, 44.4% were 18 years old, 26.5% of students aged 19 years were obese/overweight, whereas 17.5%–20% of those who were 20 years and above were obese/overweight. Similarly, a study conducted in Saudi Arabia by Alafif and Alruwaili [19] found that elevated BMI is linked to poor sleep duration and quality in college students. Sa *et al.* [20] reported that sleep duration and quality were worse in non-Hispanic blacks and South Koreans compared to non-Hispanic whites, worse in females than males, and worse in obese students than students who have a normal weight. Sleep duration for students from the Americas, Europe, Western Pacific regions, Eastern Mediterranean and Africa were 81.3%, 88.9%, 71.9%, and 95%, respectively. We observed that each nationality and their sleep duration differ, which is statistically significant. However, a study by Rae *et al.* [21] found that 44.5% of Americans and 2.5% of South Africans slept less than seven hours among men. A study in Saudi Arabia found that many medical students used their mobile phones for long hours. In that paper, they reported that the majority of participants (76%), used their smartphones for at least four hours and more each day [22]. People who used the internet for 31-60 minutes were 3.3 times more likely to sleep less, while those who used it for more than six hours were 3.9 times more likely.

3.2. Duration of sleep and internet use

The association between sleep duration and internet use at school during a typical weekday showed no statistically significant association. Those who use the internet at school during a typical weekday for less than 30 minutes reported that 26% slept more than seven hours. Those who use the internet at school during a

typical weekday for more than six hours reported that 10.9% slept more than seven hours. Even though there is no statistically significant association, we observed a difference in sleep duration. The association between sleep duration and internet use outside of school during a typical weekday showed no statistically significant association. Those who use the internet outside of school during a typical weekday for less than 30 minutes reported that 32.1% slept more than seven hours, and those who use the internet outside of school during a typical weekday for more than six hours reported that 18.2% slept more than seven hours. Likewise, we observed a difference in sleep duration, although no statistically significant association exists. On the other hand, the association between sleep duration and internet use outside of school during a typical weekend day showed a statistically significant association. Students who use the internet outside of school during a typical weekend day for less than 30 minutes reported that 48.6% slept more than seven hours. However, those who use the internet outside of school for more than six hours on a typical weekend day reported that 19.6% slept more than seven hours. We observed that the students who use the internet for the least amount have a longer sleep duration than those who use the internet for a longer period. The details are given in Table 2.

Table 2. Association between the duration of sleep and Internet use

Variable	Group	Duration of sleep <=7		Duration of sleep >7		p
		No.	%	No.	%	
Internet use at school during a typical weekday	<30 minutes	54	74.0	19	26.0	NS
	31-60 minutes	35	67.3	17	32.7	
	1-2 hours	72	76.6	22	23.4	
	2-4 hours	76	77.6	22	22.4	
	4-6 hours	51	81.0	12	19.0	
	>6 hours	57	89.1	7	10.9	
Internet use outside of school during a typical weekday	<30 minutes	19	67.9	9	32.1	NS
	31-60 minutes	28	71.8	11	28.2	
	1-2 hours	53	81.5	12	18.5	
	2-4 hours	78	71.6	31	28.4	
	4-6 hours	77	82.8	16	17.2	
	>6 hours	90	81.8	20	18.2	
Internet use outside of school during a typical weekend day	<30 minutes	18	51.4	17	48.6	<0.01
	31-60 minutes	21	77.8	6	22.2	
	1-2 hours	39	81.3	9	18.8	
	2-4 hours	63	79.7	16	20.3	
	4-6 hours	81	79.4	21	20.6	
	>6 hours	123	80.4	30	19.6	

On a typical weekday, 22.2% of students use the internet for two to four hours, while 11.7% use it for 31-60 minutes. The 24.7% of students use the internet for more than six hours a day on weekdays, while 6.3% use it for less than 30 minutes. The 34.3% of students use the internet for more than six hours on weekends, while 6% use it for 31-60 minutes. Chinwong *et al.* [23] reported that pharmacy students spend around 7.5 hours a day on weekdays and 8.1 hours a day on weekends using electronic devices. The 75% of the students use their mobile devices for more than five hours a day during weekdays, while that number increases to 81% during weekends. Another study conducted in Iran by Safarpour *et al.* [24] reported that 31.5% of the students spend more than six hours online every week outside of school. A study at Sohag University shared similar results as their research showed that, with increased usage of internet consumption, sleep quality got worse, which was in line with our results. The study did not set specific ranges for internet consumption, however, they split them into categories. They found that 39.62% of the study participants were "moderately addicted" to the internet and 4.95% were "severely addicted" to using the internet [25]. In our study, we split them into different ranges and found that people who used the internet outside of school on a weekday for more than six hours were likelier to have less than seven hours of sleep. The 81.8% of people who used the internet for more than six hours outside of school said they slept less than seven hours. This is indicative of poorer sleep quality. Another study done in Egypt and Saudi Arabia found that academic performance and sleep are negatively affected in female nursing students who are more addicted to electronic devices [26]. Both Saudi and Egyptian students experienced decreased alertness during the day and poor sleep quality due to their increased use of electronic devices. Moreover, the majority of the students reported sleeping less than eight hours on work or study days [26]. AlAmer *et al.* [27] reported that more than two-thirds of the students experienced poor sleep quality.

3.3. How long to fall asleep and sociodemographic factors

The association between how long it takes to fall asleep and age group showed a statistically significant association. 27.7% of students under 20 reported falling asleep in less than 10 minutes. However, 43.9% of those 20 or older reported falling asleep in less than 10 minutes. With this, we observed that more students of the 20 or older age group take less time to fall asleep than those younger than 20. The association between how long it takes to fall asleep and BMI showed no statistically significant association. Among those who are underweight, 32.5% reported that it took less than 10 minutes to fall asleep, whereas among those who are obese, 35.3% reported that it took them less than 10 minutes to fall asleep. Likewise, the association between how long it takes to fall asleep and both genders showed no statistically significant association. Among males, 36% show that falling asleep took them less than 10 minutes. Moreover, among females, 34.1% took less than 10 minutes to fall asleep. We observed no significant difference between males and females in the time needed to fall asleep. The association between how long it takes to fall asleep and nationality group showed no statistically significant difference. 46.9% of students from the Americas reported that falling asleep takes less than 10 minutes. 31.4% of students from South-East Asia said that it took them less than 10 minutes to fall asleep. Therefore, we observed no difference between each nationality group and how long it takes to fall asleep. The details are provided in Table 3.

Table 3. Association between how long to fall asleep and sociodemographic factors

Variable	Group	How Long to Fall Asleep								p
		<10 minutes		10-20 minutes		20-30 minutes		>30 minutes		
		No.	%	No.	%	No.	%	No.	%	
Age Group	<20	70	27.7	65	25.7	64	25.3	54	21.3	<0.01
	>=20	83	43.9	39	20.6	31	16.4	36	19.0	
BMI Group	Underweight	49	32.5	30	19.9	37	24.5	35	23.2	NS
	Normal	71	38.0	41	21.9	36	19.3	39	20.9	
	Overweight	21	31.3	22	32.8	14	20.9	10	14.9	
	Obese	12	35.3	10	29.4	6	17.6	6	17.6	
Gender	Male	49	36.0	36	26.5	27	19.9	24	17.6	NS
	Female	104	34.1	68	22.3	67	22.0	66	21.6	
Nationality Group	Americas	15	46.9	3	9.4	7	21.9	7	21.9	NS
	Africa	6	30.0	5	25.0	5	25.0	4	20.0	
	South-East Asia	33	31.4	22	21.0	31	29.5	19	18.1	
	Eastern Mediterranean	91	34.7	67	25.6	51	19.5	53	20.2	
	Europe and Western Pacific	7	38.9	5	27.8	1	5.6	5	27.8	

3.4. How long to fall asleep and internet use

The association between how long it takes to fall asleep and internet use at school during a typical weekday showed no statistically significant association. Among those who use the internet at school during a typical weekday for less than 30 minutes, it was reported that 65.8% took less than or equal to 20 minutes to fall asleep. Among those who use the internet at school during a typical weekday for more than six hours reported that 51.6% took less than or equal to 20 minutes to fall asleep. Even though there is no statistically significant association, we did not observe a significant difference in the amount of time to fall asleep. The association between how long it takes to fall asleep and internet use outside of school during a typical weekday showed no statistically significant association. Among those who use the internet outside of school during a typical weekday for less than 30 minutes reported, 67.9% took less than or equal to 20 minutes to fall asleep. Among those who use the internet outside of school during a typical weekday for more than six hours reported that 54.5% took less than or equal to 20 minutes to fall asleep. With this, it has been observed that there is no significant difference in the time taken to fall asleep. On the other hand, we observed a statistically significant association between how long it takes to fall asleep and internet use outside of school during a typical weekend. Among those who use the internet outside of school during a typical weekend day for less than 30 minutes reported that 79.4% took less than or equal to 20 minutes to fall asleep, whereas among those who use the internet outside of school during a typical weekend day for more than six hours reported that 53.6% took less than or equal to 20 minutes to fall asleep. Therefore, we observed that the students who use the internet for the least amount need less time to fall asleep compared to those who use the internet for a longer period. The details are given in Table 4.

Among those who use the internet at school during a typical weekday for less than 30 minutes and more than six hours reported that 65.8% and 51.6%, respectively, took less than or equal to 20 minutes to fall asleep. Students who use the internet outside of school during a typical weekday for less than 30 minutes and more than six hours reported that 67.9% and 54.5% took less than or equal to 20 minutes to fall asleep. According to Elsheikh *et al.* [28] students who use their electronic devices at bedtime had a significantly higher

prevalence of taking longer to fall asleep, sleep disturbances, and lower sleep duration than students who did not. They also found that poor sleep quality was significantly higher among students who used their electronic devices at bedtime (64.2%) compared to students who did not (31.7%) [28]. Another study conducted in China reported that the long-term impacts of using electronic devices caused a gradual decrease in the duration and quality of sleep as well as increasing the time needed to fall asleep [29].

Table 4. Association between how long to fall asleep and internet use

Variable	Group	How long to fall asleep <=20		How long to fall asleep >20		p
		No.	%	No.	%	
Internet use at school during a typical weekday	<30 minutes	48	65.8	25	34.2	NS
	31-60 minutes	27	51.9	25	48.1	
	1-2 hours	57	61.3	36	38.7	
	2-4 hours	58	59.8	39	40.2	
	4-6 hours	34	54.0	29	46.0	
	>6 hours	33	51.6	31	48.4	
Internet use outside of school during a typical weekday	<30 minutes	19	67.9	9	32.1	NS
	31-60 minutes	25	64.1	14	35.9	
	1-2 hours	43	67.2	21	32.8	
	2-4 hours	60	55.0	49	45.0	
	4-6 hours	50	54.3	42	45.7	
	>6 hours	60	54.5	50	45.5	
Internet use outside of school during a typical weekend day	<30 minutes	27	79.4	7	20.6	<0.01
	31-60 minutes	17	63.0	10	37.0	
	1-2 hours	28	58.3	20	41.7	
	2-4 hours	37	47.4	41	52.6	
	4-6 hours	66	64.7	36	35.3	
	>6 hours	82	53.6	71	46.4	

3.5. Odds ratio

The duration of internet use outside of school during a typical weekend day showed for those who are using the internet for 31-60 minutes, the likelihood of sleeping less is 3.3 times higher, which is statistically significant. For those using the internet for 1-2 hours, the likelihood of sleeping less is 4.1 times higher, which is statistically significant. The likelihood of sleeping less is 3.7 times higher for those using the internet for 2-4 hours, which is statistically significant. For those using the internet for 4-6 hours, the likelihood of sleeping less is 3.6 times higher, which is statistically significant. Lastly, the likelihood of sleeping less is 3.9 times higher for those using the internet for more than six hours, which is statistically significant. The duration of internet use outside of school during a typical weekend day showed for those who are using the internet for 31-60 minutes, the likelihood of taking longer to fall asleep is 2.3 times higher, which is not statistically significant; however, it is 2.8 times higher for those using the internet for 1-2 hours, which is statistically significant. The likelihood of taking longer to fall asleep is 4.3 times higher for those using the internet for 2-4 hours, which is statistically significant. However, it is not statistically significant for those using the internet for 4-6 hours, where the likelihood of taking longer to fall asleep is 2.1 times higher. Lastly, for those using the internet for more than six hours, the likelihood of taking longer to fall asleep is 3.3 times higher, which is statistically significant. The details are given in Table 5.

Table 5. Crude odds ratio of sleep duration/how long to fall asleep with internet use outside of school during a typical weekend day

Sleep duration/How long to fall sleep	Internet use outside of school during a typical weekend day	OR	CI Lower	CI Upper	P
Sleep duration	<30 minutes	1	--	--	--
	31-60 minutes	3.3	1.1	10.2	<0.05
	1-2 hours	4.1	1.5	10.9	<0.01
	2-4 hours	3.7	1.6	8.8	<0.01
	4-6 hours	3.6	1.6	8.3	<0.01
	>6 hours	3.9	1.8	8.4	<0.001
How Long to Fall Asleep	<30 minutes	1	--	--	--
	31-60 minutes	2.3	0.7	7.1	NS
	1-2 hours	2.8	1.1	7.6	<0.05
	2-4 hours	4.3	1.7	11.0	<0.01
	4-6 hours	2.1	0.8	5.3	NS
	>6 hours	3.3	1.3	8.1	<0.01

Our study showed that students who use the internet for the maximum period require more time to fall asleep compared to those who use the internet for a shorter period. We found that the likelihood of taking longer to fall asleep is 4.3 and 3.3 times higher for students using the internet outside of school during a typical weekend day for 2-4 hours and more than six hours, respectively, which is statistically significant. Students using the internet outside of school during a typical weekend day for less than 30 minutes reported that 20.6% took more than 20 minutes to fall asleep, while 46.4% of those using the internet for more than six hours reported taking more than 20 minutes to fall asleep. According to a study conducted in China by Meng *et al.* [30] medical students who used their electronic devices for more than five hours a day and those who used them for more than 30 minutes before bedtime were at risk of having poor sleep quality by 1.21–1.53 times higher and 1.41–1.59 times higher, respectively.

4. CONCLUSION

This study concluded that there was a statistically significant association between sleep duration and internet use outside of school during a typical weekend day. The 48.6% of students who use the internet outside of school during a typical weekend day for less than 30 minutes reported sleeping more than seven hours, while 19.6% of students who use it for more than six hours reported sleeping more than seven hours. We observed that the students who use the internet for the least amount have a longer sleep duration compared to those who use the internet for a longer period. The association between the duration of sleep and nationality group showed a statistically significant difference. Likewise, the association between how long it takes to fall asleep and age group also showed a statistically significant difference. Additionally, a statistically significant association exists between how long it takes to fall asleep and internet use outside school during a typical weekend day. 79.4% of students who use the internet outside of school during a typical weekend day for less than 30 minutes reported taking less than or equal to 20 minutes to fall asleep, while 53.6% of students who use it for more than six hours reported taking less than or equal to 20 minutes to fall asleep. This study recommends that individuals must turn off all blue light devices before they go to sleep, as this would aid in the improvement of sleep quality. Moreover, to decrease the duration of electronic device use to reduce sleep latency.

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