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Research Article

Correlation Between Blue Light Exposure from Digital Device Screens and Sleep Quality Among Students in the Faculty of Medicine, Universitas Sumatera Utara Class of 2019

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Abstract
Background: The use of information and communication technology facilities such as cellphones, laptops, computers, and other information facilities is really needed. From several previous studies it was noted that blue light has an impact on sleep quality, as we already know sleep quality is one of the foundations of health. **Objective:** The aim is to determine the relationship between blue light exposure on digital device screens and sleep quality, knowing the level of blue light exposure and sleep quality. **Methods:** This research is an analytical study with a cross-sectional design, namely a type of research in which the measurement of the variables is carried out simultaneously at one time. **Results:** Of the 150 study subjects, there were 64% women, 36% men. Age, 1.30% were 19 years old, 18.70% were 20 years old, 58% were 21 years old, 20% were 22 years old, 2% were 23 years old. Blue light exposure, bad 94%, good 6%. Sleep quality, bad 87.30%, good 12.70%. The relationship between blue light exposure and sleep quality obtained p-value <0.01 and coefficent r is 0.663. **Conclusion:** there is significant relationship between blue light exposure on digital screen device and sleep quality of student.

Keywords: blue light, gadget, radiation, sleep quality

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1. Introduction

As we can see, after human civilization entered the 20th century, the development of information and communication technology was accelerating so that without realizing it, this development had affected the entire scope of individual and group life, with changes in the increasingly modern era of globalization causing increasing information needs. this is the use of high information and communication technology facilities is unavoidable [1].

The use of information and communication technology facilities such as mobile phones, laptops, computers, and other information facilities is really needed, we can see that these increasingly sophisticated digital devices have so many features in them, such as games, internet, social media and others. With this sophisticated feature, we can overcome problems such as loneliness, boredom, and problems that may later reduce a person's productivity. However, this advanced technology has negative effects on health, one of which is the effect of blue light on digital device screens which can affect the quality of a person's sleep [2]. An old survey conducted by the National Sleep Foundation, 2011, stated that many adults are now sleep deprived because of electronic devices.

The habit of using gadgets or mobile phones can make it difficult for someone to fall asleep. This is related to the enjoyment experienced when using technological tools such as gadgets which can make the user busy by himself so that he forgets the time. About a quarter of respondents to the poll said they sleep with their phone in bed and about 10% said they often wake up for at least a few minutes in the middle of the night having to answer a phone, text or email. This was more often reported by young respondents, namely

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18% of respondents aged 13-19 years and 20% of respondents aged 19-29 years [2].

Simple activities such as sleep are necessary for every individual. The need for sleep and rest is as important as the need for nutrition and exercise in maintaining mental, emotional and health balance. Sleep is indeed a very simple activity but has a very big influence on one's activity patterns. With good sleep activities can increase the productivity of each individual, and vice versa. The activity of resting sleep is not just a physiological need that must be fulfilled by humans, it turns out that sleep also has a myriad of benefits for the health of the body. Sleep can restore and rest physically after a day's activities, reduce stress and anxiety, increase ability and concentration when you want to do activities the next day [3].

Sleep quality is a person's satisfaction with sleep, a person is said to have achieved good quality sleep if he does not show feelings of tiredness, irritability, feelings of anxiety, lethargy and apathy, blackness around the eyes, swollen eyelids, red conjunctiva, sore eyes, unfocused, sick headache and frequent sleepiness [3, 4]. In a study it was found that longer sleep duration, better sleep quality, and better sleep consistency were associated with a person's performance in carrying out his activities better [5].

2. Methods

This research is a descriptive analytic study with a cross-sectional design, namely a type of research in which the variables are measured simultaneously at one point in time. In this study, the samples used were students of the Faculty of Medicine, Universitas Sumatera Utara, class 2019 who had met the inclusion and exclusion criteria. The retrieval procedure is carried out online using a Google form which is distributed via social media.

Data processing starts with checking the accuracy and completeness of the data, then assigning a specific code or number to the questionnaire to facilitate the process of tabulating and analyzing data, then entering data from the questionnaire into a computer program using SPSS (Statistical Package for Social Sciences) software, checking all data that has been entered into the computer in order to avoid errors in data entry and finally, analyze the data that has been obtained, processed and tabulated using a computer.

In this study the statistical test used was the Spearman's test where this test was used to test the non-parametric hypothesis to determine the strength of the relationship between two ordinal scale variables. The instrument used by the author in measuring the two variables in this study is Pittsburgh Sleep Quality Index (PSQI) to assess the level of sleep quality, and a subjective ques- tionnaire on a sample consisting of 9 questions and has been validated.

3. Results

In this study, a sample of 150 people was obtained who met the inclusion and exclusion criteria. The characteristics that were obtained in this study were age and gender (Table 1).

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Frequency (n)	Percentage (%)
Ages (Th)		
19	2	1.30
20	28	18.70
21	87	58.00
22	30	20.00
23	3	2
Gender		
Male	54	36.00
Female	96	64.00
Total	150	100.00

It can be seen that the minimum age of respondents in this study is 19 years and the maximum age is 23 years. The data also shows that the majority of respondents are 21 years old, as many as 87 people (58%). Based on gender, there were more female respondents than male respondents, namely 96 people (64%) while there were 54 male respondents (36%).

Table 2. Frequency Distribution of Blue Light Exposure Questionnaire Responses

No.	Questionnaire	Frequency (n)	Percentage (%)
1	Duration (hours)		
	2 - 3	4	2.70
	>3 - 5	40	26.70
	> 5	106	70.70
2	Number of Device		
	1	6	4.00
	2 - 3	107	71.30
	>3	37	24.70
3	Nighttime use(19.00-24.00)		
	1/week	6	4.00
	2-3/week	7	4.70
	>3/week	137	91.30
	Total	150	100.00

The results of the data analysis of questions related to exposure to blue light, the majority of the duration of use is more than 5 hours as many as 106 people (70.70%), the majority of the number of devices is 2-3 devices as many as 107 people (71.30%) and the majority of use at night is more from 3 times a week as many as 137 people (91.30%) (Table 2).

Table 3. Frequency Distribution of Blue Light Exposure Categories

Categories	Frequency (n)	Percentage (%)
Good	9	6.00
Bad	141	94.00
Total	150	100.00

From the table above it (Table 3) can be seen that exposure to blue light in class 2019 students is in the bad category, namely 141 people (94%), while in the good category, there are as many as 9 people (6%).

Table 4. Frequency Distribution of PSQI Component Responses

No.	Component	Frequency (n)	Percentage (%)
1	Subjective Sleep Quality		
	Very Good	2	1.30
	Good	96	64.00
	Bad	48	32.00
	Very Bad	4	2.70
2	Sleep Latensy		
	Score 0	36	24.00
	Score 1-2	41	27.30
	Score 3-4	40	26.70
	Score 5-6	33	22.00
3	Sleep Duration (Hours)		
	>7	57	38.00
	>6-7	51	34.00
	5-6	28	18.70
	<5	14	9.30

4	Habitual Sleep Efficiency		
	>85%	126	84.00
	75-84%	15	10.00
	65-74%	5	3.30
	<65%	4	2.70
5	Sleep Disturbances		
	Score 0	9	6.00
	Score 1-9	103	68.70
	Score 10-18	35	23.30
	Score 19-27	3	2.00
6	Use Of Sleeping Medication		
	Never In A Month	144	96.00
	1 /Week	2	1.30
	2 /Week	2	1.30
	>3 /Week	2	1.30
7	Daytime Dysfuntion		
	Score 0	4	2.70
	Score 1-2	19	12.70
	Score 3-4	63	42.00
	Score 5-6	64	42.70

From the above data (Table 4) it can be seen that the majority of sleep quality subjectively is in the good category as many as 96 people (64%), sleep latency at a score of 1-2 as many as 41 people (27.30%), sleep duration> 7 hours as many as 57 people (38%)), sleep efficiency > 85% by 126 (84%), sleep disturbance at a score of 1-9 by 103 people (68.70%), use of sleeping pills with the majority never in a month by 144 (96%), and daytime dysfunction days on a score of 5-6 as many as 64 people (42.70%).

Table 5. Student Sleep Quality Level

Category	Frequency (n)	Percentage (%)
Student sleep quality		
Good	19	12.70
Bad	131	87.30
Total	150	100.00

From the table above it (Table 5) can be said that the sleep quality of students at the Faculty of Medicine, University of North Sumatera, class of 2019 is in the bad category, namely 131 out of 150 people (87.30%).

Tabel 6. Variable Normality Test

Variable	Statistic value	*p*-value
Sleep quality	0.52	<0.01
Blue light exposure	0.54	<0.01

Table 6, based on the data analysis above, it was found that the *p*-value <0.01, which is below the value of α (0.05), therefore it can be said that the data in this study were not normally distributed.

Table 7. Variable Correlation Test

Variable	Blue light exposure	Sleep quality
Blue light exposure		
Correlation Coefficient	1.00	.663
Sig. (2-tailed)	.	<.01
N	150	150
Sleep quality		
Correlation Coefficient	.663	1.00
Sig. (2-tailed)	<.01	.
N	150	150

The table 7, showed the data from the correlation test results above, the Sig. (2-tailed).0.01 means that the two variables have a significant relationship, and a correlation coefficient of 0.663 is also obtained, which indicates a strong relationship between the two variables. Relationship of Blue Light Exposure to Sleep Quality, based on this study, it can be seen that exposure to blue light has a significant relationship to deteriorating sleep quality, this is obtained from the significance value (*p*-value) which is <0.01 which is smaller than the value α (0.05) and the strength of the relationship between the two can seen from the value of the correlation coefficient of 0.663, which means that both have a strong relationship.

4. Discussion

Exposure to blue light has been shown to influence sleep quality, this aligns with previous studies that have found a meaningful association between blue light exposure and disruptions in sleep patterns [6-8]. The use of electronic devices before bedtime results in exposure to blue spectrum light, which can interfere with the brain's natural processes by delaying the release of melatonin. As a result, individuals may take longer to fall asleep, ultimately affecting their overall sleep quality [9-10].

Blue light mediates synchronization of circadian rhythms with environmental timing by modulat- ing retinal input to the circadian pacemaker, the Suprachiasmatic Nucleus (SCN) in the hypothal- amus. The SCN contains neurons that exhibit patterns of circadian activity and regulation of mel- atonin secretion by the pineal gland in response to light/dark environmental cycles. The hormone melatonin, which is released in low light conditions, is involved in the physiological control of sleep [5-7].

Intrinsically Photosensitive Retinal Ganglion Cells (ipRGCs), a specialized retinal ganglion cell, play a major role in non-image-forming photoreception such as regulating circadian light entrainment. Melatonin release from the pineal gland is controlled by a retinohypothalamic path- way derived from melanopsin-containing ipRGCs (which have a peak sensitivity of about 482 nm, which is the longer wavelength of blue-turquoise light). The light emitted by digital device screens can suppress melatonin secretion and delay sleep onset [11].

Blue Light Exposure Level and Sleep Quality Level, based on this study, it was found that 106 out of 150 samples had a duration of using digital devices that exceeded 5 hours where there was blue light which had a very strong effect on sup- pressing melatonin secretion, this was stated by Harvard health publishing, 2020, where the com- parison of the duration of blue light irradiation and green light which is 2 : 1 in shifting the circa- dian rhythm to (3 hours : 1.5 hours). At least 2 hours of exposure to blue light before going to bed can cause suppression of melatonin secretion and there have been 15 reports on this [8, 9].

Based on this study, it was found that 131 out of 150 (87.30%) of the samples studied had poor sleep quality and only about 9 (6%) had good sleep quality. class of 2019 in the bad category. In the previous study, it was also found that 62 of the 70 (86%) samples studied with medical student respondents were in the category of poor sleep quality [6]. The same thing was also obtained through research on nursing students at the University of Castilla-La Mancha where out of 207 respondents there were 67.10% of respondents who had poor sleep quality, so it can be said that students in the health sector, especially medical students, have an average sleep quality bad [10].

These findings align with previous research emphasizing the detrimental effects of blue light exposure on sleep patterns. Exposure to blue light from electronic devices suppresses melatonin secretion, delays sleep onset, and disrupts circadian rhythms. The relationship between blue light exposure and sleep quality has been consistently observed in various studies. Therefore, it is crucial to raise awareness about the potential negative impact of blue light and develop strategies to mitigate its effects, especially among students in the

healthcare field who may already experience high levels of stress and sleep disturbances. Further research and interventions are warranted to promote healthier technology usage habits and improve sleep quality among this population [11].

5. Conclusion

In conclusion, this study highlights a clear relationship between blue light exposure and reduced sleep quality among students of the Faculty of Medicine, Universitas Sumatera Utara, class of 2019. The findings show that a large proportion of students are frequently exposed to blue light due to prolonged use of digital devices, especially during nighttime. Additionally, the overall sleep quality among these students tends to be poor, suggesting that excessive screen time may be a contributing factor. These insights underscore the importance of promoting healthier digital habits to support better sleep health.

6. Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations but are available from the corresponding author upon reasonable request.

7. Ethical Statement

Ethical approval for this study was obtained from the Research Ethics Committee of Universitas Sumatera Utara.

8. Author Contributions

All authors contributed to the design and implementation of the research, data analysis, and finalizing the manuscript.

9. Funding

No funding.

10. Conflict of Interest

Authors declares no conflict of interest.

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