A Cross-Sectional Study on Digital Media Use, Sleep Quality and Sense of Time During Covid-19 Pandemic Among Undergraduate Students

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Abstract

On December 2019, the world has been struck by the Covid-19 pandemic, and this resulted in WHO declaring this pandemic a global health emergency. The current situation is probably going to negatively impact numerous components that influence sleep quality. This study was aimed to determine the association of digital media use and sense of time on sleep quality among undergraduate students during this stressful time. A cross-sectional study was conducted from April to June 2020 in Melaka Manipal Medical College, Melaka, Malaysia. Purposive sampling was used to enrol students for this study and data were collected using self-administered questionnaire. The questionnaire consists of four parts which includes sociodemographic profile, Pittsburgh Sleep Quality Index (PSQI), digital media usage 2 hours before bedtime in the last 7 days based on activities and also questions regarding their sense of time which consists of three domains; Time track, Time expansion and Schedule. Chi square test and binary logistic regression analysis were utilized. A total of 228 students participated in this study; we find that 50.4% of them were categorized as poor-quality sleepers and the other 49.6% were having good sleep quality. In binary logistic regression analysis, we discovered that, there were no significant association between digital media usage before bedtime on sleep quality of the students. Nevertheless, there is significant association between those who have difficulty in keeping track in time with the outcome of poor sleep quality. Similarly, those who frequently had feeling of boredom and feeling of time does not flow have significant association with poor sleep quality. Students that on many occasions or occasionally went to bed at their regular time have significantly lower odds of having poor sleep quality. Future research should explore association between sleep hygiene with sleep quality. Besides that, study on impact of sleep quality on physical and emotional wellbeing can also be conducted.

1. Introduction

Students classified as poor-quality sleepers revealed fundamentally increasingly mental issues, indicating a linear trend of progressively declining global sleep quality associated with greater mood and anxiety symptomatology. [1] A good quality of sleep is crucial to enable university students to understand, analyse and perceive large amount of information during the process of studying, yet they usually experience sleep problems. [2] Proper behaviour and condition are in this way, a necessity to accomplish sufficient quality and amount of sleep. In this unique situation, a few studies demonstrated the negative impacts of sleep time with blue light emitting gadget use before bedtime. [3]

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Based on a study done among university students in Malaysia, the most noteworthy access to social media was found to be during the evening time as 66.7% of them access it at the time between 8pm-12am. While, minimal time of access was in the morning between 8am-12pm in 24% of respondents. The utilization of devices (laptop, tablet or handphone) on bed not long before sleeping show significant affiliation with sleep disturbances. [4] The present study found that the greater part of the sampled students utilized electronic media to acquire new data, stay in contact with companions and for school work. This finding is reliable, found among Indian undergraduates that electronic media was utilized as a less expensive online mode for talking with friends, keeping in contact with family and for sharing pictures, documents and videos. [5] In supporting the present finding, electronic media gives advantageous methods of peer-to-peer exchange of information and collaboration. [6]

Youngsters prefer keeping their phones within close reach during the night because of sentiments of detachment and missing out without access to social media. [7] This has suggestions for sleep outcomes, as users who invested more time on social media complained of poor sleep quality and may find it a burden to detach from social media before bed time. [8]

The possible connection between electronic media use and sleep has been ascribed to three well-notable underlying mechanisms for the unfriendly effect of electronic media use on sleep. First, the time youths spend on electronic media may infringe on the time that is accessible to rest, this is the time displacement hypothesis. Secondly, electronic media use is known to increase arousal. [9] For instance, in a study conducted by Mauri and colleagues in 2011, found that during Facebook use, participants demonstrated high physiological excitement. These increased levels of physiological excitement may make it progressively hard for young people to fall asleep. [10] Third, when youth are involved in electronic media, they are exposed to bright screen lights which can interrupt the secretion of melatonin, which is the sleep hormone. [11] In accordance with this reasoning, it has been demonstrated that individuals who use electronic media that emits bright screen lights before sleep time, all things considered take more time to fall asleep, their circadian rhythms are disturbed, and they experience an increase in daytime lethargy. [12] Whereas one study showed that increase in frequency of usage was related to more sleep disturbances, including having more difficulty falling asleep along with lower sleep quality. [13] Moreover, study that have been carried out among young adults demonstrated that electronic media reliance caused the delay in sleeping and rising times. [14]

Given the fairly limited proof on young adults' electronic media use and sleep, little is thought about what groups might be increasingly susceptible to potential negative impacts. Media effect studies have emphasized that media effects may not be similar for all media users. [15] Studies have reported remarkable gender differences in electronic media use among young people and adults, and that females exhibit extreme use than males in general. [16, 17] A research carried out in Sweden, indicated that excessive use of online correspondence was bound to cause sleep disruption and increased tensity among females. [18] However, other studies noticed no gender difference for electronic use among adults. [19] Notable gender differences are recorded in terms of sleep as well. Furthermore, the relationship between various sorts of electronic media use and sleep complaints appear to be different for young males and females. [20, 21]

On the 31st of December 2019, public health officials from China informed the World Health Organization (WHO) that an unknown new virus was causing pneumonia-like illness in Wuhan, Hubei Province, China. A novel coronavirus was eventually identified, which was named as Covid-19. Since then, it had spread globally and on the 11th of March 2020, WHO declared it as a pandemic. [22] Since the emergence of Covid-19 in Malaysia, the Malaysian government has implemented the procedures set by WHO and has counsel experts to deal with and mitigate further transmission of the disease. [23] The pandemic not only has brought the risk of death from the disease but also intolerable psychological pressure, especially among students. [24] The present situation is probably going to negatively effects numerous components that influence sleep quality. A great number of people are encountering major changes in their routines, living with uncertainty, and with stress, insecurity about their health, and worries about the situation and its duration. Most working parents are having to combine their work with home-schooling, home organization and household errands. Every one of these changes, thus may influence how many hours a day they can really spend on sleep and rest. [25]

Based on a study conducted in Italy during the restriction of Covid-19 pandemic, it has been found that there was an increase in frequency of digital media use before going to the bed from approximately 27 activities per week before the restriction to approximately 31 activities during the lockdown. There was also significant increase in the Pittsburgh Sleep Quality Index (PSQI) score under the implementation of lockdown which indicates that the sleep quality has worsen with no difference between students and workers. The proportion of poor sleepers increased from 40.5% to 52.4%. Concerning time experience, the lockdown prompted a significant surge in difficulty to monitor time with individuals

encountering disarray about what day of the week, of the month, and what time of the day was, around multiple times in the week compared to 3 times before lockdown. Additionally, they encountered an expansion of time during the lockdown, with individuals progressively feeling bored and they felt stuck in time around 5 times in the week in contrast with 3.5 occasions before lockdown. The increased in digital media use before bed moderately affect sleep habits such as sleep latency, bed-time and wake-time but not sleep quality. [26]

Based on our knowledge, there is no such research that assesses the digital media use before bed, sleep quality and sense of time during Covid-19 pandemic in Malaysia especially among undergraduate students. The objectives of our study are to determine the sleep quality among undergraduate students during Covid-19 pandemic as well as to assess the frequency of digital media use before bed in the last 7 days. Furthermore, we would also like to determine the sense or perception of time of the undergraduate students during the pandemic. We also would like to ascertain the association between sleep quality, digital media usage before sleep and sense of time during Covid-19 pandemic among undergraduate students in Malaysia.

2. Methodology

2.1. Study Design and Study Time

The study conducted was a cross sectional study, conducted from April to June 2020 in our college, Melaka Manipal Medical College, Melaka, Malaysia.

2.2. Study Setting and Study Population

Undergraduates students of Melaka Manipal Medical College (MMMC), a private institution located in Malaysia which consists of two campus, in Muar, Johor and Bukit Baru, Melaka was part of this study. This campus consists of 3 courses, Foundation in Science (FIS), Bachelor of Dental Surgery (BDS), and Bachelor of Medicine and Bachelor of Surgery (MBBS). The Muar campus offer MBBS semester 6 and 7, while Melaka campus offer MBBS semester 8, 9, 10, BDS and FIS.

2.3. Sample Size

According to a previous study conducted in Italy during the Covid-19 pandemic, they found that 57.1% of the participants experienced poor sleep quality, from which an estimated proportion of 0.571 was taken. [27] Based on the application software "Epi Info version 7.2.3.1" with population size of 1100, expected frequency of 57.1%, and precision error of 7%, therefore with a confidence level of 95% we conclude that our sample size is 163.

Figure 1. Sample size.

We allowed non-response of 20% and n_{final} was determined using the formula stated below:

$$n_{final} = \frac{n_{calculated}}{1 - non\ response\%} = \frac{163}{1 - 0.2}$$

204 was considered the final sample size for this research.

2.4. Sampling Method

Purposive sampling which is a non-probability sampling method was utilized while conducting the study. The inclusion criteria were MBBS, BDS and FIS students who voluntarily consented to participate in the study and the questionnaires must be completed to be considered valid for the research after they filled up the consent form. Exclusion criteria included those who did not give consent, not available when the questionnaires were distributed, incomplete questionnaires and irrelevant responses. Our questionnaires were circulated to MBBS students of semester 6 and 7 from Muar Campus and semester 8, 9 and 10 from Melaka campus. In addition to this, BDS students and FIS students from Melaka Campus were also included.

2.5. Data Collection

The independent variables for this study are gender, ethnicity, and digital media use 2 hours before bedtime among undergraduate students as well as sense or perception of time among undergraduate students during Covid-19 pandemic. While the dependent variables are the sleep quality.

The questionnaire consisted of four parts. The first part contained the demographic data (age, gender, ethnicity, nationality and study program). The second part included the Pittsburgh Sleep Quality Index (PSQ1) which consisted of 19 questions related to the usual sleep habits during the past month of the participants. [28] There are several domains that

made up the questionnaire which will be totalled up to give a global PSQI score with a range of 0 to 21. It included sleep durations, sleep disturbance, sleep latency, daytime dysfunction, habitual sleep efficiency, overall sleep quality and use of sleeping medications. Total PSQI score of 5 or less indicate good sleep quality and score higher than 5 indicate poor sleep quality. Besides that, from the PSQI we also derived information about how many hours they spent in bed.

The third part is regarding digital media use near bedtime. The use of digital media was assessed by asking participants to report the frequency of digital media activity choices use by them in the two hours before bedtime in the previous week. Based on the work of Orzech et al. (2016), ten digital media activities were selected which includes, computer work, email/instant messaging, social networking site, videogame, surf internet, videocall/call on phone, watch online video, read e-book, watch TV/DVD, watch TV series. [29] Response options consists of "Never", "One day", "Two days", "Three days", "Four days", "Five days", "Six days" and "Everyday" were transformed into weighted responses to estimate total digital media use per week (range 0-70), as previously done by Orzech et al. (2016).

Participant's ability to keep track of physical time, subjective experience of time and to assess regularity of daily routines were assessed in the fourth part. The questions were based on the study conducted by Cellini et al. (2020). [26] To assess the ability of participants to keep track of physical time (Time Track), 3 items referring to the difficulties to remember the day of the week, the day of the month, and to keep track of the time of the day were included with a Yes or No option. If any of the question was answered with a Yes option, they are considered to have difficulty in keeping track of time. For the evaluation of the subjective experience of time (Time Expansion), 2 items referring to the feeling of boredom and of the time that does not flow were used. For each statement, participants can choose either "Never", "Rarely", "Sometimes", "Very often", or "Always". To assess the regularity of daily routines (Schedule), 2 items referring to maintaining routines such as meal- and bed-times were used with the response options identical to the Time Expansion. For data analysis, the data of Time Expansion and Schedule, was then categorized into Never/Rarely, Sometimes and Very often/Always to evaluate its association with sleep quality.

2.6. Data Processing and Data Analysis

The data collected from the distributed questionnaires were processed with Microsoft Excel. All the processed data were analysed by using Epi Info version 7.2.3.1 from the Centers for Disease Control and Prevention website (CDC). For the quantitative data (age, frequency of digital media use 2 hours before bed, PSQI score and hours spent in bed) the mean and standard deviation were calculated, whereas for the qualitative data (gender, ethnicity, nationality, program, sleep quality, and sense or perception of time among medical undergraduates during Covid-19 pandemic), the frequency of those data were counted and the percentage were calculated. We set the level of significant at 5% which is 0.05. Statistical test that was used for the hypothesis testing was determined based on the independent and dependent variable and the details are tabulated as below.

Table 1. Statistical test used.

Independent variable	Dependent variable	Statistical test
Gender (Male, Female)	Sleep quality	Chi-square test
Ethnicity (Malay, Chinese, Indian, Others)	Sleep quality	Chi-square test
Nationality (Malaysian, International students)	Sleep quality	Chi-square test
Digital media use 2 hours before bedtime among medical undergraduates.	Sleep Quality	Binary logistic regression
Sense or perception of time	Sleep quality	Chi-square test

2.7. Ethical Consideration

Participations of the study were purely voluntary. Consent of the participants were gained through means of informed consent forms provided by our team, signed by the subjects themselves agreeing that they participated in the study through their own will. They were able to withdraw at any time without any reason. It should be noted that confidentiality of all information was maintained throughout the study. Furthermore, the study was ethically conducted with approval obtained from the Research Ethics Committee, Faculty of Medicine of Melaka Manipal Medical College, Malaysia.

3. Results

Table 2. Sociodemographic characteristics of undergraduate students (n = 228).

Variables	Frequency (%)
Age	
<22	67 (29.4)
22-23	128 (56.1)
>23	33 (14.5)
Mean (SD)	21.8 (2.0)
Minimum – Maximum	16.0-27.0
Gender	
Male	64 (28.1)
Female	164 (71.8)
Ethnicity	
Malay	41 (18.0)

Variables	Frequency (%)
Chinese	62 (27.2)
Indian	96 (42.1)
Others	29 (12.7)
Nationality	
Malaysian	213 (93.4)
International students	15 (6.6)
Program	
MBBS	142 (62.3)
BDS	43 (18.9)
FIS	43 (18.9)

Table 2 shows the sociodemographic characteristics of undergraduate students. Age of the students were divided into 3 groups in this study, 29.4% were less than 22 years, 56.1% were between the ages of 22 to 23, and 14.5% were from ages more than 23. The mean age was 21.8 years with a standard deviation of 2.0. The minimum age was 16 while the maximum age of the undergraduate students was 27. Majority of the students were females, 71.8% compared to males which is 28.1%. The percentage of Indians students in this study was 42.1%, followed by 27.2% Chinese students, 18.0% Malay students, and 12.7% of others ethnicity. 93.4% of students were Malaysians and only 6.6% were non-Malaysians. Majority of the undergraduate students in this study is from MBBS program, 62.3% while the percentage of students enrolled in BDS and FIS program was similar at 18.9%.

Table 3. Sleep quality categories and PSQI score of undergraduate students (n=228).

Variables	Frequency (%)
Sleep quality	
Good	113 (49.6)
Poor	115 (50.4)
PSQI Score	
Mean (SD)	5.97 (3.3)
Median (Q1, Q3)	6.0 (4.0,8.0)
Minimum - Maximum	0.0–18.0

Table 3 shows the sleep quality categories and data on PSQI score of undergraduate students. Out of the 228 participants, 49.4% of them experiences good sleep quality while 50.4% have reported poor sleep quality. The mean PSQI score of the undergraduate students was 5.97 with a standard deviation of 3.3. Median PSQI score was 6.0 with 4.0 and 8.0 as the first quartile and third quartile respectively. Minimum PSQI score obtained by the undergraduate students was 0.0 whereby the maximum score was 18.0.

Table 4. Descriptive statistics of hours spent in bed of undergraduate students.

Variables	
Hours spent in bed	
Mean (SD)	7.4 (1.8)
Median (Q1, Q3)	7.5 (6.3,8.5)
Minimum-maximum	3.0-13.5

Based on the PSQI questionnaire, we were also able to derive number of hours the participants spent in bed during the past month as illustrated in Table 4. Mean hours of the participants spent in bed was 7.4 with a standard deviation of 1.8. While, the median was 7.5 hours with first and third quartile of 6.3 and 8.5 respectively. The minimum hours the participants spent in bed was 3.0 whereby 13.5 was the maximum hours they spent in bed.

Table 5. Digital media activity uses by the participants in the two hours before bedtime in the last 7 days.

Variables	
Digital media activity per week (0-70)	
Mean (SD)	37.4 (16.9)
Median (Q1, Q3)	38.5 (23.0,51.0)
Minimum-Maximum	1.0 – 70.0

Table 5 highlights the digital media activity used by the participants in the two hours before bedtime in the previous week, which has a mean of 37.4 with a standard deviation of 16.9. The median of the data above shows a total of 38.5, with first quartile of 23.0 and third quartile of 51.0. Next, the minimum and maximum digital media activity used by the participants in the two hours before bedtime in the previous week are 1.0 and 70.0, respectively.

Table 6. Response of undergraduate students regarding sense of time (n=228).

TIME TRACK	Frequency (%)
Difficulties to remember the day of the week	
Yes	61 (26.8)
No	167 (73.2)
Difficulties to remember the day of the month	
Yes	87 (38.2)
No	141 (61.8)
Difficulties to keep track of the time of the day	
Yes	52 (22.8)
No	176 (77.2)
TIME EXPANSION	
Feeling of boredom	
Never	9 (3.9)
Rarely	36 (15.8)
Sometimes	111 (48.7)
Very often	44 (19.3)
Always	28 (12.3)
Feeling of time that does not flow	
Never	52 (22.8)
Rarely	66 (28.9)
Sometimes	77 (33.8)
Very often	23 (10.1)
Always	10 (4.4)
SCHEDULE	
Eating meals at regular time	
Never	6 (2.6)
Rarely	26 (11.4)
Sometimes	54 (23.7)
Very often	81 (35.5)
Always	61 (26.8)
Went to bed on their regular time	
Never	21 (9.2)
Rarely	48 (21.1)
Sometimes	71 (31.1)
Very often	60 (26.3)
Always	28 (12.3)

Table 6 shows the frequency and percentage of the response by the participants in assessing their sense or perception of time. In assessing Time Track or their ability to keep tracking of the time, 26.8% of the participants answered "Yes" for difficulties to remember the day of the week and 73.2% answered "No". Next, 38.2% of the participants reported that they have difficulties in remembering the day of the month while 61.8% do not have those difficulties. Meanwhile, the frequency of the participants that replied to have difficulties to keep track of the time of the day were 22.8% and 77.2% of the participants chose "No" as their response.

In time expansion, 3.9% of participants responded that they have "Never" felt bored while 19.3% felt bored "Very often" and 12.3% were "Always" bored. Moreover, the frequency of participants that reported to feel bored "Sometimes" and got bored "Rarely" was 48.7% and 15.8% respectively. With respect to "time that does not flow", 33.8% "Sometimes" encountered that feeling, 28.9% "Rarely" felt it, 4.4% of

people "Always" felt that time did not flow and 10.1% of the participants felt it "Very often". Other than that, 22.8% of the participants "Never" felt that time did not flow.

According to schedule of undergraduate students, Table 5 has shown that the majority of the students (35.5%) "Very often" had meals at regular timings. The remaining students who "Always" had meals at regular timings consists of 26.8% of all students, while the ones who "Sometimes" had meals at regular timings are only 23.7%, those who "Rarely" had meals at regular times are only 11.4% of all students, and only 2.6% of undergraduate students were found to "Never" have meals at regular times. Regarding the schedule of bed timings, among all undergraduates only 31.1% "Sometimes" went to bed on their regular times, while 26.3% of them "Very often" went to bed on their regular times. Individuals who "Rarely" went to bed on their regular times consists of 21.1% of students only, while 12.3% of them "Always" and 9.2% of them "Never" went to bed on regular times.

Table 7. Association between gender, ethnicity and nationality with sleep quality among undergraduate students (n=228).

Independent variables	Sleep quality		OR (95% CI)	Chi-square	P-value
	Poor n (%)	Good n (%)			
Gender					
Male	30 (46.9)	34 (53.1)	0.8 (0.5,1.5)	0.5	0.501
Female	85 (51.8)	79 (48.2)	1 (Reference)		
Ethnicity					
Chinese	24 (38.7)	38 (61.3)	1 (reference)		
Malay	22 (53.7)	19 (46.3)	1.8 (0.8,4.1)	2.2	0.135
Indian	55 (57.3)	41 (42.7)	2.1 (1.1,4.1)	5.2	0.023
Others	14 (48.3)	15 (51.7)	1.5 (0.6,3.6)	0.7	0.389
Nationality					
Malaysian	109 (51.2)	104 (48.8)	1.6 (0.5,4.6)	0.7	0.403
International students	6 (40.0)	9 (60)	1 (Reference)		

Table 7 illustrates the association between the sociodemographic profiles with sleep quality among undergraduate students. According to our study, the odds of males in having poor sleep quality is 0.8 times less likely compared to females. However, the finding was not significant (95% CI 0.5-1.5; x^2 0.5; p-value 0.501). As for ethnicity, the odds of having poor sleep quality is 1.8 times more likely in Malay participants as compared to Chinese, nevertheless it is not significant (95% CI 0.8-4.1; x^2 2.2; p-value 0.135). In comparison with Indian participants, it was noted that the odds

of having poor sleep quality is 2.1 times more likely in contrast to Chinese participants. This finding was statistically significant (95% CI 1.1-4.1; x^2 5.2; p-value 0.023). Furthermore, the odds of other ethnicities in having poor sleep quality is 1.5 times higher compared to Chinese, however this finding is not statistically significant (95% CI 0.6-3.6; x^2 0.7; p-value 0.389). The other variable was found to be insignificant. Malaysian students were 1.6 times more likely to have poor sleep quality compared to the international students (95% CI 0.5-4.6; x^2 0.7; p-value 0.403).

Table 8. Binary logistic regression of digital media activity used by the participants in the two hours before bedtime with sleep quality.

Independent variable	Sleep Quality	SE	P-value
	OR (95% CI)		
Digital media activity uses by the participants in the two hours before bedtime in the last 7 days. (Total score)	1.0 (0.9,1.0)	0.003	0.362

Table 8 focuses on the binary logistic regression of digital media activity used by the participants in the two hours before bedtime in the last 7 days with sleep quality. In our study, we determined that the data is not statistically

significant and there were no association between the frequency of digital media use by the participants within two hours before bedtime in the previous week with their sleep quality (95% CI 0.9-1.0; p-value 0.362).

Table 9. Association between sense of time and sleep quality among undergraduate students (n=228).

Independent variables	Sleep quality		OR (95% CI)	Chi-square	P-value
	Poor n (%)	Good n (%)			
Difficulty in keeping track of time					
Yes	66 (61.7)	41 (38.3)	2.4 (1.4,4.0)	10.2	0.001
No	49 (40.5)	72 (59.5)	1 (Reference)		
TIME EXPANSION					
Feeling of boredom					
Very often/Always	51 (70.8)	21 (29.2)	5.4 (2.4,12.1)	17.7	<0.001
Sometimes	50 (45.1)	61 (54.9)	1.8 (0.9,3.9)	2.6	0.109
Never/Rarely	14 (31.1)	31 (68.9)	1 (Reference)		
Feeling of time that does not flow					
Very often/Always	26 (78.8)	7 (21.2)	4.3 (1.7,10.6)	10.7	0.001
Sometimes	34 (44.2)	43 (55.84)	0.9 (0.5,1.6)	0.1	0.737
Never/Rarely	55 (46.6)	63 (53.4)	1 (Reference)		
SCHEDULE					
Eating meals at regular time					
Very often/Always	65 (45.8)	77 (54.2)	0.5 (0.2,1.1)	2.9	0.087
Sometimes	30 (55.6)	24 (44.4)	0.8 (0.3,1.8)	0.4	0.528
Never/Rarely	20 (62.5)	12 (37.5)	1 (Reference)		
Went to bed on their regular time					
Very often/Always	25 (28.1)	64 (71.9)	0.1 (0.1,0.2)	38.3	<0.001
Sometimes	37 (52.1)	34 (47.9)	0.3 (0.1,0.6)	10.2	0.001
Never/Rarely	53 (77.9)	15 (22.1)	1 (Reference)		

Table 9 shows the association between the sense of time and sleep quality among 228 undergraduate students. Students who have difficulty in keeping track of time are 2.4 times more likely to have poor sleep quality compared to those who voted have "No". This finding is statistically significant (95% CI 1.4-4.0; x^2 10.2; p-value 0.001). Concerning time expansion, undergraduate students have also experienced the feeling of boredom and also feeling of time that does not flow. It is shown that participants who "Very Often/Always" are 5.4 times more prone to face poor sleepy quality compared to those who "Never/Rarely" felt boredom. This finding is therefore statistically significant (95% CI 2.4-12.1; x^2 17.7; p-value <0.001). Students who "Sometimes" experienced feeling of boredom are 1.8 times more likely to have poor sleep quality compared those who voted "Never/Rarely". This finding is not significant, and there is no obvious association (95% CI 0.93.9; x^2 2.6; p-value 0.109). With respect to feeling of time that does not flow, participants who voted "Very Often/Always" are 4.3 times more likely to have poor sleep quality compared to those who voted "Never/Rarely". This finding is significant (95% CI 1.7-10.6; x^2 10.7; p-value 0.001). Students who "Sometimes" felt that time does not flow are 0.9 times less likely to have poor sleep quality compared to who "Never/Rarely" felt this feeling nevertheless this is not significant (95% CI 0.5-1.6; x^2 0.1; p-value 0.737).

In terms of schedule, the odds of participants who "Very often/Always" eat their meals at regular time is 0.5 times less likely to have poor sleep quality than participants who "Never/Rarely" took their meals at regular time. This finding is not significant (95% CI 0.2-1.1; x^2 2.9; p-value 0.087). In addition to this, participants who "Sometimes" took their meals at regular time is 0.8 times less likely to have poor sleep quality in contrast to those who "Never/Rarely" took their meals at regular times. However, this finding is also not statistically significant (95% CI 0.3-8.1; x^2 0.4; p-value 0.528). According to our study, those participants who "Very often/Always" went to bed on their regular time were significantly 0.1 times less likely to have poor sleep quality compared to those who "Never/Rarely" went to bed on their regular time (95% CI 0.1-0.2; x^2 38.3; p-value <0.001). We also found out that participants who "Sometimes" went to bed on their regular time is 0.3 times less likely to have poor sleep quality when compared to those who "Never/Rarely" went to bed on their regular times. This discovery shows statistically significant association (95% CI 0.1-0.6; x^2 10.2; p-value 0.001).

4. Discussion

A cross-sectional study was conducted to determine the sleep quality among undergraduate students during Covid-19 pandemic as well as to assess the frequency of digital media use before bed in the last 7 days. Furthermore, we would like to determine the sense or perception of time of the undergraduate students during the pandemic. We also would like to ascertain the association between sleep quality, digital media usage before sleep and sense of time during Covid-19 pandemic among undergraduate students in Melaka Manipal Medical College, Malaysia. In our study, we found out that 50.4% of the students experienced poor sleep quality while only 49.6% of them experienced good sleep quality. Moreover, this study also shows that the mean PSQI score was 5.97 ± 3.3. In a previous study that was done among

tertiary students in Malaysia in 2013, 32.9% of the students were defined as poor quality sleepers. [30] Similarly, a study that was done in Saudi Arabia among medical students in 2017, shows high prevalence of poor sleep quality (76%) with mean PSQI score of 7.11 ± 3.84. [31] During Covid-19 pandemic, Cellini and colleague found out that 52.4% of their participants in Italy experienced poor sleep quality which has increased since the implementation of lockdown. [26] Whereas, a similar study that was conducted in Italy to study the effects of quarantine on sleep quality during Covid-19 revealed that 57.1% of participants reported of poor sleep quality. [27]

In our study, it was found that the mean usage of digital media activities two hours before bedtime among the participant in the last 7 days was of 37.4 (out of maximum possible score of 70). A similar study conducted in Morocco among young medical students in 2019 showed that around 97.3% of the students used blue-emitting devices before bed and 35.3% among them were presented with poor sleep quality of (PSQI score >5). [3] However, in a study done among Italians, there was an increase in the usage of digital media near bedtime during the lockdown of Covid-19. [26] In addition to this, another study on digital technologies and their impact on public-health strategies done in 2020, it was found that an increment in the usage of digital media during the Covid-19 pandemic. [32]

We found that in our study, while assessing Time Track or their ability to keep track of the time, one quarter of the participants had difficulties to remember the day of the week. Other than that, 38% of them reported that they have difficulties in remembering the day of the month. Meanwhile, one fifth of the participants had replied to have difficulties to keep track of the time of the day. According to the study done in Italy, as regards to track of time, the Covid-19 pandemic prompted an obvious rise in difficulty remembering the day of week, the month, and the time of the day which was around 6 times per week in contrast to 3 times before the implementation of lockdown. [26] We found that in time expansion, nearly half of the participants reported feeling bored sometimes, while one third of the participants sometimes encountered the feeling of time that does not flow. Based on the study conducted in Italy, the people encountered an extension of time during the lockdown, with them progressively feeling a sense of boredom and feeling that time does not flow around 5 times per week compared to 3.5 times before lockdown. [26] Regarding the schedule of undergraduate students, our study also showed that the majority of the students, very often and always had meals at regular timings but only 38% of them voted very often and always when it comes to going to bed at regular time.

In this research, we concluded that there is no association between the frequency of digital media use by the participants within two hours before bedtime in the last 7 days with their sleep quality. In the study conducted on changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy, it has been shown that during the first week of lockdown there were not many disturbances in sleep. However, during the second week of the lockdown the usage of digital media increased profoundly and sleep–wake rhythms markedly changed, with people going to bed and waking up later, and spending more time in bed, but they also reported a lower sleep quality. [26] An experimental study design that was conducted among healthy young adults in Boston, United States of America which compared the biological effects of reading an electronic book on a light-emitting device with reading a printed book in the hours before bedtime, showed that increase in frequency of electronic media usage before bedtime resulted in the participants having more difficulty falling asleep along with lower sleep quality. [12] In 2011, Mauri and colleagues conducted a study among students from IULM University of Milan and Catholic University of Milan to find out whether the use of social networking sites elicits a specific psychophysiological pattern. They discovered that when the participants use social networking sites such as Facebook and Myspace, they demonstrated increased physiological excitement which made it hard for them to fall asleep. [10]

In our study, participants who had agreed to having difficulties keeping track of time have shown significant association with outcome of poor sleep quality. In a study that was aimed to determine the effects of the sleep quality and sleep length on the retention of autobiographical memories among Dutch volunteers residing in the Netherlands, it showed that poor sleep quality was associated with deteriorating autobiographical memory performance. [33] In terms of time expansion, we discovered that there was a significant relationship between sleep quality and boredom. A study which was done in the United States of America among adolescents, revealed a significant relationship between amount of sleep and boredom in females when compared with males. [34] Boredom can lead to disrupted sleep in humans as observed in a research done among inpatients in a Chinese General Hospital in 2009. [35] Based on our findings, we also concluded that the students who on most occasions feeling time that does not flow have significant outcome with poor sleep quality. Cellini and her colleagues determined that an increase in subjective time dilation was affiliated with poorer sleep quality among the Italian population during Covid-19 lockdown. [26]

Based on our study, we ascertained that those participants who

on most occasions or occasionally have meals at their regular time are less likely to have poor sleep quality. In a study conducted in 2011 that was conducted to analyse relationship between food intake and sleep patterns in healthy individuals, it was found that food intake during the nocturnal period is associated with negative impacts on the sleep quality. Intake of food near the sleeping period such as dinner and late-night snack was negatively associated with sleep quality. [36] In another research done in the United States of America that targeted the impact of sleep and meal misalignment on resting state functional connectivity, which was done among participants who were non-smokers, regular breakfast eaters and inactive, they observed that there was an interaction between effect of sleep and mealtime. [37] Similarly, in another experimental study done among female participants with night eating syndrome and control subjects done at the Hospital of the University of Pennsylvania, the researcher found out that participants with night eating syndrome have reported greater sleep disturbance that included lower sleep quality. [38] Furthermore, we found out that participants who went to bed at regular times at intervals of sometimes, very often and always are said to be significantly associated with sleep quality during this Covid-19 pandemic. According to a study that was conducted in Taiwan among university students in 2009, it was discovered that students with unpredictable bedtime had poor sleep quality even after an adjustment to sleep timings. Other than that, in that study it was also determined that students with uncertain bedtime also had moderately short average sleep time daily, which could put them in danger of sleep inadequacy. [39]

There were few limitations in our study. We conducted this study within 6 weeks and our study was a cross-sectional study which allowed us to observe participants at one point in time only. Hence, we were unable to establish temporal relationship between digital media use, sense of time and also sleep quality. Secondly, we are unable to study the incidence rate of sleep quality among the students before the Covid-19 pandemic, therefore we were unable to observe the variability before and during the pandemic. Besides that, our study was done among undergraduate students of MMMC only, therefore the study cannot be generalized to other population or settings. Since we discovered that majority of the undergraduate students have poor sleep quality during this pandemic, thus students should equip themselves with knowledge on proper sleep hygiene practices and apply them in their daily lives to minimize sleep disturbances. Consequently, future research should explore association between sleep hygiene with sleep quality. Besides that, study on impact of sleep quality on physical and emotional wellbeing can also be conducted.

5. Conclusion

In conclusion, among undergraduate medical students of MMMC, it was found that 50.4% had poor sleep quality while 49.6% of them experienced good sleep quality. We determined in our study, that there is no association between digital media used in 2 hours before bedtime with the outcome of sleep quality among students during this Covid-19 pandemic. Whereas, in the case of sense of time and sleep quality, those who had difficulty in keeping track of time showed significant association with poor sleep quality while those who felt bored and time that does not flow in relation with sleep quality displayed great association as well. In terms of schedule and sleep quality, students who went to bed and had meals at regular time have significant negative association with poor sleep quality. Hence, to improve the sleep quality, first and foremost students should maintain a regular sleep schedule by going to bed and waking up at the same time each day without any delay. Also, be cautious not to sleep for a prolonged period as excessive sleep can cause the feeling of frustration and fatigue. This being said, afternoon nap should be avoided and should be motivated to stay active during the day by working out or exercising at home. Usage of electronic devices such as cell phones should be limited at least an hour before going to bed. Future research should explore association between sleep hygiene with sleep quality. Besides that, study on impact of sleep quality on physical and emotional wellbeing can also be conducted.

Acknowledgements

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