

Original Research Article

Bedtime Electronic Device Usage and Daytime Sleepiness aAmong Medical Students: A Cross-sectional Study

ABSTRACT

Introduction: In the 21st century, use of digital devices has become a daily ~~thing~~affair. This has led to excessive daytime sleepiness, which ~~is~~has also ~~been~~prevalent among medical students. However, there is a gap of awareness regarding the association of the use of digital devices and its impact on sleep.

Aim: This study was carried out to determine the prevalence of daytime sleepiness among medical students, and the awareness of the association between daytime prevalence and use of digital devices.

Study design: A cross-sectional analytical study

Methodology: This study was conducted at a private medical university among medical students. Purposive sampling was done to enroll respondents. A questionnaire was distributed online using Google forms to undergraduate students. The data was statistically analysed using Epi Info version 7.2.5.0 the statistical test conducted was chi square test and Fisher's exact test. The frequency and percentage were then analysed for qualitative data.

Results: A total of 123 students responded to the survey. In this study, 39.84% respondents reported of having excessive daytime sleepiness, with a mean score for the ESS ~~(expand)~~scale at 9.49 (SD \pm 3.85). When considering the level of awareness, Chinese ethnicity had high level of awareness than the other groups of ethnicities. There was no statistically significant association between the demographic characteristics and daytime sleepiness and awareness levels among the respondents.

Conclusion: This study showed that there was a higher prevalence of excessive daytime sleepiness than other populations. However, most of the participants did not have negative impact on their work and social life.

Keywords: Awareness, Bedtime Electronic Device Usage, Daytime Sleepiness.

1. INTRODUCTION

Sleep is an important physiological need of every individual in order to achieve a healthy lifestyle. Sleep is vital for various reasons such as dealing with stress the entire day, to prevent exhaustion, to conserve energy and for body and mind healing [1]. The sleep-wake cycle regulates the phenomena of drowsiness, which is characterised by a strong desire to sleep [1]. Extreme drowsiness refers to a strong desire to sleep in settings requiring a person to be up and alert during the day [2]. Sleep issues affect over one-third of the adult

23 population, and this ratio is significantly greater among the student population due to their
24 unique lifestyle [3]. Carter et al. found that using media devices before bedtime was
25 associated with poor sleep quality and increased daytime sleepiness in a recent meta-
26 analysis [4]. This is especially the case in the bedroom, which has become a media-rich
27 environment in many homes. The smartphone, in particular, has made it convenient to use
28 at least one sort of electronic gadget in bed because of its accessibility, portability, and
29 connectivity [5]. Even in 2011, the National Sleep Foundation's 2011 Sleep in America poll
30 found that 95% of respondents used electronic devices within the hour before bedtime at
31 least a few evenings a week [6]. Several studies have shown that using cellphones for a
32 lengthy period of time have resulted in reduced sleeping hours, weariness, later rising
33 timings, insomnia etc [7-9]. A study conducted in Malaysia in 2009 with medical students
34 showed that daytime sleepiness was present in 35.5% of the participants [10], and a study
35 done in Brazil in 2022 compared technology and daytime sleepiness, and showed daytime
36 sleepiness in 34% of the participants [11].

37 There is a considerable effect on circadian rhythm in those students as a result of
38 continuous usage of mobile phones, particularly at night, which has a detrimental impact on
39 sleep quality. The use of gadgets with light-emitting diode (LED) backlight screens before
40 night has been demonstrated to have a deleterious impact on sleep and circadian rhythm
41 [12]. The blue region of the visible spectrum of light is abundant in light emitted from mobile
42 phone screens. The retinal ganglion cells that contain melanopsin are highly stimulated by
43 this type of light. The activation of those cells reduces tiredness by inhibiting melatonin
44 release from the pineal gland. Normal sleep-wake cycles are disrupted, sleep is postponed,
45 and melatonin secretion is reduced when people use cell phones, especially at night [1]. In
46 comparison to the general population and other students, medical students are more likely to
47 suffer from sleep disturbances [13]. This outcome was most likely attributable to medical
48 students' unique lifestyles, which included late-night studying, irregular sleep, and chronic
49 weariness, especially during exam season [1]. The use of LED backlight gadgets before
50 bedtime had a negative effect on sleep and circadian rhythm in people, as demonstrated in a
51 study [12]. According to the findings of study done by Rafique et al, participants who used
52 the cell phone for at least 30 minutes after the lights had been turned off (without a blue light
53 filter) had a strong positive link with poor sleep quality, daytime sleepiness, sleep
54 disruptions, and increased sleep latency [14]. Wearers of a blue light shield worn two hours
55 before sleep had dramatically reduced sleep latency compared to controls in an
56 interventional research [15].

57 Another interesting finding found from the study was that by keeping the phone close to the
58 pillow while asleep produced higher sleep latency, sleep disruptions, and daytime tiredness.
59 This is due to the vibrations from notifications and messages, heat generated by charging
60 phones, and radiofrequency electromagnetic field (RF-EMF) radiation from mobile phone.
61 Electroencephalogram (EEG) alterations in Rapid eye movement (REM) and non-REM sleep
62 can be caused by RF-EMF exposure [16]. These RF-EMFs can pass through the skull and
63 into the brain, resulting in neuronal hyper-excitability and a variety of sleep disorders [17].

64 There have been many researches done regarding sleep quality in the International
65 Community [7-11]. However, there is a lack of sufficient researches with regard to the
66 association between the use of electronic devices before bedtime and daytime awareness.
67 Also, the studies done regarding this is very limited when considering with regard to the
68 Medical Students in Malaysia. Hence, this study hopes to address this area for research.
69 The aim of this study was to determine the prevalence of daytime sleepiness among medical
70 students of MUCM, and the awareness of the association between daytime prevalence and
71 use of digital devices.

Comment [A1]: Reframe the sentence

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2. MATERIAL AND METHODS

2.1 STUDY DESIGN AND SETTING

76 This cross sectional study was conducted from May 2022 to July 2022 in a private medical
77 university. The participants involved in the study were undergraduate students from MBBS
78 programs.

2.2 STUDY INSTRUMENT

80 The study was done via a questionnaire distributed online via Google forms. The
81 questionnaire included the following sections: (1) Demographic details (Batch, International
82 or Local students, Ethnicity etc.), (2) Questions regarding the participant's usage of digital
83 devices and variable factors (Number of devices, how long they use devices before sleep,
84 Hours of sleep they obtain etc.), (3) Daytime Sleepiness, and (4) the awareness of
85 participants with regard to the relationship between sleep and use of screens. Daytime
86 sleepiness was measured by using the validated questionnaire "Epworth Sleepiness Scale",
87 which is authored by Johns MW, and is distributed by "Mapi Research Trust, through
88 eProvide platform".

89 The reliability analysis was calculated for these 13 items on awareness, and had a score of
90 0.747 on Cronbach's Alpha Based on standardized items. This was >0.7 , and hence
91 considered as acceptable reliability.

2.3 SAMPLE SIZE AND SAMPLING

93 Sample size was calculated using Epi Info Version 7.2.5.0. The Population size was 800.
94 Based on a previous study done in Malaysia, medical students showed daytime sleepiness
95 of 35.5% [10]. Hence, expected frequency was considered at 35.5%. The acceptable margin
96 of error was considered as 8%, design effect as 1.0 and 1 cluster. Hence, at a confidence
97 level, the calculated cluster size was 117 participants. The final sample size required was
98 130 participants after taking into consideration of 10% non-response rate.

99 All students from the study university who were enrolled in MBBS studies from Semester 1
100 to Semester 10 were eligible. The sampling was done by purposive sampling, in which
101 whoever willing to participate by responding to the questionnaire is considered as a member
102 of the sample group. The inclusion criteria for the sample were undergraduate medical
103 students, both International and Local students. Students from other programme and all
104 Academic and Non-academic members were excluded from the study.

2.5 DATA ANALYSIS

106 Data was analysed using Epi info version 7.2.5. The independent variables used in this
107 study were age, gender, ethnicity, nationality, semester of study, BMI, coffee and energy
108 drinks, exercise, and hours of sleep. The dependent variables for this study were the
109 prevalence of daytime sleepiness, and the awareness of the association between bedtime
110 electronic device use and daytime sleepiness among medical students. The association
111 between the prevalence and the knowledge and awareness were assessed with inferential
112 statistics. The significant level (p value) was set up at 0.05 with a 95% confidence interval.

113 The ESS scores were split into two categories with scores <11 as normal daytime
114 sleepiness, and scores ≥11 as excessive daytime sleepiness. The scoring for the questions
115 of awareness were done as 1 for agree, and 2 for those who responded as neutral or
116 disagree, and the total was taken. Then, they were categorized into two based on a mean
117 split, with respondents less than a mean having relatively better awareness and above mean
118 having relatively lower awareness.

119 2.6 ETHICAL CONSIDERATIONS

120 The use of Epworth Sleepiness Scale was authorized by the Mapi Research Trust, who
121 owns the licence for its distribution. Participants of this study were obtained by voluntary
122 participation. Informed consent form detailing the important and relevant particulars of the
123 study were provided to the participants. No incentives were given to encourage participation,
124 nor were the participants coerced or forced into taking part in this study.

125 This research was approved by the Research Ethics Committee of the Faculty of Medicine,
126 Manipal University College Malaysia, Melaka, Malaysia.

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128 3. RESULTS

129
130 Table 1 reports the demographic characteristics of the respondents. Among the 123
131 participants, 37.40% were male and 62.60% were female. The age was split into two
132 categories as ≤ 22 years, which had 62.60% participants and >22 years, which had 37.40%
133 participants. The ethnicity was under 4 categories, which had 8.94% Malay, 32.52%
134 Chinese, 36.59% Indian, and 21.95% others. The participants were also categorized based
135 on their semester of study, which had Pre-Clinical years (Semester 1 to 4) and Clinical Years
136 (Semester 6-10), and there were 2.20% participants from Pre-clinical years, and 87.80%
137 participants from Clinical years. Among the respondents, 9.76% were underweight, 56.91%
138 participants were normal weight, 24.39% participants were overweight, 6.50% participants
139 were obese, and 2.44% participants were extremely obese. 3.25% participants had
140 underlying Health conditions which impact their sleep, and 0.81% participant had taken
141 medication to help with their sleep (Table 1).

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151 Table 1. Sociodemographic characteristics of respondents (n = 123)

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Variable	Frequency (%)
Age	
≤ 22 years	77 (62.60)
>22 years	46 (37.40)
Gender	
Male	46 (37.40)
Female	77 (62.60)
Ethnicity	

Malay	11 (8.94)
Chinese	40 (32.52)
Indian	45 (36.59)
Others*	27 (21.95)
Nationality	
Malaysian	102 (82.93)
International	21 (17.07)
Study year	
Pre-clinical years	15 (12.20)
Clinical years	108 (87.80)
BMI	
<18.5 (Underweight)	12 (9.76)
18.5 - 24.9 (Normal)	70 (56.91)
25 - 29.9 (Overweight)	30 (24.39)
30 - 34.9 (Obese)	8 (6.50)
35 - 39.9 (Extremely Obese)	3 (2.44)
Health condition	
Yes	4 (3.25)
No	119 (96.75)
Medication to sleep	
Yes	1 (0.81)
No	122 (99.19)

* Sri Lankans, and others.

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156 ESS score was considered as ≥ 11 as having excessive daytime sleepiness, and < 11 as
157 having normal daytime sleepiness. Among the participants, 39.84% participants had
158 excessive daytime sleepiness, and 60.16% of the participants had normal daytime
159 sleepiness. The mean score was 9.49 (SD \pm 3.85) and median and mode was 10. The total
160 score for the ESS scale ranged from 1-17.

161 There was no significant association between daytime sleepiness and age, gender, ethnicity,
162 nationality, study year, and BMI. Among the participants who consumed coffee to any level,
163 40.63% had excessive daytime sleepiness, and among the participants who did not
164 consume coffee, 37.04% had excessive daytime sleepiness. Hence, those who consumed
165 coffee had more prevalence for excessive daytime sleepiness.

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167 There is positive association between Use of digital devices and sleeping less than 6-8
168 hours and daytime sleepiness (OR 1.75). They are 1.75 times more likely to have excessive
169 daytime sleepiness compared to those who sleep for 6-8 hours. However, there is no
170 statistical significance between gender and daytime sleepiness (P= 0.36) (Table 2).

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172 **Table 2.** Association between respondents' demographic characteristics and daytime
173 sleepiness. (n=123)
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Variable	Excessive daytime sleepiness	Normal Daytime sleepiness	Odds Ratio	95% Confidence Interval	Statistical Tests (Chi-Square test)	P
Age						
≤ 22 years	30 (38.96)	47 (61.04)	Reference			

>22 years	19 (41.30)	27 (58.70)	1.10	0.52-2.32	0.06	0.79
Gender						
Male	15 (32.61)	31 (67.39)	Reference			
Female	34 (44.16)	43 (55.84)	1.63	0.76-3.5	1.60	0.21
Ethnicity						
Malay	6 (54.55)	5 (45.45)	Reference			
Chinese	16 (40.00)	24 (60.00)	0.55	0.14-2.13	0.11*	0.74*
Indian	18 (40.00)	27 (60.00)	0.55	0.14-2.09	0.76*	0.50*
Others	9 (33.33)	18 (66.67)	0.41	0.09-1.74	1.47*	0.28*
Nationality						
International	9 (42.86)	12 (57.14)	Reference			
Malaysian	40 (39.84)	62 (60.78)	0.86	0.33-2.23	0.09	0.76
Study year						
Pre-clinical year	6 (40.00)	9 (60.00)	Reference			
Clinical year	43 (39.81)	65 (60.19)	0.99	0.32-2.98	0.0002	0.99
BMI						
18.5-24.9 (Normal)	25 (35.71)	45 (64.29)	Reference			
<18.5 (underweight)	6 (50.00)	6 (50.00)	1.80	0.52-6.17	0.88*	0.36*
25-29.9 (overweight)	12 (40.00)	18 (60.00)	1.20	0.49-2.89	0.17	0.68
30 – 34.9 (Obese)	4 (50.00)	4 (50.00)	1.80	0.41-7.82	0.62*	0.46*
35 – 39.9 (Extremely obese)	2 (66.67)	1 (33.33)	3.60	0.31-41.70	1.18*	0.55*
Hours of sleep at night time						
6-8 hours	17 (32.69)	35 (67.31)	Reference			
Less than 2 hours	0 (0)	1 (100)	0.00	Undefined	0.48*	1.00*
2-4 hours	2 (66.67)	1 (33.33)	4.12	0.35-48.65	1.45*	0.27*
4-6 hours	29 (43.94)	37 (56.06)	1.61	0.76-3.43	1.55	0.21
More than 8 hours	1 (100)	0 (0)	Undefined	Undefined	1.98*	0.34*
Use of digital devices immediately before sleep						
Devices are used	48 (39.67)	73 (60.33)	Reference			
Devices are not used	1 (50.00)	1 (50.00)	1.52	0.09-24.90	0.087*	1.00*
Use of digital devices with lack of sufficient sleep						
Sleeps 6-8 hours or more	4 (28.57)	10 (71.43)	Reference			
Uses digital devices and less than 6-8	45 (41.28)	64 (58.72)	1.75	0.51-5.95	0.84	0.36

hours of sleep

Based on hours of use of digital devices per day

6-10 hours	11 (31.43)	24 (68.57)	Reference			
< 2 hours	2 (50.0)	2 (50.0)	2.18	0.27-17.57	0.56*	0.59
2-6 hours	29 (42.03)	40 (57.97)	1.58	0.67-3.73	1.10	0.29
10-14 hours	6 (46.15)	7 (53.85)	1.87	0.51-6.88	0.89*	0.49*
> 14 hours	1 (50)	1 (50)	2.18	0.12-38.18	0.29*	1.00*

Based on coffee & energy drink consumption level

2-3 drinks per week	14 (53.85)	12 (46.15)	Reference			
Do not consume	10 (37.04)	17 (62.96)	0.50	0.17-1.51	1.51	0.22
Less than once a week	6 (26.09)	17 (73.91)	0.30	0.90-1.01	3.89	0.04
One drink per week	5 (62.50)	3 (37.50)	1.43	0.28-7.26	0.18*	1.00*
Once daily	8 (30.77)	18 (69.23)	0.38	0.12-1.19	2.84	0.09
Twice daily	2 (33.33)	4 (66.67)	0.43	0.06-2.77	0.82*	0.65*
More than two per day	4 (57.14)	3 (42.86)	1.14	0.21-6.16	0.02*	1.00

Based on level of exercise

3-4 days a week	12 (38.71)	19 (61.29)	Reference			
None	12 (42.86)	16 (57.14)	1.19	0.42-3.36	0.10	0.75
Once a week	23 (38.98)	36 (61.02)	1.01	0.41-2.47	0.0006	0.98
6-7 days a week	2 (40.00)	3 (60.00)	1.05	0.15-7.27	0.003*	1.00*

Based on level of awareness.

High awareness	24 (39.34)	37 (60.66)	Reference			
Low awareness	25 (40.32)	37 (59.68)	1.042	0.51-2.14	0.012	0.92

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176 *Fisher's Exact test.

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182 Table 3 shows the responses each participant gave with regard to the 13 items that were
183 asked relevant to awareness.

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Questions	Agree n (%)	Neutral n (%)	Disagree n (%)
The electronic devices emit a blue light, which affect our sleep quality and patterns.	103 (83.74)	18 (14.63)	2 (1.62)
There are blue light filters, night time modes, eye	100 (81.3)	23 (18.7)	0 (0)

comfort etc which can be used to reduce the impact of blue light rays.			
Spectacles and contact lenses can have blue-light filters to help reduce the blue light emissions.	83 (67.48)	35 (28.45)	5 (4.06)
Use of digital devices before bedtime will decrease your alertness at morning.	71 (57.72)	43 (34.96)	9 (7.32)
You should stop using electronic devices at least 30 minutes before bedtime.	93 (75.61)	27 (21.95)	3 (2.44)
Daytime sleepiness is due to poor sleep quality at night.	94 (76.42)	22 (17.89)	7 (5.69)
Engaging in stimulant activities like gaming on electronic devices can contribute to daytime sleepiness.	87 (70.73)	27 (21.95)	9 (7.32)
The recommended average sleep time is 6-8 hours per day.	106 (86.18)	16 (13.01)	1 (0.81)
I am not getting sufficient sleep due to engaging in non-academic activities at night.	43 (34.96)	51 (41.46)	29 (23.58)
I am not getting sufficient sleep due to engaging in studies and other university related work.	70 (56.91)	50 (40.65%)	3 (2.44)
Sleep deprivation can lead to cognitive complications such as decreased information processing, working memory, inhibitory control and problem solving.	110 (89.43)	12 (9.76)	1 (0.81)
Sleep deprivation can contribute to depression.	90 (73.17)	25 (20.33)	8 (6.50)
Sleep deprivation can lead to an increased appetite for high caloric food.	75 (60.98)	38 (30.89)	10 (8.13)

Table 3. Participants' responses relevant to the awareness questions (n=123).

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189 Table 4 reports the respondents' awareness level, which shows a Mean of 16.86 (SD±2.91),
 190 50.4% participants had a less level of awareness, and 49.6% participants had a high level of
 191 awareness. There was no significant association between the demographic characteristics of
 192 the respondents and awareness level (Table 4).

193
 194 Table 4. Association between respondent's demographic characteristics and the Level of
 195 Awareness.
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Variable	High Aware	Less Aware	Odds Ratio	95% Confidence Interval (CI)	Statistical tests (Chi- Square Test)	P
	n (%)	n (%)				
Age						
>22 years	22 (47.83)	24 (52.17)	Reference			
≤ 22 years	39 (50.65)	38 (49.35)	1.120	0.539- 2.326	0.092	0.762
Gender						
Female	22 (47.83)	24 (52.17)	Reference			
Male	39 (50.65)	38 (49.35)	1.120	0.539- 2.326	0.092	0.762
Ethnicity						
Malay	5 (45.45)	6 (54.55)	Reference			
Chinese	24 (60)	16 (40)	1.800	0.469- 6.908	0.744*	0.498*
Indian	21 (46.67)	24 (53.33)	1.050	0.280- 3.944	0.005	0.942
Others	11 (40.74)	16 (59.26)	0.825	0.201- 3.391	0.071*	1.000*
Nationality						
International	11 (52.38)	10 (47.62)	Reference			
Malaysian	50 (49.02)	52 (50.98)	0.874	0.341- 2.238	0.079	0.779
Study year						
Pre-clinical year	7 (46.67)	8 (53.33)	Reference			
Clinical year	54 (50)	54 (50)	1.143	0.387- 3.373	0.059	0.809

*Fisher's Exact test.

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 198
 199 Table 5 shows the responses obtained for the questionnaire with regard to behaviour that we
 200 considered might be important contributors for daytime sleepiness. In this study, most
 201 respondents had 3 devices (49.59%), followed by respondents who owned 4 devices
 202 (25.21%). Also, it showed that majority of the respondents sleep 4-6 hours, which was less
 203 than the recommended time of 6-8 hours. Furthermore, only a small amount of respondents
 204 checked their phones during sleep on a regular basis (7.32%) (Table 5).
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213 **Table 5.** Mobile phone usage among respondents (n=123)
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No	Item	n(%)
1	How many Electronic Devices do you own?	
	1	3 (2.44)
	2	28 (22.76)
	3	61 (49.59)
	4 or more	31 (25.21)
2	How many hours do you sleep at night on average?	
	2-4 hours	3 (2.44)
	4-6 hours	66 (53.68)
	6-8 hours	52 (42.28)
	Less than 2 hours	1 (0.81)
	More than 8 hours	1 (0.81)
3	How often do you get up during sleep to check your phone?	
	Always	2 (1.63)
	Often	7 (5.69)
	Sometimes	22 (17.89)
	Rarely	49 (39.84)
	Never	43 (34.96)

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 216 Table 6 shows the methods that the participants used to overcome daytime sleepiness, and
 217 also how they were able to determine the level of impact of daytime sleepiness on their life.
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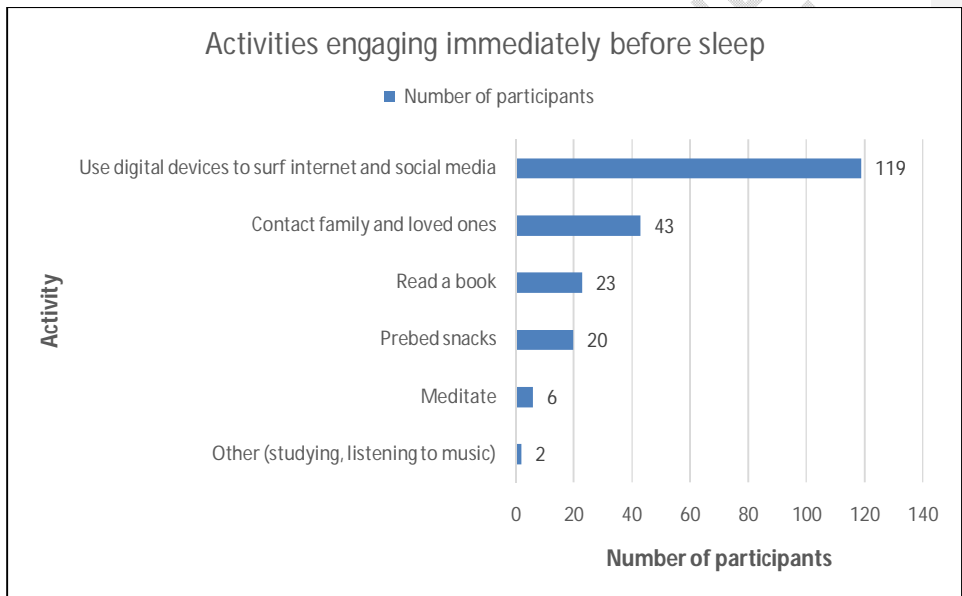
219 **Table 6.** The activities to overcome daytime sleepiness, and the impact of daytime
 220 sleepiness on the respondents life (n=123)
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No	Items	n (%)
1	Caffeine/ energy drink intake	
	Do not drink coffee and energy drinks	27 (21.95)
	Less than once a week	23 (18.70)
	One can a week	8 (6.50)
	Two-three cans a week	26 (21.14)
	One can a day	26 (21.14)
	Two cans a day	6 (4.88)
	More than two cans a day	7 (5.69)
2	Sport activities	
	None	28 (22.76)
	Once a week	59 (47.97)
	3-4 days a week	31 (25.20)
	6-7 days a week	5 (4.07)

3	Satisfied with their level of attention during lecture	
	Yes	49 (39.84)
	No	74 (60.16)
4	Excessive daytime sleepiness has a negative impact on work and social life	
	Yes	47 (38.21)
	No	76 (61.79)

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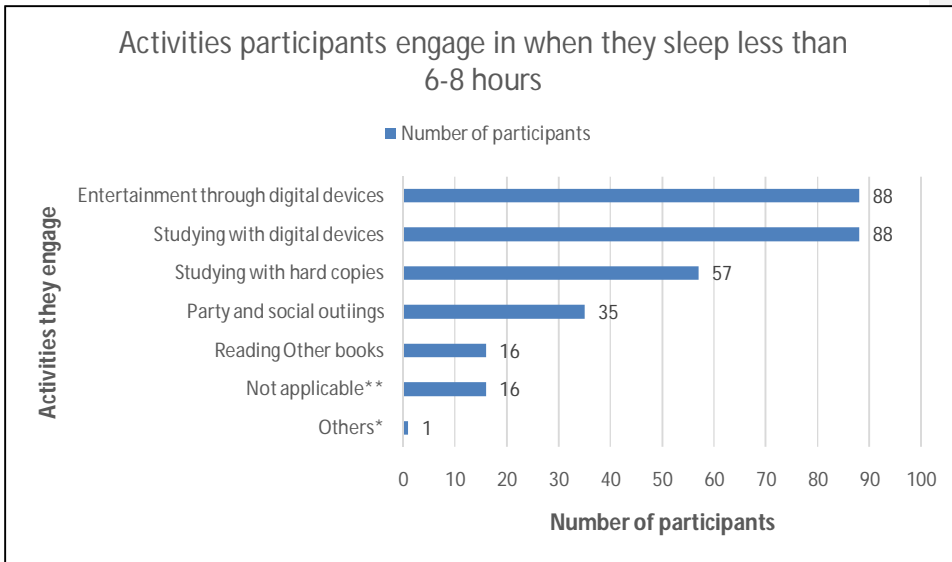
Figure 1 shows the activities that the participants engage in immediately before they sleep. Based on this, most participants show preference to use digital devices to access social media and other online websites.



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Figure 1 – Activities respondents engage in immediately before sleep (multiple options were selected) (n=123)

Figure 2 shows the activities that the participants engage in when they sleep less than 6-8 hours per day. The responses showed that students would either spend the time mostly either studying, or else engaging in other activities to help overcome their stress via entertainment etc.



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Figure 2 – Activities respondents engage in when they sleep less than 6-8 hours (n=123)

***Sleeps 6-8 hours a day.*

**Cleaning, exercises, eating snacks etc.*

Figure 3 shows the products used by students to help overcome their daytime sleepiness, where participants were able to select multiple options. Based on the chart, most of the participants find that the consumption of coffee and energy drinks help overcome their daytime sleepiness, followed by eating foods and snacks.

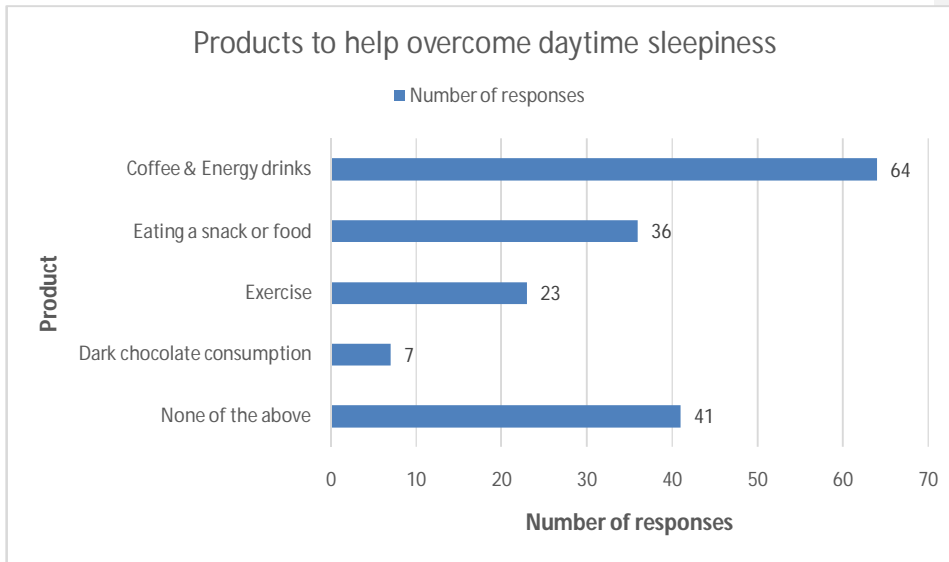


Figure 3. Products used by the respondents to help overcome daytime sleepiness (n=123)

4. DISCUSSION

This cross-sectional study was conducted to assess the awareness of the association between the daytime sleepiness and the use of digital devices before sleep, among the medical students in a Private Medical University of Malaysia. The prevalence of excessive daytime sleepiness among medical students, and their awareness with regard to how the use of digital devices are contributing to their daytime sleepiness. In the present world, most students have access to digital devices which they use for various purposes including for education and for entertainment. Previous researches have shown that there is an impact between the use of digital devices before bed, and a decrease in sleep quality [1, 3]. Hence, this study aimed to determine the extent of daytime sleepiness and the awareness of the association between digital devices and daytime sleepiness among medical students.

The findings showed that there was excessive daytime sleepiness was reported in 39.84% of the participants, with 60.16 % having normal daytime sleepiness. These findings showed that there is an increase of participants with excessive daytime sleepiness when compared to other similar studies [10,11]. Furthermore, 47 participants (38.21%) had agreed that they have daytime sleepiness at a level which brings a negative impact on their work and social life, while 76 (61.79%) participants did not have negative impact. Hence, a small amount of 1.63% of the participants had excessive daytime sleepiness, but they did not have it at a level which will have a negative impact on their work and social life. When considering the excessive daytime sleepiness with regard to B.M.I. value of the participant, we saw a trend of increase in the number of participants with excessive daytime sleepiness with increase in the B.M.I. which was similar to the findings of other researches conducted with regarding to obesity and daytime sleepiness and sleep quality [18].

The findings showed that most students use digital devices before sleep. Due to the increase in level of use of digital devices among medical students, there is an increase in

282 risk of symptoms associated with Computer Vision Syndrome [19], and hence, it is
283 necessary to spread the awareness regarding this to identify and manage it early. Based on
284 a study, use of digital devices more than 6 hours a day can lead to a majority of the
285 population (57.4%) to have Computer Vision Syndrome, and since about 40% of our
286 participants use devices for more than 6 hours, there is increased risk and necessity for
287 spreading awareness.
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289 Furthermore, findings of this study showed that most participants prefer the consumption of
290 coffee and energy drinks and other snacks to overcome their daytime sleepiness. This can
291 lead to an increase in the risk of nutrition based diseases like Diabetes Mellitus and other
292 related issues. An article showing the relationship between energy drinks and obesity [20],
293 can indicate similar reasons with regard to consumption of such products. In this study, there
294 is an increase in Excessive Daytime sleepiness among the respondents who consumed
295 coffee than who did not, and this is similar to another research done in India [21]. A research
296 article related to Caffeine consumption showed that caffeine is mostly consumed in people
297 who are having sleep disturbances and also excessive daytime sleepiness, and it further
298 stated that Caffeinated products may have a disruptive effects on sleep, and is also
299 becoming more prevalent among children and adolescents [22].
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301 The number of participants who used electronic devices before bed and those who suffered
302 from excessive daytime sleepiness are similar prevalence in this study. Hence, the use of
303 phones in the pre-bed or during bed-time can lead to excessive daytime sleepiness. Similar
304 studies have shown this data, where they have shown sleep quality has decreased due to
305 use of digital devices at pre-bed and bed-times, and lead to sleep disturbances [23, 24].
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307 The findings of this study revealed that there was no significant pattern of the variation of the
308 awareness regarding the use of digital devices, and the prevalence of daytime sleepiness.
309 Hence, it is suitable to consider that even though they may be aware of such criteria, they
310 rarely implement them into action. Furthermore, other studies showed that there was a lack
311 of knowledge on side-effects, which can contribute to complications such as daytime
312 sleepiness [25].
313

314 This study has some limitations. Due to the time limitation, the researchers were unable to
315 recruit all the students in the study institution. The response rate of the preclinical year
316 students was 12.20%, that was relatively low when compared to the clinical year responses,
317 which was 87.80%. Also, since a cross-sectional study was conducted, there was no ability
318 to measure the changes that happened over time. The study was also done within only one
319 private university in Malaysia, and as such we are unable to consider the students from other
320 regions, and from public medical universities, and the other private universities.
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325 **5. CONCLUSION**

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The prevalence of daytime sleepiness among respondents in this study was 39.84. It was considered to be moderate level, however, there was no association with their awareness level. Next, the data collected showed that there is no statistically significant association between age, gender, ethnic, nationality, study year, BMI, usage of digital devices and sleeping less than 6-8 hours and daytime sleepiness.

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333 **6. RECOMMENDATION**

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Based on the findings of our study, we recommend the implementation of intervention techniques which can help promote the quality of sleep of students in order to reduce their daytime sleepiness, and also to spread the awareness with regard to the association between the excessive daytime sleepiness and the use of digital devices. Furthermore, our research showed that there was no significant variation in the level of daytime sleepiness based on their level of awareness, which brings about the need for more study into why those who have a relatively higher level of awareness also show same levels of daytime sleepiness as those who had relatively lower levels of awareness. Hence, we would like recommend for the development of such an instrument. Since the study setting was restricted to only one private university, we would like to recommend for future studies that recruit participants from public universities as well. This would help determine a more representative result.

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CONSENT

Informed consent was obtained from the study respondents.

ETHICAL APPROVAL

Ethical approval was granted by the Research Ethics Committee (Faculty of Medicine), Manipal University College Malaysia.

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