ORIGINAL ARTICLE

Associated Factors of Sleep Quality and Behavior among Students of Two Tertiary Institutions in Northern Malaysia

Pey-Peng Lai, Yee-How Say, PhD

Universiti Tunku Abdul Rahman (UTAR), Biomedical Science, Jalan Universiti, Bandar Barat, Kampar, Perak 31900, Malaysia

SUMMARY

The objective of the study was to investigate the associated factors of sleep quality and behavior among Malaysian tertiary students. The response rate to the questionnaire study was 41.0%. 1,118 students (M = 486, F = 632; mean age = 20.06 ± 1.53 years) were recruited from Universiti and Kolej Tunku Abdul Rahman (Perak campuses) who completed a sleep quality and behavior questionnaire based on Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Horne-Ostberg Morningness-Eveningness Scale (MES) and craving of high-calorie foods. Results showed that students had the following sleeping habits – bed time = 2.41 a.m. ± 3.35 hr, rise time = 9.00 a.m. ± 1.76 hr, sleep latency = 16.65 ± 14.30 min and sleep duration = 7.31 ± 1.45 hr. 32.9% of the students were defined as poor quality sleepers, 30.6% suffering excessive daytime sleepiness (EDS) and 81.6% were categorized as individuals with 'definitely eveningness', defined as people who are definitely most alert in the late evening hours and prefer to go to bed late. There were no significant gender differences in sleep quality, 'chronotype' and EDS. Although there was no association of sleep quality and EDS with cumulative Grade Point Average (cGPA) and class skipping, EDS was associated with the tendency to fall asleep in class. Body Mass Index (BMI) was not associated with total sleep, PSQI, ESS and MES scores. Meanwhile, high-calorie food craving was associated with sleep duration, PSQI and ESS, but not MES. In conclusion, poor sleep behavior among Malaysian tertiary students in this study was not associated with gender, academic performance and BMI, but was associated with craving of high-calorie foods instead.

KEY WORDS:

College students; sleep quality; excessive daytime sleepiness; chronotype; academic performance; high-calorie food craving; obesity; Malaysia

INTRODUCTION

Sleep can be characterized into three main behavioural states: wakefulness (W), Rapid-Eye-Movement sleep (REM) and Non-Rapid–Eye-Movement sleep (NREM) through detection and quantification of brain waves of the electroencephalogram (EEG)[1]. Sleep architecture refers to the basic structural organization of a normal sleep, and can be explained as the right mix of sleep[2]. For example, in a young adult, normal sleep architecture usually consists of four or five alternating NREM and REM periods[2]. The amount of time spent in any given stage is not constant over the course of a night, with REM sleep comparatively shorter during the first sleep cycle but gradually becomes longer across the night[1]. Sleep architecture is altered by sleep deprivation. However, it does not affect all sleep stages equally as it depends on duration of sleep and the number of days of reduced sleep - some aspects of sleep remain the same, occur sooner, or are intensified, while other aspects of sleep time are diminished3.

Sleep research shows that the average adult needs, a range of 7 to 9 hours of sleep each night, teenagers need about 9.5 hours, and infants generally require around 16 hours per day[4]. According to Louis *et al.*[5], an average adult might be sleeping less than the 8 hours, which is widely believed to be the mode. When entering college life, students face new challenges, such as, being responsible for himself, new schedules, unfamiliar environment, social obligations, as well as academic stress[6]. Most students are forced to change their sleeping time and alter their sleeping habits for these reasons[7]. Thus, college students are recognized as a population group particularly affected by sleep difficulties and defined as one of the most sleep deprived age group[8]. Some studies found that over 70% of college students who faced some degree of sleep-related problems[9,10]. Generally, college students tend to have a later bed time and rise time, longer sleep latency, and shorter total sleep[11]. In addition, college students also reported suffering from poor sleep quality and daytime sleepiness[12].

The consequences of sleep deprivation are severe, impacting adolescents' physical and mental health, as well as functioning adequately in the daytime[13]. Sleep restriction in healthy adults has been found to have adverse effects on endocrine functions, metabolic and inflammatory responses[3]. An example of the impact of sleep deprivation on endocrine responses is the secretion of certain hormones that are linked to obesity and diabetes, such as the hormone leptin which regulates the carbohydrate metabolism[14], as well as neuropeptide Y (NPY) which stimulates food intake[15]. Besides, one study found that sleep deprivation might lead to increased serum levels of glucagon, corticosterone, and norepinephrine in rats[15]. Some epidemiological studies have concluded that chronic sleep complaints are associated with an increased risk of cardiovascular morbidity and mortality[16]. Furthermore, sleep deprivation may affect the brain's ability to process information, which may lead to problems in terms of hyperactive behaviour, like sitting still and others[17]. Behaving impulsively and the inability to stay focused, in students with sleep deprivation, resemble behaviours commonly found in attention deficit hyperactive disorder[17].

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Corresponding Author: Yee-How Say, Universiti Tunku Abdul Rahman (UTAR), Biomedical Science, Jalan Universiti, Bandar Barat, Kampar, Perak 31900 Malaysia Email: howsyh@gmail.com

Another study also found that insomnia and short sleep duration are associated with a wide range of behavioural and emotional problems in adolescents[18].

Realizing the deleterious effects of sleep disorders among college students, more sleep studies focused on this particular demography have been done and published in recent years. Of these studies, most were conducted in the Unites States some European countries, with some studies in Asia. Sleep studies are relatively new in Malaysia. Due to different ethnicity, lifestyle and culture, findings obtained from one population might not necessarily be true for another population. Therefore, the main aim of this study was to investigate the associated factors of sleep quality and behavior among Malaysian tertiary students in the northern state, Perak, encompassing Universiti Tunku Abdul Rahman (UTAR) and Kolej Tunku Abdul Rahman (KTAR) students. The possibilities of association between sleep quality and daytime sleepiness, between sleep quantity/problems and academic achievement, and between poor sleep quality and obesity and food craving were also investigated.

MATERIALS AND METHODS

Participants

This was a cross-sectional study, where participants recruited by convenience sampling, completed a self-administered paper survey within a 6 month period (August 2011 - February 2012). Students were approached at canteens, lecture halls and tutorial rooms whenever available during the duration of the study. The questionnaire consisted of English and Chinese questions printed side-by-side, and the majority of the students referred to the Chinese version as it was their mother tongue. It consisted of 5 parts containing 67 questions, namely I: Personal details and Academic Performance, II: Pittsburgh Sleep Quality Index (PSQI), III: Epworth Sleepiness Scale (ESS), IV: Horne-Ostberg Morningness-Eveningness questionnaire, and V: Craving of High-calorie Foods Questionnaire. The students took about 20 minutes each to complete the questionnaire. Students were asked to provide demographic information such as age, gender, faculty, field of study, ethnicity, body weight, as well as height. Body Mass Index (BMI) kg/m^2 was calculated by dividing weight (in kg) over height^2 (in m^2). Besides, they were required to report about their performance in college such as their latest semester's cumulative Grade Point Average (cGPA), tendency to fall asleep in class and class attendance. Questions regarding the use of alcohol, cigarettes, as well as frequency of exercise were also asked. The institutional board approved this study, all individuals participating in this study signed informed consent forms (with anonymity and data confidentiality guaranteed) and all samples were taken in accordance with the Declaration of Helsinki (as revised in Seoul 2008).

Sleep quality and behavior measures

The Pittsburgh Sleep Quality Index (PSQI) differentiates between poor quality and good quality sleepers by measuring 7 aspects which include subjective sleep quality ,sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction over the past month[19]. Scoring of an answer is based on a '0' to '3' scale, whereby '3; reflects the negative extreme. The global sum of "5" or greater indicates "poor" quality sleeper while less than "5" indicates "good" quality sleeper. The Chinese translation of this questionnaire was provided by MAPI Research Trust[20]. The internal consistency of PSQI as estimated by Cronbach's α was 0.793.

Epworth Sleepiness Scale (ESS) is a brief questionnaire in which the individual rates eight items on the likelihood that they would doze in eight situations with response from 0 (would never doze) to 3 (high chance of dozing)[21]. The score of the ESS is the sum of ratings for the eight items which ranges from 0 to 24. Those with scores 10 and above were considered to have significant levels of daytime sleepiness or known as excessive daytime sleepiness (EDS). The validated Chinese translation of this questionnaire was adopted from Chen *et al*[22]. The internal consistency of ESS, estimated by Cronbach's α was 0.658.

The Horne-Ostberg Morningness-Eveningness questionnaire was used to assess the 'chronotype' or the sleeping habit of individuals, referring to people as morning types/people with morningness/'larks' - for those who wake up early and are most alert in the first part of the day, or evening types/people with eveningness/'owls' – for those who are most alert in the late evening hours and prefer to go to bed late, and the ones in between. Students were required to answer the questionnaire based on their experience for the past one year, the score from each question were added together, and the sum were converted into five points Morningness-Eveningness Scale (MES): Definitely morning type (70-86); moderately morning type (59-69); neither type (42-58); moderately evening type (31-41) and definitely evening type (16-30)[23]. The validated Chinese translation of this questionnaire was adopted from Li *et al*[24]. The internal consistency of MES, estimated by Cronbach's α was 0.758.

The Nutriton Society of Malaysia defined foods and their calorie contents to be very high (> 600 kcal), high (401 - 600 kcal), medium (101 - 400 kcal) and low (0 - 100 kcal)[25]. Therefore, craving of high-calorie foods questionnaire consisted a food list with 9 common medium- to very high-calorie foods in Malaysia (according to the Nutrient Composition of Malaysian Foods[26]). To enable a better recall of food craving, subjects were presented with colour images of different foods printed on an A4 size paper, with appropriate serving sizes to reflect their calorie content. The foods and their calorie content included fried chicken (2-piece meal with coleslaw, mash potato, french fries and bun; 465 kcal), nasi lemak (rice dish cooked in coconut milk with gravy added; 1 plate; 644 kcal), stir-fried kway teow (ricecake strips) or noodles (1 plate; 510 kcal) , burger (cheese; 1 whole; 341 kcal), fried squid (1 small plate; 630 kcal), ice-cream (2 scoops; 305 kcal), French fries (1 big cup; 1124 kcal), chocolate (dairy milk, 1 bar; 520 kcal) and cake (cheese, 1 slice; 400 kcal). Students were required to give a score that represent the question "Over the past month, how often have you experienced a craving for these foods?" The response alternatives were 1 = never, 2 = very rarely, 3 = rarely, 4 = sometimes, 5 = often, 6 = very often, and 7 = always/almost everyday[27].

Statistical analysis
Statistical analysis was done using SPSS® for Windows® v16.0 software (SPSS, Chicago, IL). Descriptive results were expressed as frequency, percentage, and mean ± S.D. Kolmogorov-Smirnov test was used to check for normal distribution. Student's t-test was used to test for differences for PSQI and ESS scores between genders and for MES between genders and age groups. Mann-Whitney U test was used to test for significant difference between two variables for data not normally distributed, while Kruskal-Wallis test was to compare between more than two variables. Pearson's Chi-square analysis was used to assess differences in the frequency distributions between variables. Partial correlation analysis was used to correlate PSQI and ESS scores, PSQI and MES scores, and to correlate students' PSQI, ESS and MES scores with BMI and craving of high-calorie foods, controlling for gender and ethnicity. The statistical significance was set at $p < 0.05$.

RESULTS

Sample characteristics
A total of 2,728 students were approached and 1,323 responded and attempted the questionnaire, yielding an initial response rate of 48.5%. Out of the 1323 responses, 205 of them were excluded from the study because they were incomplete (15.5%). With the final response rate of 41.0%, the final respondents (n = 1,118, 84.5%) consisted of 632 females (56.5%) and 486 males (43.5%), ranged between 18 to 27 years old with a mean age of 20.06 (± 1.53 years).The majority of them were from UTAR and almost of them were ethnic Chinese (n = 1094, 97.9%) while the remainder were ethnic Indians (n = 24, 2.1%), reflective of the demographics of UTAR and KTAR. Only 1,096 students who had their cGPA scores had their scores recorded as the remaining respondents were still in year 1 semester 1 of degree or foundation.

Sleep patterns and behaviors
The average bed time of UTAR/KTAR students was 2.41 a.m. (± 3.35 hr) and woke up relatively late at 9.00 a.m. (± 1.76 hr). They required 16.65 (± 14.30) min to fall asleep and had an average of 7.31 (± 1.45 hours) of daily total sleep time. Table 1 shows the comparison of sleep patterns and behavior between genders, fields of study, cGPA and BMI groups. No significant difference between genders and BMI groups was found. However, rise time and total sleep time were associated with the students' field of study, whereby arts and social sciences students had the latest rise time and highest total sleep time (Table I). With the exception of rise time, bed time, sleep latency and total sleep were all not significantly different between the cGPA classes (Table I).

Sleep quality
As measured by PSQI, 8.7 % of students reported that their overall sleep was very good, 58% - fairly good, and 33.3% - fairly bad or very bad. The majority of the students (67.1%) were good sleepers. Table II presents how often the respondents had sleep disturbances, whereby majority of the students did not experience them during the past month. Although most of the students were reported as significantly facing sleep disturbance, only 43 students admitted to taking medicine to help them sleep (Table II). 16.1% (n = 180) of them had no problems at all in having enough energy in getting things done, 53.2% (n = 595) had only a very slight problem, 25.7% (n = 287) had somewhat of a problem and only 5.0% (n = 56) had a very big problem (data not shown in Table II).

Most of the students (n = 669; M = 376, F = 293) had no bed partner/roommate. Among the students who had sleep partners/roommate (n = 449), most of them (73.5%) reported that they slept on a different bed. There was no association of gender with sleep quality ($\chi^2 = 1.736$; $p = 0.188$), as the amount of female students who had good sleep quality (n = 432; 86%) was similar to males (n = 314; 87%) - consistent with the PSQI scores which showed no significant difference (F - 4.89 ±1.87 vs. M - 4.83 ± 1.95; $t = 0.549$; $p = 0.583$).

EDS
Table III presents how likely it was for the respondents to doze off or fall asleep in several situations. The mean ESS score was 8.64 ± 3.86. Majority of the students had no EDS (n = 776; 69.4%). There was no association of gender with EDS ($\chi^2 = 0.487$; $p = 0.485$), as the amount of female students who had good sleep quality (n = 188; 29.7%) was similar with males (n = 154; 31.7%); consistent with the ESS scores which showed no significant difference (F - 8.54 ± 3.85 vs. M - 8.69 ±3.85; $t = 0.649$; $p = 0.516$). ESS score was significantly positively correlated with PSQI score ($r = 0.247$, $p < 0.001$).

Chronotype
In this study, none of the students were categorized into moderately and definitely morning type, while the distribution of the rest of the chronotypes is as shown in Table IV. MES score was not significantly correlated with PSQI score, indicating that there was no relationship ($r = 0.004$, $p = 0.899$ by partial correlation, controlling for gender and ethnicity) between morningness-eveningness and sleep quality of the students in this study. There were no significant difference in the MES scores between genders (F - 25.50 ± 5.11 vs. M – 25.88 ± 4.82; $p = 0.212$).

Association of sleep quality and EDS with sleep behaviors, academic performance and lifestyle
Good sleepers had significantly shorter sleep latency and longer total sleep time compared to poor sleepers; however, this was not true between EDS groups (Table V). No significant difference was found in bed time and rise time between sleep qualities and EDS groups (Table V). Besides, there was no association between sleep quality and EDS with cGPA. However, EDS was associated with the tendency to fall asleep in class ≥ 1× per week, with those without EDS will tend to stay awake in class more regularly (Table V). Class truancy did not seem to be related with sleep quality and EDS. Finally, sleep quality was associated alcoholic beverage intake and smoking frequency, whereas EDS was only associated with the frequency of exercise (Table V).

Obesity, food craving of high-calorie foods and sleep behavior
The results showed that BMI was not correlated with all PSQI, ESS and MES scores ($r = 0.043$, $p = 0.152$; $r = 0.009$, $p = 0.843$; $r = 0.043$, $p = 0.152$, respectively). Similarly, BMI class was not associated with the total sleep time (Table VI). Meanwhile high-calorie food craving had a significant positive

Table I: Comparison of sleep patterns and behaviour between genders, fields of study, cGPA and BMI groups

	Bed time [a.m. (± SD hr)]	Sleep latency (min ± SD)	Rise time [a.m. (± SD hr)]	Total sleep (hr ± SD)
Gender				
Female (n = 632)	2.36 ± 3.34	17.25 ± 14.93	8.56 ± 1.80	7.32 ± 1.43
Male (n = 486)	2.47 ± 3.35	15.87 ± 13.42	9.05 ± 1.72	7.30 ± 1.49
p[a]	0.351	0.141	0.667	0.978
Field of study				
Science (n = 234)	2.44 ± 3.21	15.97 ± 12.29	9.08 ± 2.08	7.50 ± 1.43
Arts & Social Sciences (n = 254)	2.26 ± 3.25	18.11 ± 16.35	9.12 ± 1.79	7.52 ± 1.48
Engineering (n = 39)	2.25 ± 2.82	15.21 ± 14.23	8.29 ± 0.94	6.87 ± 1.11
Business (n = 371)	2.53 ± 3.42	15.31 ± 13.64	9.02 ± 1.62	7.20 ± 1.55
Foundation/A-level (n = 220)	2.44 ± 3.57	18.22 ± 14.68	8.40 ± 1.69	7.15 ± 1.29
p[b]	0.421	0.054	0.006	0.003
cGPA (n = 1096)				
1st (3.5000-4.0000)(n = 90)	2.42 ± 3.28	19.32 ± 17.30	9.07 ± 1.44	7.39 ± 1.31
2nd upper (3.0000-3.4999)(n = 287)	2.29 ± 3.06	15.96 ± 12.59	9.01 ± 1.65	7.31 ± 1.49
2nd lower (2.2000-2.9999)(n = 568)	2.46 ± 3.49	16.64 ± 15.04	8.56 ± 1.77	7.35 ± 1.48
3rd (2.0000-2.1999)(n = 78)	2.17 ± 3.22	18.18 ± 13.66	9.14 ± 1.99	7.31 ± 1.46
<2.000 (n = 73)	2.53 ± 3.44	14.73 ± 11.25	8.38 ± 1.65	7.08 ± 1.37
p[b]	0.718	0.350	0.034	0.595
BMI group				
Underweight (<18.5) (n = 270)	2.43 ± 3.26	17.28 ± 14.53	8.57 ± 1.84	7.40 ± 1.37
Normal (18.5-22.999) (n = 585)	2.30 ± 3.27	17.00 ± 14.74	8.57 ± 1.79	7.25 ± 1.43
Overweight (23-26.999) (n = 181)	2.59 ± 3.61	15.39 ± 13.25	9.10 ± 1.51	7.38 ± 1.64
Obese (≥27) (n = 82)	3.09 ± 3.58	14.94 ± 12.44	9.13 ± 1.80	7.37 ± 1.45
p[b]	0.594	0.328	0.682	0.488

[a]p-value by Mann Whitney U test, significant at <0.05, bp-value by Kruskal Wallis test, significant at <0.05

Table II: Assessed sleep quality and prevalence of sleep disturbance as measured by PSQI

Reason for having trouble sleeping	Not during the past month n (%)	Less than once a week n (%)	Once or twice a week n (%)	3 or more times a week n (%)
Cannot get to sleep within 30 minutes	404 (36.1)	329 (29.4)	249 (22.3)	136(12.2)
Wake up in middle of the night or early morning	447 (40.0)	303 (27.1)	236 (21.1)	132 (11.8)
Have to get up to use the bathroom	721 (64.5)	172 (15.4)	105(9.4)	120 (10.7)
Cannot breathe comfortably	915 (81.8)	128 (11.4)	58 (5.2)	17 (1.5)
Cough or snore loudly	790 (70.7)	178 (15.9)	90 (8.1)	59(5.3)
Feel too cold	482 (43.1)	310 (27.7)	230 (20.6)	96 (8.6)
Feel too hot	424 (37.9)	289 (25.8)	242 (21.6)	163(14.6)
Have bad dreams	535 (47.9)	375 (33.5)	147 (13.1)	61 (5.5)
Have pains	799 (71.5)	223(19.9)	68 (6.1)	28 (2.5)
Others reasons	1034 (92.5)	46 (4.1)	19 (1.7)	19 (1.7)
How often have you…				
Take medicine to aid in sleep?	1075 (96.2)	32 (2.9)	7 (0.6)	4 (0.4)
Had trouble staying awake during social activities?	571 (51.1)	28(25)	160 (14.3)	107 (9.6)

Table III: Excessive daytime sleepiness (EDS) measured by ESS

Situation that may cause dozing or sleeping	Never n (%)	Slight chance n (%)	Moderate chance n (%)	High chance n (%)
Sitting and reading	143 (12.8)	422 (37.7)	361 (32.3)	192 (17.2)
Watching TV	407 (36.4)	522 (46.7)	156 (14.0)	33 (3)
Sitting inactive in a public place (e.g. a theatre or a meeting)	352 (31.5)	402 (36.0)	260 (23.3)	104 (9.3)
Being a passenger in a motor vehicle for an hour or more	525 (47)	297 (26.6)	178 (15.9)	118 (10.6)
Lying down in the afternoon	81 (7.2)	267 (23.9)	352 (31.5)	418 (37.4)
Sitting and talking to someone	744 (66.5)	298 (26.7)	58 (5.2)	18 (1.6)
Sitting quietly after lunch (without alcohol)	213 (19.1)	453 (40.5)	301 (26.9)	151 (13.5)
In a car, while stopped for a few minutes in traffic	739 (66.1)	263 (23.5)	82 (7.3)	34 (3.0)

Table IV: Distribution of sleep chronotypes based on good and poor sleep quality categories

Sleep chronotype (based on MES score)	Sleep quality (based on PSQI score)	
	Good n (%)	Poor n (%)
Definitely evening type (MES 16-30)	607 (66.6)	305 (33.4)
Moderately evening type (MES 31-41)	137 (67.2)	67 (32.8)
Neither type (MES 42-58)	2 (100)	0

% within sleep chronotype

Table V: Association of sleep quality and excessive daytime sleepiness (EDS) with sleep behaviors, academic performance and lifestyle

Parameters	Good sleep quality (n = 750)	Poor sleep quality (n = 368)	EDS present (n = 342)	EDS absent (n = 776)
Bed time [a.m. (± SD hr)]	2.44 ± 3.42	2.23 ± 3.19	2.47 ± 3.41	2.38 ± 3.32
pa	0.637		0.957	
Sleep latency (min ± SD)	14.24 ± 11.72	21.57 ± 17.49	16.80 ± 14.60	16.59 ± 14.18
pa	<0.001		0.557	
Rise time [a.m. (± SD hr)]	9.06 ± 1.72	8.48 ± 1.85	8.53 ± 1.80	9.03 ± 1.75
pa	0.097		0.345	
Total sleep (hr ± SD)	7.66 ± 1.30	6.61 ± 1.50	7.31 ± 1.45	7.32 ± 1.46
pa	<0.001		0.960	
cGPA				
1st	59 (8.0)	31 (8.6)	30 (8.9)	60 (7.9)
2nd upper	194 (26.4)	93 (25.8)	98 (29.2)	189 (24.8)
2nd lower	392 (53.3)	176 (48.8)	164 (49)	404 (53)
3rd	43 (5.9)	35 (9.7)	27 (8.1)	51 (6.7)
<2.000	47 (6.4)	26 (7.2)	16 (4.8)	57 (7.6)
χ^2 , pb	6.375, 0.173		6.000, 0.199	
Fall asleep in class ≥ 1×/week				
Yes	209 (27.9)	111 (30.2)	128 (37.4)	192 (24.7)
No	541 (72.1)	257 (69.8)	214(62.6)	584 (75.3)
χ^2 , pb	0.637, 0.425		18.70, <0.001	
Skipped classes > 2×/month				
Yes	567 (75.6)	289 (78.5)	271(20.8)	585(75.4)
No	183 (24.4)	79 (21.5)	71(79.2)	191(24.6)
χ^2 , pb	1.183, 0.277		1.964, 0.161	
Alcoholic beverage intake				
< 3×/week	221 (29.6)	142 (38.2)	141 (32.6)	222 (32.4)
≥3×/week	16 (2.1)	3 (0.8)	10 (2.3)	9 (1.3)
Did not take any	509 (68.2)	227 (61.0)	281 (65.0)	455 (66.3)
χ^2 , pb	10.161, 0.006		1.641, 0.440	
Exercise Frequency				
< 3×/week	365 (48.9)	191(51.3)	194 (44.9)	362 (52.8)
≥3×/week	170 (22.8)	81 (21.8)	101 (23.4)	150 (21.9)
None	211 (28.3)	100 (26.9)	137 (31.7)	174 (25.4)
χ^2 , pb	0.581, 0.748		7.406, 0.025	
Smoker				
Yes	33 (4.4)	27 (7.3)	26 (6.0)	34 (5.0)
No	713 (95.6)	345 (92.7)	406 (94.0)	652 (95.0)
χ^2 , pb	3.927, 0.048		0.589, 0.443	

Data for cGPA, fall asleep in class, skipped class, alcohol intake, exercise and smoker are n (% within sleep quality/EDS)
ap-value by Mann Whitney U test, significant at <0.05, bp-value by Pearson's $\chi 2$ test, significant at <0.05

Table VI: Comparison of BMI and craving of high-calorie foods by total sleep time

Total Sleep	< 7 hr (n = 342)	7-9 hr (n = 692)	> 9 hr (n = 84)	
BMI	**n (% within BMI)**	**n (% within BMI)**	**n (% within BMI)**	**pa**
Underweight	78 (29.9)	175 (64.8)	17 (6.3)	0.689
Normal	189 (32.3)	354 (60.5)	42 (7.2)	
Overweight	53 (29.3)	111 (61.3)	17 (9.4)	
Obese	22 (26.8)	52 (63.4)	8 (9.8)	
Craving of	**Mean ±(SD)**	**Mean ±(SD)**	**Mean ±(SD)**	**pb**
high-calorie foods	35.88 ±8.13	26.05 ±7.17	25.48 ±8.31	<0.001

ap-value by Mann Whitney U test, significant at <0.05, bp-value by Kruskal Wallis test, significant at <0.05

correlation with PSQI (r = 0.231, p < 0.001) and ESS (r = 0.086, p = 0.004), but not MES (r = 0.003, p = 0.917). Table VI also shows that poor sleepers who slept <7 hours had significantly higher level of food craving of high calories food than those who slept 7-9 or more than 9 hours.

DISCUSSION

College students seem to be sleep deprived, reporting an average 7–7.5 hr of sleep per night, which was 1–1.5 hr less than their ideal estimate of 8.5 hr per night[28] . For example, Forquer *et al.* who examined sleep habits among 313 USA university students found that mean sleep duration of students on weekdays was 7.2 (± 1.2 hr)[29]. Similarly in our study, UTAR/KTAR students reported 7.31 (± 1.45 hr) of total sleep per night. However, the averaged nocturnal sleep length (wake up time minus bed time) was 6 hr 19 min (9.00 a.m. minus 2.41 a.m.), which means there was 1 hr 12 min gap between total and nocturnal sleep length (7.31 hr – 6.19 hr). This might suggest there were over 1 hr of daytime nap by the

students, which was not assessed in the questionnaire. Poor sleep can be explained as late bed time, long sleep latency and short total sleep time. This is true for UTAR/KTAR students. The present study found that poor sleepers had longer sleep latency and shorter total sleep time than good sleepers, similar to the above USA study[29]. However, there was no association of sleep quality with bed time and rise time.

Physical and cognitive symptoms of poor sleep quality include tiredness, loss of concentration, low pain threshold, anxiety, nervousness, irrational thoughts, moodiness and others[30]. Besides, poor sleep quality has been believed to affect one's mood and enthusiasm[31]. Thus, students with poor sleep quality would normally feel less interested in attending class than good sleepers. However, no significant difference in frequency of skipping class between good and poor quality sleepers was found in this study - possibly all had reported good attendance to avoid being barred from sitting for their final examination.

EDS is more prevalent among Western populations as compared to Asians populations. For example, in a study of prevalence of EDS among Malaysian medical students,[32] and also in our study, a lower prevalence of EDS (35.5% and 30.6%, respectively), was found compared to Brazilian medical students (42.4%)[33]. However, when compared to other Asian studies, UTAR/KTAR students demonstrated a very high prevalence of EDS (30.6%) compared to the Korean (12.2%)[34] and Singaporean (9%)[35] adult populations. When compared with other Malaysian tertiary students, our students had higher ESS score than East Malaysian public university students (8.64 vs. 7.8)[36]; but lower than medical students (8.64 vs. 9.0)[32]. There are several factors contributing to EDS which include age, clinical and sleep-related factors, physical activity, perceived insufficient sleep and others[34]. EDS have significant association with young people, short sleep duration, poor sleep quality and subjective insufficient sleep. Among these factors, short sleep duration is the strongest predictor of EDS[37]. However in our study, we found that EDS was not associated with all sleep behaviors, indicating population and subject group differences.

A cross-cultural research in six different temperate and less temperate countries (USA, England, The Netherlands, Colombia, Spain and India) among university students showed that students from the latter three temperate countries were more morning-oriented individuals[38]. In contrast, most of the Malaysian tertiary students in our study were categorized as 'definitely evening' or 'moderately evening' people, similar to male Japanese students in the study of Park *et al*[39]. Generally, older people tend to have a more morning-orientated chronotype[40]. Teens and young adults tend to be more evening-orientated but tend to be more morning-orientated at about age 50 as the neuronal activity of the hypothalamic body clock is reduced with age[41]. None of the students was in the 'morningness' category as they were all aged below 50. Last but not least, although a recent study showed that people with evening types reported lower subjective sleep quality[42], our study proved otherwise as sleep chronotype was not correlated with sleep quality.

A study by Reyner and Horne found no significant gender differences in sleep latency, wake up time, total sleep time, or sleep quality in the 20–34 years group[43]. This is true for the present study. Besides, no significant gender difference in EDS among our students was found, consistent with previous studies[44,45]. Contradictorily, another study found that significant gender differences on EDS has been observed[46] and gender differences were also shown in the relationship between sleep quality and other sleep variables such as sleep quality, rise time, bed time and sleep efficiency[47]. We speculate that gender difference in sleep patterns and sleep disturbances are inconsistent and thus factors which might contribute to the inconsistency of gender influences in sleep patterns and sleep disturbance can be studied in the future.

The mean hours of sleep were significantly different among students of humanities & social sciences, science & engineering, education, health sciences and arts & sports[48]. It was shown consistently in this study, sleep latency, rise time and total sleep time were significantly associated with the students' field of study, whereby arts and social sciences students had the latest rise time and highest total sleep time. However, this finding might be confounded by the unequal distribution of subjects within the fields of study (there were fewer engineering students), therefore limiting the power for statistical analysis.

Poor sleep, increased sleep fragmentation, late bed times and early awakenings are found to seriously affect learning capacity, school performance, and neurobehavioral functioning[49]. According to Curcio *et al.*, sleep is an active, repetitive and reversible behavior serving several different functions, such as repair and growth, learning or memory consolidation, and restorative processes[50]. The integrity of learning and memory process is crucial in academic achievement and performance. Thus, it is hypothesized that students with sleep deprivation would get lower overall cGPAs and have poorer academic performance. However, we showed that there was no association between sleep behavior, sleep quality and EDS with cGPA – consistent with a Malaysian study among biomedical science students which found that students' academic achievements were not affected by sleeping hours[51]. Shapiro *et al.* also found that there was no relationship between sleep behavior and academic performance[52].

Our study found that students with EDS tend to fall asleep in class more often than those students without EDS. Students would be less able to pay attention in class because of EDS. Thus, it is believed that EDS is negatively correlated to academic achievement, as lower sleepiness scores were better associated with school performance[49] and those who had EDS did not achieve as well as others in their final examination[53]. However there was no association of cGPA with EDS in our study, consistent with another study which found that ESS score was not significantly associated with examination results[54].

Obesity and being overweight often occur amongst those with sleep problems such as sleep apnea and sleepiness[55]. Some studies have found a relationship between sleep quantity and BMI classes. For example, a study stated that

there was an inverse relationship between sleep duration and BMI[56]. Another has found a U-shaped association, with a lower BMI among people who has 7-8 hours of sleep, while a higher BMI among those with shorter and longer sleep durations[57]. However, there were no significant sleep duration differences in different BMI classes among our students. As body weight and height were self-reported, there might be inaccuracies in the frequencies of the BMI classes.

Short sleep duration is associated with risk behaviors that are known to promote weight gain and obesity[58]. Recent studies found that short sleep duration act as one among other risk factors for weight gain and obesity in adults populations[59,60]. In the case of short sleep, obesity could be due to subtle sleep-loss induced energy-balance impairments linked to insulin resistance or glucose tolerance, and changes to leptin and ghrelin levels which represented 'satiety' and 'hunger' hormones, respectively, which lead to increased craving for high-calorie foods[14]. Thus, our students who had short sleep duration reported higher food craving of high-calorie foods than those with normal or long sleep duration.

We are aware of several limitations in this study. First, the poor response rate lays the study open to bias. Second, as this study design consisted of a one-time cross-sectional survey, it does not allow for a cause-effect conclusion to be made. Third, the study consisted of healthy, well-educated and virtually ethnically-homogenous tertiary students from one geographical area, and thus our results may not necessarily extrapolate to other multi-ethnic tertiary students in other parts of Malaysia or the general Malaysian young adult population. Fourth, as in any survey data, there is a potential for under- or over-reporting due to responder fatigue and recall bias. Furthermore, variation of internal consistency and reliability of PSQI, ESS and MES in different populations might influence the interpretation of results. Lastly, measurement scales such as PSQI, ESS and MES are not accurate clinical diagnoses for sleeping disorders but are only subjective measures of sleep.

CONCLUSIONS

Taken together, UTAR/KTAR students generally showed poor sleeping habits and behaviors. Almost one third of students defined as poor quality sleepers or suffered from EDS. The Majority of them were categorized as 'definitely eveningness'. Craving of high-calorie foods was related to sleep behavior, but not gender, academic performance and BMI. These results highlight the importance of sleep quantity and quality when promoting mental and physical health in adolescents and young adults. College students who are consistently getting poor sleep quantity and quality sleep may not be at risk at academically. However, they are at risk for poor eating habits like an increased craving for high-calorie foods, as shown in our study. This may possibly lead to detrimental health effects such as the metabolic syndrome and cardiovascular diseases. Future studies should include studying other factors that have been reported to be linked with sleep deprivation or sleep disorders, such as mood and affective disorders and physical health conditions. Sleep education is highly recommended in tertiary institutions to increase awareness among students towards their sleeping habits and problems. Professional advice and help should be given to students especially those who consistently face sleeping problems.

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