The Effects of Sleep Deprivation on Academic Performance of Health Sciences Students in Kuala Lumpur: An Institutional Study

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ABSTRACT

Adequate and efficient sleep plays a crucial role in memory and learning. Thus, it is so important for students to have adequate and efficient sleep to perform well in academics. This cross-sectional study was conducted to investigate the correlation between sleep quality and academic performance of undergraduate students from health-science-related courses attending a public institution in Kuala Lumpur, Malaysia. 395 students from the faculty of Dentistry, Pharmacy and Allied Health were randomly selected and approached via email for participation in the study. Consented students were given a set of questionnaires through the Google Form, consisting of information regarding their demographic data, grade point average (GPA) of last semester and Pittsburgh Sleep Quality Index (PSQI) questionnaire. Collected data were analysed using Statistical Package for the Social Sciences (SPSS) software. The correlation between the global PSQI scores and the GPA of the students from each faculty was determined using Spearman's rank coefficient correlation. Majority of the students across the faculties reported good sleep quality, good sleep efficiency, minimal sleep alteration and not taking any substance to help them to sleep better. 79.6 % of students from the Faculty of Pharmacy reported a global PSQI score of >5, followed by the Faculty of Allied Health (76.2%) and Faculty of Dentistry (66.4%). Mean GPA for all students lies within the excellent and good category. Only students from the Faculty of Pharmacy showed a weak negative correlation between the global PSQI scores and GPA, $r_s(98) = 0.266$, p=0.008.

1. INTRODUCTION

It is crucial to practice a good night's sleep in order to ensure the health and wellbeing of a student. The duration of sleep required varies between individuals and across the age group. Approximate eight hours of sleep every night is required for a normal person to perform his or her daily activities efficiently and hence maintain good health [1]. Young adults (18-25 years old) and adults (26-64 years old) require between seven to nine hours of sleep per day as recommended by the National Sleep Foundation [2].

Sleep durations less or beyond the recommended time may be appropriate, but should not deviate far from the normal range. Sleeping hours less than six hours a day is considered sleep deprivation. Many aspects of one's daily life are significantly affected due to sleep deprivation. Signs and symptoms of compromised health can be seen especially in those who usually sleep outside the normal range of bedtime. Sleep deprivation is commonly associated with poor judgment, mood disturbance, significant stress and anxiety, reduced achievement or performance [3], increase risk of obesity [4], diabetes mellitus [5], cardiovascular morbidity [6] and substance abuse [7].

Although sleep deprivation has been reported more commonly affecting adults and tends to increase with age, young people are also suffering from sleep deprivation during school and university years [8]. University students are one of the high-risk groups that may be affected by sleep disorders [9] as they are often bombarded with a great deal of commitments from academic and social aspects. Students from health science-based courses for example are involved with a heavy educative curriculum and demanding clinical requirements. On top of that, students need to cope with various assignments, lab reports, clinical case presentations and tests as part of their continuous assessment.

This requires the students to be physically and mentally fit, imposing a heavy burden on the students in order to perform well in such courses [10]. This phenomenon is even worse when the Covid-19 pandemic hit the world as online classes have replaced the conventional teaching and learning methods across the globe. Since face-to-face classes and tutorials are prohibited in order to prevent the spread of the infection, more online assignments and quizzes have been imposed on the students [11] to assess and maintain the students' competency.

Pittsburgh Sleep Quality Index (PSQI) has been designed to measure the quality and quantity of sleep in a population [12]. This questionnaire provides a reliable, valid and standardised measure of sleep quality, can differentiate 'good' and 'poor' sleepers, and provide an index that is simple for the subjects to understand and for researchers to analyse [13]. Various studies have been conducted using the PSQI and compared it with the academic performance of students, utilising their grade point average (GPA). In Malaysia, studies involving medical [14- 16], architecture [17], biomedical sciences [18] and allied health [19] students has been reported. However, studies of similar objectives among dental students are lacking. Dentistry itself is a unique course where the students will be exposed to hands-on practice and need to perform the clinical procedures on the patient themselves. This can be challenging and demanding, even more than the medical course as the students will be imposed with numerous clinical requirements that need to be met as part of their clinical competency assessment.

It is quite interesting to explore this research gap as the information from the study may give us new insight on whether clinically oriented courses with a high clinical requirement such as dentistry give a negative impact on the students' sleep quality and affect their academic performance as compared to less clinical demanding courses or vice versa. This information can be useful for the academician in shaping and improving the learning experience of the students of such courses in the future. Hence, we conducted the present study to determine the quality and quantity of sleep among undergraduate students of health science-based courses in our institution, encompassing students from the Faculty of Dentistry, Faculty of Pharmacy and Faculty of Allied Health using the PSQI questionnaire and compare it with their respective academic achievements.

2. Material and methods

2.1 Student recruitment

This observational, cross-sectional study was conducted among undergraduate students from three different faculties: Faculty of Dentistry, Faculty of Pharmacy and Faculty of Allied Health. The minimal sample size needed in the study for each faculty was based on a calculation by Raosoft sample size calculator, incorporating 5% margin of error, 95% confidence level and 50% response distribution, yielding 110,120 and 165 students from the Faculty of Dentistry, Pharmacy and Allied Health respectively.

The students' list, identified through their university matrix number was obtained from the Dean's Office of respective faculties. The list was entered into Microsoft Excel and a random list of students from each faculty was generated through the software based on the sample size calculated. The selected students were approached through their official university email and were asked to participate in the study. An information sheet explaining the objective and conduct of the study was attached to the email as well. Only students who consented to participate will be given the questionnaire, which comprises of two sections using the Google Form.

The first section of the questionnaire includes demographic information such as gender, any known chronic medical illness, faculty, current year of academics, and GPA of last semester. Students who reported a confirmed medical diagnosis of sleep disorder were excluded from the study and were not be replaced. The second part of the questionnaire consists of Pittsburgh Sleep Quality Index (PSQI), a self-rated questionnaire developed to assess the sleep quality over a time interval of one month. It consists of seven components: the sleep quality of the individual, time is taken for the individual to fall asleep, total sleep duration, sleep efficiency, bedtime difficulties or problems, any use of sleeping medications, and any impairment in daily function.

The scores for each component range from 0 to 3, where 0 indicates the highest quality of sleep, while 3 indicates the poorest sleep quality. The scores for every component were then summed up to yield a global PSQI score. A global PSQI score that is equal to or greater than 5 will be an indicator of poor quality of sleep. The PSQI has internal consistency and a reliability coefficient (Cronbach's alpha) of 0.83 for the seven components in the questionnaire. The academic performance of each student or GPA is stratified into excellent (>3.5), good (3 – 3.49), average (2 – 2.99), and poor (<2.0).

2.2 Data analysis

Statistical Package for the Social Sciences (SPSS) software, version 28.0 for Windows (IBM; SPSS Inc., Chicago, IL., USA) was used to enter and analyse the data. The demographic data were calculated and reported in terms of frequency and percentages. The mean GPA of students from the three faculties was calculated. The global PSQI scores were compared with the GPA of the student from each faculties using Spearman's rank correlation coefficient. A p-value of ≤0.05 was taken as significant.

3. Results

3.1 Demographic data

Table 1 demonstrates the complete demographic characteristics of the students involved in the study. A total of 356 students participated in the study, where 43 % of them come from the Faculty of Allied Health, followed by the Faculty of Dentistry (29.5%) and the Faculty of Pharmacy (27.5%). Majority of them were females (75%). Form the total number, 151 (42.4%) of them were students from Year 2, 71 (19.9%) were students from Year 3, 113 (31.7%) students were from Year 4, and the remaining 21 (5.9%) students were from Year 5. Only 7.6 % of the students reported having a chronic medical illness. The mean GPA of the

students from the Faculty of Allied Health was the highest (3.67), followed by the Faculty of Pharmacy (3.53) and Faculty of Dentistry (3.25) in descending order.

Table 1 Demographic data and mean GPA of students

	Frequency (n)	Percentage (%)
PART A		
Gender		
Male	89	25
Female	267	75
Chronic medical illness		
Yes	27	7.6
No	329	92.4
Faculty		
Dentistry	107	29.5
Pharmacy	98	27.5
Allied Health	151	43.0
Current Year of Study		
Year 2	151	42.4
Year 3	71	19.9
Year 4	113	31.7
Year 5	21	5.9
PART B		
Mean GPA of Last Semester		
		Mean GPA[a]
Dentistry		3.25
Pharmacy		3.53
Allied Health		3.67

[a]Mean GPA regarded as: Excellent ($\geq$3.5), Good (3-3.49), Average (2-2.99), Poor (<2).

3.2 PSQI analysis of students from each faculty

Table 2 summarizes the analysis of the seven components from the PSQI questionnaire reported by the students from the three faculties. Majority of the students across the faculties reported good sleep quality, good sleep efficiency, minimal sleep alteration and not taking any substance to help them to sleep better. However, 75 students from the Faculty of Dentistry need longer time to go to sleep, while 83 students from the Faculty of Pharmacy slept less than 7 hours per night. Almost half (44%) of the students from the Faculty of Allied Health reported daytime sleep dysfunction. More than 75% of the students from the three faculties have abnormal sleep quality with a global PSQI score of more than 5.

3.3 Correlation between PSQI and GPA of students from each faculty

There was a statistically significant, weak negative correlation between the global PSQI scores of the Faculty of Pharmacy students and their GPA, $r_s(98) = 0.266$, p=0.008. On the other hand, there was no significant correlation between the global PSQI scores and their respective GPA for the students from the Faculty of Dentistry and Faculty of Allied Health with the p-value of 0.747 and 0.251 respectively (Table 3).

Table 2 PSQI analysis of students from each faculty

	Dentistry	Pharmacy	Allied Health

PSQI

C1 Subjective Quality [a]

Poor	24	22	28
Good	83	76	123

C2 Sleep Latency [b]

High	75	33	39
Low	32	65	112

C3 Sleep Duration

<7 hours	33	83	59
>7 hours	74	15	92

C4 Sleep Efficiency

<75%	7	10	15
>75%	100	88	136

C5 Sleep Alterations [c]

High	15	13	25
Low	92	85	126

C6 Substance Use

<1 time/week	106	95	143
>1 time/week	1	3	8

C7 Daytime Sleep Dysfunction [d]

High	20	24	46
Low	87	74	105
Global PSQI Scores			
Normal (<5)	36	20	36
Abnormal (≥5)	71	78	115

a. - Poor (categories PSQI - very poor, fairly poor), Good (categories PSQI - very good, fairly good); *b.* - High (categories PSQI - 31-60 minutes, ≥60 minutes), Low (categories PSQI - <15 minutes, 16-30 minutes); *c.* - Low (categories PSQI scores between 0 and 1-9 points), High (categories PSQI scores between 10-18 and 19-27 points); *d.* - High (categories PSQI - 1-2times/week, ≥3 times/week), Low (categories PSQI <1 time per week, never in the last month).

Table 3 Correlation between global PSQI score and CGPA of students from each faculty

Faculty	**Spearman's rho**	**p-value**
Pharmacy	0.266	0.008[*]
Dentisry	0.032	0.747
Allied Health	0.094	0.251

*Denotes statistically significant difference, with $p<0.05$

4. Discussions

Sleep adequacy is essential among students as it has been proven that good quality of sleep can reinforce cognitive skills, especially memory retention. [20] have described the role of slow-wave sleep (SWS) in the process of memory consolidation. During SWS, the consolidation process takes place following reactivation of recently encoded neuronal memory, which later will be transformed for integration into long-term memory. Thus, it is not surprising that sleep deprivation is inversely related to good academic performance. A study which was conducted by [21] has shown that university students are noted to have poor sleep quality and most of these students feel tired the next morning. It has also been shown in a study conducted by [22] that college and university students have a tendency to experience sleeping difficulties, insufficient sleep and mostly require more sleeping hours to feel rested. Further, [23] has found that in relation to academic achievement, the high-performing group generally had an earlier bedtime compared to the low-performing group. Sleep latency was also shown to be longer in the low-performing group. Lower academic achievement

is associated with chronic sleep reduction although sleep quality was not found to be significantly associated with academic achievement [24].

In present study, the initial sample size calculated was 395 students across the three faculties. However, the final number that was eligible for data analysis was 356 students, with a response rate of 90%. The discrepancy between the figures was due to incomplete data entry, no response towards the email sent, and 5 students did not consent for participation in the study. Majority of the students who participated in the study were females, with the female to male ratio of 3:1. This is quite a common finding in universities across the globe as the distribution of the students, mainly in health-sciences-related courses were dominated by the female [25], [26]. Gastrointestinal disease and benign cancer were among the common chronic medical illness reported by the students in this study, and none of them have been diagnosed with any type of sleeping disorder before.

Students from the Faculty of Allied Health predominates as the faculty itself is a large faculty comprised of 13 different programs such as Optometry, Environmental Health, Occupational Therapy, Speech Therapy, Diagnostic Imaging and Radiotherapy and Physiotherapy, while Faculty of Dentistry and Faculty of Pharmacy only have 1 program running in each faculty. Year 1 students were not included in this study as they have not sat for their examination yet at the commencement of this study while only a small number of Year 5 students were recruited as compared to another year of study. This was due to only the Faculty of Dentistry having a 5-years course as compared to a 4-years course in other faculties.

Excellent mean GPAs were obtained by the students from both Faculty of Allied Health and Pharmacy in the last semester, while students from the Faculty of Dentistry obtained a good mean GPA, between 3.0 to 3.49. The 'lower' mean GPA for students from the Faculty of Dentistry was contributed by the low academic achievement of pre-clinical years students, with a mean GPA of 2.76. Several factors have been discussed in the literature associating the poor learning style, poor coping strategies [27] and culture shock with poor academic performance among pre-clinical students. As the students progress into the clinical years, better coping strategies and learning techniques have helped them to integrate their pre-clinical knowledge into their clinical practice.

Analysis of the seven PSQI components showed that not all components affect the students' sleep quality. Students from the Faculty of Dentistry were affected by high sleep latency, which means that they take a longer time to fall asleep, which affects 70% of the students. On the other hand, 30% of the students from the Faculty of Allied Health suffered from daytime sleep dysfunction, 5% and 11% more than students from the Faculty of Pharmacy and Dentistry respectively. In addition, 85% of the students from the Faculty of Pharmacy reported of sleep duration of fewer than 7 hours per day as compared to 39% and 31% reported by students from the Faculty of Allied Health and Dentistry respectively. This is beyond the recommended duration of sleep proposed by the National Sleep Foundation; which is around 7 to 9 hours per day [2].

Majority of the students involved in this study have abnormal and poor sleep quality as reflected by the global PSQI score. The faculty of Pharmacy has the highest number of students with a global PSQI score of more than 5 (79.6%), followed by the Faculty of Allied Health (76.2%) and the Faculty of Dentistry (66.4%). Nevertheless, the global PSQI score obtained from this study should be interpreted with caution. Despite the high percentage of students with abnormal sleep quality, in-depth analysis of the score revealed that the average global PSQI score per student in each faculty were at the lower margin of the score: 5.74 (Faculty of Dentistry), 6.4 (Faculty of Allied Health) and 6.54 (Faculty of Pharmacy) respectively.

This is also reflected by Spearman's rank coefficient correlation between the global PSQI score and the academic performance of the students. The 'poor' sleep quality only has a weak negative correlation for the students from the Faculty of Pharmacy, while no correlation was found for the students from the Faculty of Allied Health and Dentistry. [28] also reported similar outcomes in a study conducted among college students in Saudi Arabia. Hence, the heavy academic and clinical requirement faced by the students enrolled in the clinically-oriented courses did not affect their quality of sleep and academic performance.

In addition, the vast number of female students involved in this study might also influence the outcome of the study. [29] reported that female students had more weekday sleep loss, reported a lower subjective sleep quality score and excessive daytime sleepiness as compared to male students. Nonetheless, this does not rule out the importance of adequate sleep in maintaining health, well-being and excellent academic performance as reported by various studies in the literature [8], [23], [30], [31].

This study only investigates the impact of students' academic performance from the sleep quality point of view. As this is an observational self-reported study, quality of sleep is mainly based only on subjective assessment by the students. Thus, false information may be provided by the students during answering the questionnaires, and students may be unable to understand or misinterpret the questions as well. Furthermore, other factors such as stress, mental health and financial status were not included. Hence, we suggest that socioeconomic variables should also be included in further studies investigating the correlation between sleep disturbance and academic performance of undergraduate students. This can help the students to better understand and acknowledge the problems that contribute to their academic performance.

5. Conclusion

This study demonstrates a high prevalence of poor sleep quality among the undergraduates students. However, there was only a weak negative correlation between the sleep quality and academic performance of the students from the Faculty of Pharmacy, while no correlation was found for the students from the faculty of Dentistry and Allied Health. Further research is needed with the inclusion of socio-economic factors in order to dissect the actual problem that might hinder the students' academic excellence.

6. References

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