ORIGINAL ARTICLE

Poor Sleep Quality Linked to Lower Academic Performance in Dental Students: A Cross-Sectional Study

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ABSTRACT

Introduction: Sleep is essential for both physical and mental health. Studies have shown that sleep problems are prevalent among university students. The purpose of this study was to investigate the association between sleep quality and academic performance among dental students at a Malaysian university. **Methods:** All dental students of the university were invited to participate in this cross-sectional study, which used a self-administered Pittsburgh Sleep Quality Index (PSQI) scale and the psychological health domain of the Lifestyle and Habits Questionnaire- Brief. The academic performance was determined by their Grade Point Average (GPA). Descriptive statistics, independent t-tests, Pearson's Chi square test for independence, and ANCOVA tests were used to analyse the data. **Results:** A total of 341 students (233 females and 108 males) participated in the study, with 36.7% reporting poor sleep quality (PSQI > 5). There was a significant difference in academic performance between students with good and poor sleep quality. Controlling for gender and psychological health, poor sleep quality was associated with lower GPA in both preclinical (adjusted mean GPA: 2.84 for poor sleepers, 3.28 for good sleepers, $P < 0.001$) and clinical year students (adjusted mean GPA: 2.99 for poor sleepers, 3.13 for good sleepers, $P = 0.003$). **Conclusion:** Dental students with poor sleep quality performed worse academically than students with good sleep quality after controlling for gender and psychological health. This finding was consistent in both the preclinical and clinical phase groups.
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INTRODUCTION

Sleep is necessary for optimal cognitive and emotional functioning. A good night's sleep recharges the body and mind, resulting in a refreshed feeling when you wake up. Studies that investigated the relationship between sleep quality and academic achievement, including among health students with demanding academic needs, discovered that those who had poor sleep quality appeared to perform worse academically (1–3). This is not surprising given the roles of sleep in memory consolidation,(4) learning,(5) and neurocognitive performance (6). Furthermore, psychological factors such as self-efficacy, motivation, and stress have been identified as being responsible for students' lower academic abilities (7).

Our study aimed to investigate the association between sleep quality and academic performance among undergraduate dental students at a Malaysian university. To the best of our knowledge, this is the first study on sleep quality and academic performance among dental students conducted in the northern region of Peninsular Malaysia.

MATERIALS AND METHODS

The sleep quality was determined using the Pittsburgh Sleep Quality Index (PSQI) responses from students (8). This is a self-administered 19-item instrument designed to assess subjective sleep quality over the previous month. The PSQI's seven components: (i) sleep quality; (ii) sleep latency; (iii) sleep duration; (iv) sleep efficiency; (v) sleep disturbance; (vi) medication use; and (vii) daytime dysfunction, are totaled to produce the global score, which can range from 0 to 21. Poorer sleep quality is indicated by higher global scores. PSQI has been reported to have a sensitivity of 89.6 percent and a specificity of 86.5 percent when the global cut off is greater than 5. In our sample, the Cronbach's alpha value was 0.51, indicating an acceptable level of internal consistency.

The study sought to determine whether sleep quality affects academic performance, while taking into account potential confounding factors such as gender and psychological health. Psychological factors were assessed using the 'psychological health' domain of The Lifestyle and Habits Questionnaire-Brief version (LHQ-B). The internal consistency of the LHQ-B domains, as measured by the Cronbach's alpha coefficient, ranges from 0.65 to 0.91 among 18 to 25-year-old college students (9). The psychological health domain consisted of seven items, rated on a scale of 1 (strongly disagree) to 5 (strongly agree). The total scores ranged from 7 to 35, with higher scores indicating more positive psychological factors. Permission to use both instruments was granted by the respective developers. Academic performance was evaluated using the students' Grade Point Average (GPA) scores from the previous semester prior to the study period. The data were obtained from faculty records and anonymized prior to analysis.

All 374 undergraduate dental students enrolled at the university were invited to participate voluntarily in this cross-sectional study. The PSQI and LHQ-B questionnaires, as well as the study information and consent forms, were distributed individually to the students in physical form.

R (ver.4.0.2) statistical software was used to analyze the data (10). Continuous variables were described using mean and standard deviation (SD), while categorical variables were described using frequency and percentages. Gender was coded into two groups: "male=1" and "female=0," and clinical levels were classified as "preclinical" (years 1 and 2) and "clinical" (years 3, 4 and 5). Sleep quality was classified as "good" (PSQI scores $\leq$ 5) or "poor" (PSQI scores > 5). The independent t-test was used to test the mean differences of numerical variables (GPA and psychological health scores) in the overall sample, while Pearson's Chi-square test was used to test the differences of categorical variables (gender and sleep quality).

The Analysis of Covariance (ANCOVA) test was initially performed on the entire sample, with sleep quality, gender, and clinical phase included as independent variables and psychological health included as a covariate. However, the two-way interaction term between sleep quality and clinical phase was statistically significant, indicating that the ANCOVA assumption of homogeneity of regression slopes was violated. Therefore, the subsequent analyses were stratified by the clinical phase of the students. Residual plots were used to test the assumptions of overall linearity (model fitness), linear relationship between the covariate and independent variable, normality, and equal variances. All statistical tests were two-sided, and statistical significance was defined as a P value less than 0.05.

The approval from the university's Human Ethics Committee was obtained prior to the collection of data (Ref: AUHEC/FOD/2019/18, dated 11 June 2019). The study protocol followed the recommendations of the Declaration of Helsinki.

RESULTS

A total sample of 341 students consisting 233 females (68.3%) and 108 males (31.7%) participated in the study, giving a 91.2% response rate. The overall prevalence of subjects with poor sleep quality (PSQI > 5) was 36.7% (n = 125). The overall psychological health scores ranged from 7 (unhealthy state) to 35 (healthy state), with a mean of 24.5 (SD 4.41), and the overall GPA was 3.09. (SD 0.50).

Table I shows the distributions of gender, sleep quality, psychological health, and GPA among subjects stratified by clinical phase. There were 144 preclinical subjects (42.2%) and 197 (57.8%) who were already in the clinical years. The proportion of females was higher among preclinical subjects (73.6%) than among the clinical phase group (64.5%), but this difference was not statistically significant (P = 0.073). There was also no significant difference between the preclinical and clinical groups in the prevalence of good and poor sleep quality, psychological well-being, or GPA mean scores. Students with poor sleep quality performed worse academically than those with good sleep quality in both the preclinical and clinical phases. This was supported by the significant differences in GPA between students with good and poor sleep quality (Table II). Analyses controlling for gender and psychological health showed that the adjusted mean GPA for students with good sleep quality in the preclinical group was 3.28 (95% CI: 3.13, 3.43), whereas it was 2.84 (95% CI: 2.65, 3.03) for poor sleepers (Table III). Similarly, in the clinical year, the adjusted mean GPA was 3.13 (95% CI: 3.07, 3.19) for students with good sleep quality and 2.99 (95% CI: 2.91, 3.06) for those with poor sleep quality, and the differences in both clinical levels were significant (P < 0.001 and P = 0.003, respectively). Neither gender nor psychological health played a significant role in the models.

DISCUSSION

In this study, we evaluated the academic performance of undergraduate dental students in relation to their subjective sleep quality, while taking into account gender and psychological health as potential confounding variables. The data were stratified by clinical phase to eliminate the previously mentioned interaction, which could potentially confound the relationship between sleep quality and academic performance. Separate

Table I: Gender, sleep quality, psychological health and academic performance (GPA) of preclinical and clinical students.

Variables	Preclinical phase n = 144 (42.2%)		Clinical phase n = 197 (57.8%)		*P* value
	n (%)	Mean (SD)	*n* (%)	Mean (SD)	
Gender					
Female	106 (73.6)	-	127 (64.5)	-	0.073*
Male	38 (26.4)		70 (35.5)		
Sleep quality					
Good	94 (65.3)	-	122 (61.9)	-	0.526†
Poor	50 (34.7)		75 (38.1)		
Psychological Health Score	-	24.7 (4.77)	-	24.4 (4.13)	0.436
Grade Point Average (GPA)	-	3.10 (0.66)	-	3.09 (0.33)	0.784§

SD = Standard deviation
* Pearson's Chi square test of independence; χ^2 [degrees of freedom (*df*)] = 3.21 (1).
† Pearson's Chi square test of independence; χ^2 (*df*) = 0.40 (1).
Independent *t*-test: Mean difference = 0.4 [95% Confidence Interval (CI): -0.6, 1.4], *t* statistic (*df*) = 0.78 (339).
§ Independent *t*-test: [a] Population variances were significantly different (Levene's test p-value < 0.001), therefore *t* statistic without assuming equal variances was used. Mean difference = 0.02 [95% CI: -0.10, 0.14)], *t* statistic (*df*) = 0.28 (196).

Table II: Comparison of academic performance (GPA) between subjects with good and poor sleep quality

Sleep quality	*n*	Mean (SD)	Mean diff. (95% CI)	*t* stat (*df*)	*P* value†
Preclinical phase					
Good sleep quality	94	3.24 (0.656)	0.40 (0.18, 0.62)	3.64 (142)	<0.001
Poor sleep quality	50	2.84 (0.596)			
Clinical phase					
Good sleep quality	122	3.15 (0.320)	0.15 (0.06, 0.25)	3.22 (195)	0.002
Poor sleep quality	75	3.0 (0.34)			

SD= Standard deviation; CI = Confidence Interval; df = degrees of freedom
† Independent *t* test with equal variances assumed (Levene's test p-value > 0.05)

analyses were then conducted for each subgroup (preclinical and clinical phases) to obtain strata-specific estimates of this relationship and better understand the effects of sleep quality on academic performance within each group. Indeed, one strategy proposed for managing significant interaction terms is to report strata-specific estimates, which are obtained by separating groups in which the confounder does not vary across different exposure-outcome levels (11).

In the preclinical and clinical phases, approximately 34.7% and 38.1% of respondents, respectively, reported overall poor sleep quality. In a study conducted in Iraq (12), healthcare students were found to have a prevalence of poor sleep quality of 60.4% using the same scale and a similar cut-off value (PSQI > 5), while a Ghanaian study (13) reported a prevalence of 56.2%. Our findings are consistent with a prevalence of poor sleep quality of 31.0% reported in a sample of college students in China (14) and 57.5% in India (15).

The mean GPA for preclinical and clinical students in our study were reported as 3.10 (SD 0.66) and 3.09 (SD 0.33) respectively. The findings confirmed our hypothesis that sleep quality is associated with academic performance, which was demonstrated at each clinical phase through univariable and multivariable analyses. Significant differences in GPA scores were observed between good and poor sleepers in both the preclinical (P < 0.001) and clinical (P = 0.002) samples.

These findings corroborate a previous study on medical students in Saudi Arabia, which found that students with self-reported poor sleep quality performed worse academically (16). In a study of sleepiness factors among college students, early sleepers and risers were found to have higher GPAs than subjects with nocturnal habits. It is worth noting that the authors reported a stronger relationship between sleep pattern and academic

Table III: Comparison of academic performance (GPA) between subjects with good and poor sleep quality controlling for gender and psychological factors

Sleep quality	*n*	Adjusted mean[a] (95% CI)	Adjusted mean diff. (95% CI)	*F* stat[a] (*df*)	*P* value†
Preclinical phase					
Good sleep quality	94	3.28 (3.13, 3.43)	0.44 (0.21, 0.68)	13.82 (1,140)	<0.001
Poor sleep quality	50	2.84 (2.65, 3.03)			
Clinical phase					
Good sleep quality	122	3.13 (3.07, 3.19)	0.14 (0.05, 0.24)	8.88 (1, 193)	0.003
Poor sleep quality	75	2.98 (2.91, 3.06)			

CI = confidence interval; *df* = degrees of freedom
† Adjusted mean using ANCOVA controlling for gender and psychological health.
Bonferroni adjustment for 95% confidence interval for difference.

performance than between sleep duration and academic performance (17).
Our study uncovered a significant association between poor sleep quality and lower academic performance, even after adjusting for gender and psychological health ($P < 0.001$ for the preclinical phase, $P = 0.004$ for the clinical phase). This finding is in line with previous research by Seun-Fadipe and Mosaku (18), who found that sleep quality is a significant predictor of academic achievement. Specifically, their study showed that a one unit increase in the PSQI score, which is indicative of poorer sleep quality, was associated with a 0.05 decrease in GPA. Khalsa et al. (19) investigated the association between subjective sleep quality, habitual sleep duration, and white matter differences in the brain. The study found that both sleep factors were linked to regional white matter microstructural abnormalities in the frontal and temporal lobes, which are important for cognitive functions such as memory and focus. Poor sleep quality has also been found to be associated with decreased connectivity in the resting default mode network (DMN) in adolescents (20). The DMN is a group of brain regions that is activated during familiar tasks, but recent research suggests it also plays a role in cognitive functions such as memory. For example, children with better language, reading, and math skills have been shown to have higher connectivity in specific DMN regions (21).

Lunsford-Avery and colleagues (22) reported that healthy adolescents and young adults with regular sleep and wake patterns had shorter inter-node distances in the right and left lateral parietal lobules of DMN regions, indicating increased network connectivity within these areas. These findings suggest that sleep has a positive impact on network connectivity in DMN regions. However, some studies discovered contradictory findings, indicating that sleep quality has no effect on academic achievement (23, 24). The lack of significance observed in these studies could be partly attributed to uncontrolled confounding factors.

In our study, the difference in academic performance between good and poor sleepers was greater in the preclinical group than in the clinical group. The preclinical phase is a crucial time for dental students to adapt to the university education and lifestyle. During the early stages of their studies, they need to acquire the essential knowledge and practical skills in the laboratory to prepare for their clinical years later. The high academic workload during the preclinical phase can be overwhelming, and if not managed properly, it can potentially impair their sleep quality and jeopardize their academic performance. On the other hand, their seniors in the clinical phase may have already adjusted well to the demands of being a dental student, and as a result, they can balance their studies and personal lives better than their peers in the preclinical phase (25).

The effects of gender and psychological health were accounted for during the analysis in this study. Previous research has investigated gender and psychological health as predictors of academic achievement, with mixed findings. For instance, one study found that female students performed similarly to male students in academic performance (26), suggesting that the majority of students now have equal opportunities and access to education. Additionally, with the advancement of technology, almost all students, regardless of gender, have smartphones and other mobile devices with internet access that allow them to learn and access information at their convenience (27).

In contrast, in a sample of Turkish college students, female subjects were reported to outperform male subjects in academic performance (28), while in another study, male students performed better than their female peers (29). It is noteworthy that each gender has distinct learning styles. Corbin (30) found that female students prefer dependent, participative, and collaborative learning, while male students prefer independent and competitive learning. This implies that female students prefer studying together and assisting one another, while male students prefer studying alone. Regarding psychological health, it has been discovered that stress caused by unhealthy lifestyle habits correlates with lower academic performance (31). Other psychological factors, such as students' cognitive abilities, self-efficacy, and personality, have been linked to academic success (32–34).

The study has some limitations, including the lack of control for other potential confounders such as fear, anxiety, and other behavioral characteristics that could influence students' academic achievement. Additionally, family background, use of social media, self-motivation, and intelligence were not assessed. The cross-sectional design of the study limits the interpretation of whether poor sleep quality is a cause or result of lower academic performance. Furthermore, the responses to sleep and psychological state were self-reported, which could lead to inaccurate estimation.

For future research, it would be valuable to objectively assess sleep quality using actigraphy, in addition to self-reported measures such as the PSQI. In addition, investigating individual differences in circadian preference may provide insight into how sleep quality impacts academic performance in different groups. These additional measures could help to further clarify the association between sleep quality and academic performance, and provide additional information for the development of interventions to improve sleep and academic outcomes in students.

CONCLUSION

In summary, this study shows that poor sleep quality is significantly associated with lower academic performance among undergraduate dental students at a Malaysian university, even after accounting for gender and psychological health. This association is consistent across both the preclinical and clinical phases, highlighting the need for sleep quality self-assessment, particularly among students experiencing academic difficulties. Understanding the modifiable predictors of poor academic performance can assist the university in developing appropriate interventions and support services for students.

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