ORIGINAL ARTICLE

Sleep Quality and Its Influencing Factors in Medical Students

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Background: Sleep is a vital biological process essential for cognitive function, mental well-being, and overall physical health. Medical students, due to their rigorous academic demands, often experience poor sleep quality, which can adversely affect their academic performance and personal lives.

Objective: To evaluate sleep quality and the factors influencing it among pre-clinical and clinical students at medical school.

Materials and Methods: A cross-sectional study was conducted among 403 medical students between June 1 and December 31, 2022. Participants were evaluated using the Thai version of the Pittsburgh Sleep Quality Index (PSQI) to measure sleep quality and disturbances over a one-month period. The data were analyzed using Stata, version 16.

Results: Clinical students reported significantly shorter sleep durations (5.55 versus 6.12 hours, p<0.001) and a higher prevalence of poor sleep quality (73.0% versus 62.0%, p=0.018) compared to pre-clinical students. Multivariable analysis revealed that female students were less likely to have poor sleep quality (AOR 0.65, 95% CI 0.40 to 1.07, p=0.011), while LGBTQ+ students (AOR 2.16, 95% CI 0.86 to 5.38, p=0.011) and smokers (AOR 2.08, 95% CI 1.00 to 4.33, p=0.049) were at higher risk. Physical inactivity and bedtime routines, such as reading, were also significantly associated with sleep quality.

Conclusion: Clinical medical students experience poorer sleep quality compared to pre-clinical students, with individual behaviors like smoking, physical inactivity, and bedtime habits influencing sleep more significantly than academic phase or demographic factors. Interventions focused on promoting healthy sleep hygiene, regular exercise, and stress reduction may improve sleep quality and overall well-being among medical students.

Keywords: Sleep quality; Medical students; Health behavior

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Sleep is a crucial biological process essential for optimal brain function and overall physical health. It plays a significant role in cognitive processes and bodily functions[1]. The National Sleep Foundation recommends that adults aged 17 and older aim for 7 to 9 hours of sleep each night. However, various factors influence sleep quality. Four key attributes of quality sleep are sleeping efficiency, sleep latency, sleep duration, and wake time after sleep onset[2]. Good sleep quality promotes cardiovascular health, mental well-being, cognitive function, memory consolidation, immune function, reproductive health, and hormone regulation. In contrast, poor sleep quality can lead to sleep disorders, fatigue, irritability, daytime dysfunction, and slower reaction times[3]. These issues can significantly affect health, exacerbate existing conditions, and impact students' cognitive and behavioral performance.

For individuals involved in rigorous academic programs like medical education, sleep quality is a critical component of overall well-being. The demanding nature of medical training, which includes intensive coursework, clinical responsibilities, and long study hours, significantly affects students' sleep patterns[4]. Previous research has highlighted the prevalence of sleep disturbances among medical students, linking these issues to factors like heavy academic workloads, clinical rotations, and irregular schedules, all of which contribute to sleep deprivation and diminished sleep quality[5-7]. However, there is a noticeable gap in studies that directly compares sleep

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patterns between the pre-clinical and clinical phases of medical education.

This study aims to evaluate sleep quality among medical students at Thammasat Medical School by comparing pre-clinical and clinical students. The comparison between pre-clinical and clinical students was conducted because the learning context changed across medical training. Pre-clinical students primarily engage in classroom-based learning with structured schedules, whereas clinical students face shift-based duties, night calls, and direct patient care. These changes may influence sleep duration, circadian rhythm, and behavioral factors associated with sleep quality. The Pittsburgh Sleep Quality Index (PSQI), which has undergone thorough validation to ensure its reliability, accuracy, and appropriate cutoff values for Thai participants[8], will be used to assess sleep quality and disturbances over a one-month period.

Materials and Methods

Sampling

A cross-sectional study was conducted with all medical students at Thammasat Medical School between June 1 and December 31, 2022. Participants were excluded if they had cognitive or physical impairments that hindered their ability to complete the questionnaires independently, as well as those diagnosed with mood or psychiatric disorders by certified physicians or psychiatrists. Out of 436 medical students, 403 provided written informed consent and completed the questionnaires for analysis. This sample size was sufficient to estimate the 95% confidence interval (CI) for the prevalence of poor sleep quality, which was estimated at 25% with a ±5% margin[9]. The Thai version of the PSQI was used to assess participants' overall sleep quality and disturbances over a one-month period prior to questionnaire completion. It was administered once and not repeatedly. The study received approval from the Ethics Committee of Thammasat University (MTU-EC-SA-0-132/63).

Data collection

Data were collected through a self-administered online questionnaire aimed at assessing respondents' sleep quality and its influencing factors. The PSQI will be used to assess sleep quality and disturbances over a one-month period. Although originally developed in English, the research utilizes the validated Thai version of the PSQI, which has undergone thorough validation to ensure its reliability, accuracy, and appropriate cutoff values for Thai participants[8]. A PSQI score above 5 indicates poor sleep quality, while a score exceeding 6.5 may suggest a potential sleep disorder.

The questionnaire was distributed to participants, with strict measures in place to ensure that all collected data remained confidential and anonymous.

Statistical analysis

The data for this study were analyzed using Stata Statistical Software, version 16 (StataCorp LLC, College Station, TX, USA). Continuous variables were summarized as means and standard deviations, while categorical variables were reported as counts and percentages. Chi-square tests were used to compare proportions between pre-clinical and clinical students, and Student's t-tests were employed to compare means. A significant level of 0.05 was applied to all statistical tests. To identify independent risk factors associated with poor sleep quality, a multivariable logistic regression analysis was performed, including variables with a p-value of less than 0.20 from the univariate analysis. The final model included academic year, gender, obesity, smoking, exercise, and bedtime behaviors such as reading, listening to music, and playing digital games.

Results

Of the 403 respondents, 266 (66%) were pre-clinical students and 137 (34%) were clinical students. The demographic data of the medical students, divided into the two study groups, is presented in Table 1.

In terms of gender, the majority of both pre-clinical and clinical students were female, comprising 54.9% in the pre-clinical phase and 51.1% in the clinical phase. The proportion of LGBTQ+ students was higher in the clinical students, at 12.4%, compared to 8.6% in the pre-clinical students. Clinical students were significantly older than pre-clinical students, with a mean age of 22.5 years versus 19.9 years. Living arrangements also differed. A greater proportion of clinical students lived alone (73.7%) compared to pre-clinical students (55.3%), while more pre-clinical students resided with friends. Household income displayed more variation, with most pre-clinical students (37.2%) coming from households earning between 50,000 and 100,000 baht per month. In contrast, a larger proportion of clinical students (42.7%) reported household incomes exceeding 100,000 baht per month. Overall, the data indicates that clinical students tend to be older, more

Table 1. Characteristics of medical students between pre-clinical and clinical years

Characteristics	Preclinic (n=266)	Clinic (n=137)	p-value
Gender; n (%)			0.663
Male	97 (36.5)	50 (36.5)	
Female	146 (54.9)	70 (51.1)	
LGBTQ+	23 (8.6)	17 (12.4)	
Age (years); mean±SD	19.9±0.1	22.5±0.2	<0.001
Living partner; n (%)			0.001
Alone	147 (55.3)	101 (73.7)	
Friends	102 (38.4)	28 (20.4)	
Family	17 (6.4)	8 (5.8)	
Obesity; n (%)			0.978
No (BMI ≤25 kg/m^2)	223 (83.8)	115 (83.9)	
Yes (BMI >25 kg/m^2)	43 (16.2)	22 (16.0)	
Household income (Baht/month); n (%)			<0.001
<20,000	14 (5.3)	13 (9.6)	
20,000 to 50,000	87 (32.7)	29 (21.3)	
50,000 to 100,000	99 (37.2)	36 (26.5)	
>100,000	66 (24.8)	58 (42.7)	

SD=standard deviation; BMI=body mass index

Table 2. Risk behavior of medical students between pre-clinical and clinical years

Characteristics	Pre-clinic (n=266) n (%)	Clinic (n=137) n (%)	p-value
Coffee drinking			0.139
Never	47 (17.7)	21 (15.3)	
1 to 2 times/week	87 (32.7)	34 (24.8)	
≥3times/week	132 (49.6)	82 (59.9)	
Alcohol drinking			0.021
Never	171 (64.3)	87 (63.5)	
1 to 2 times/week	92 (34.6)	42 (30.7)	
≥3 times/week	3 (1.1)	8 (5.8)	
Smoking			0.142
Never	244 (91.7)	123 (89.8)	
From time to time	17 (6.4)	11 (8.0)	
Almost everyday	5 (1.9)	3 (2.2)	
Smartphone use per day			0.001
<2 hours	3 (1.1)	4 (2.9)	
3 to 4 hours	59 (22.2)	54 (39.4)	
5 to 7 hours	114 (42.9)	51 (37.2)	
≥8 hours	90 (33.8)	28 (20.4)	
Exercise			<0.001
Never	62 (23.3)	60 (43.8)	
1 to 2 times/week	144 (54.1)	58 (42.3)	
≥3 times/week	60 (22.6)	19 (13.9)	
Activity before bed			
Reading books	116 (43.6)	52 (38.0)	0.276
Listening to music	150 (56.4)	71 (51.8)	0.383
Playing digital games	99 (37.2)	48 (35.0)	0.666
Social media	218 (82.0)	107 (78.1)	0.859
TV/movies	116 (43.6)	64 (46.7)	0.552

likely to live alone, and financially better off.

As shown in Table 2, a greater proportion of clinical students consume coffee three or more times per week (59.9%) compared to pre-clinical students (49.6%). However, this difference is not statistically significant. The majority of pre-clinical students (64.3%) report never consuming alcohol, which is comparable to the clinical group, where 63.5% also indicate that they do not drink alcohol. Smoking habits are consistent across both groups, with most students in the pre-clinical (91.7%) and clinical phases (89.8%) reporting that they have never smoked. Notably, a significantly higher percentage of pre-clinical students (76.7%) use their smartphones for five or more hours per day, in contrast to 57.6% of clinical students. Furthermore, clinical students are significantly more likely to report never engaging in physical activity (43.8%) compared to their pre-clinical counterparts (23.3%). When comparing the activities that medical students engaged in before bedtime, the most frequent activity was playing games, followed by listening to music. Overall, the study found that the types of activities students engaged in before bed were similar between the pre-clinical and clinical phases, with no statistically significant differences in any of the activities.

The analysis of the PSQI was performed for the entire sample as well as for each of the two study groups, as shown in Table 3. Clinical students demonstrated a statistically significant shorter sleep duration, averaging 5.55 hours compared to 6.12 hours for pre-clinical students. While the mean PSQI global score was slightly higher for clinical students (7.22) than for pre-clinical students (6.66), this difference did not reach statistical significance (p=0.072). Nonetheless, a higher proportion of clinical students reported poor sleep quality (73.0% versus 62.0%) and were more likely to fall asleep within 15 minutes (70.1% versus 56.8%, p=0.005). Additionally, clinical students reported a significantly higher usage of sleep medication (14.6% versus 6.4%). In contrast, a significantly lower percentage of clinical students experienced daytime sleepiness compared to their pre-clinical counterparts (35.8% versus 60.2%).

Multivariable logistic regression analysis showed that clinical year students were more likely to experience poor sleep quality than their pre-clinical

Table 3. Sleep quality of medical students between pre-clinical and clinical years

Sleep characteristics	Preclinic (n=266)	Clinic (n=137)	p-value
Sleep duration (hours); mean±SD	6.12±0.08	5.55±0.09	<0.001
PSQI global score; mean±SD	6.66±0.18	7.22±0.25	0.072
Sleep quality			0.018
Good (PSQI ≤5)	101 (38.0)	37 (27.0)	
Poor (PSQI >5)	165 (62.0)	100 (73.0)	
Sleep duration			0.001
Adequate (≥7 hours)	219 (82.3)	129 (94.2)	
Inadequate (<7 hours)	47 (17.7)	8 (5.9)	
Sleep latency			0.005
<15 minutes	151 (56.8)	96 (70.1)	
15 to 30 minutes	75 (28.2)	35 (25.6)	
31 to 60 minutes	34 (12.8)	5 (3.7)	
>60 minutes	6 (2.3)	1 (0.7)	
Sleep medication			0.010
Yes	17 (6.4)	20 (14.6)	
No	249 (93.6)	117 (85.4)	
Daytime sleepiness			<0.001
Yes	160 (60.2)	49 (35.8)	
No	106 (39.9)	88 (64.2)	

SD=standard deviation; PSQI=Pittsburgh Sleep Quality Index

counterparts (AOR 1.42, 95% CI 0.88 to 2.29, p=0.152). Female students were significantly less likely to report poor sleep quality than male students (AOR 0.65, 95% CI 0.40 to 1.07, p=0.011), whereas LGBTQ+ students faced a heightened risk (AOR 2.16, 95% CI 0.86 to 5.38, p=0.011). Additionally, smoking was significantly associated with poor sleep quality (AOR 2.08, 95% CI 1.00 to 4.33, p=0.049), while regular exercise was linked to a reduced risk (AOR 0.65, 95% CI 0.47 to 0.90, p=0.009). Reading books before bedtime was also associated with a lower risk of poor sleep quality (AOR 0.60, 95% CI 0.38 to 0.96, p=0.031). Other factors, including living arrangements, household income, obesity, coffee and alcohol consumption, and smartphone use, did not demonstrate a significant association with sleep quality as shown in Table 4.

Discussion

The quality of sleep among medical students is a significant concern, as it impacts both their academic performance and personal well-being. Therefore, assessing sleep quality with a validated tool like the PSQI is crucial for monitoring sleep health within this population. This methodology also enables the development of targeted interventions aimed at enhancing awareness and addressing sleep-related issues among medical students.

This study investigated sleep quality among medical students in both pre-clinical and clinical phases, emphasizing the various factors that influence sleep patterns and behaviors. The response rate was notably high, with 92% of the 436 invited students completing the survey, demonstrating the willingness of medical students to participate in research addressing their sleep health concerns. This response rate aligns with the findings of previous studies, which also reported high participation rates among medical students in similar contexts[10].

The study analysis revealed significant demographic and lifestyle differences between pre-clinical and clinical students. Clinical students were older, more likely to live alone, and reported higher household incomes compared to pre-clinical students. Lifestyle habits also varied between groups. A significantly larger proportion of clinical students never engaged in physical activity (43.8% versus 23.3%, p<0.05), suggesting a decline in physical activity as students advance in their medical education, due to increased academic demands. Regular physical activity has been shown to improve sleep latency, sleep efficiency, and overall sleep quality through circadian regulation and stress reduction mechanisms[12]. Moreover, although not statistically significant, clinical students reported higher coffee consumption compared to pre-clinical students, a trend observed in other studies as a coping mechanism for increased workload and stress[13,14].

The PSQI analysis indicated that clinical students had poorer sleep quality than pre-clinical students, with 73.0% of clinical students reporting poor sleep quality compared to 62.0% of pre-clinical students. This finding is consistent with previous research that identified higher rates of poor sleep quality among clinical students, attributed to the demanding nature of clinical rotations and increased stress levels[10]. Additionally, clinical students reported a shorter average sleep duration (5.55 versus 6.12 hours, p<0.05), further highlighting the impact of clinical duties on sleep. It is recommended that individuals obtain seven to nine hours of sleep to function optimally. Unhealthy sleep patterns can negatively affect daily functioning, with daytime sleepiness being more prevalent among pre-clinical students than their clinical counterparts. This difference may be due to better adaptation to routines and academic demands in later years. Clinical years emphasize active learning and hands-on experiences, contrasting with the lecture-based pre-clinical years. This shift

Table 4. Risk factors associated with poor sleep quality among medical students

Risk factors	Odds ratio (n=266)		p-value	Adjusted odds ratio* (n=137)		p-value
	Point estimate	95% CI		Point estimate	95% CI	
Academic years			0.026			0.152
Pre-clinic	-			-	-	
Clinic	1.65	1.05 to 2.60		1.42	0.88 to 2.29	
Gender			0.006			0.011**
Male	-	-		-	-	
Female	0.63	0.41 to 0.99		0.65	0.40 to 1.07	
LGBTQ+	2.01	0.83 to 4.90		2.16	0.86 to 5.38	
Living partner			0.630			
Alone	-	-				
Friends	0.86	0.55 to 1.34				
Family	1.29	0.52 to 3.21				
Household income (Baht/month)			0.645			
<20,000	-	-				
20,000 to 50,000	0.69	0.27 to 1.77				
50,000 to 100,000	0.70	0.28 to 1.78				
>100,000	0.57	0.23 to 1.46				
Obesity (BMI >25)	1.58	0.87 to 2.86	0.126	1.28	0.68 to 2.41	0.436
Coffee drinking	0.83	0.48 to 1.46	0.522			
Alcohol drinking	1.14	0.74 to 1.75	0.560			
Smoking	2.81	1.14 to 6.92	0.014	2.08	1.00 to 4.33	0.049**
Smartphone use	1.03	0.80 to 1.34	0.802			
Exercise	0.59	0.37 to 0.94	0.024	0.65	0.47 to 0.90	0.009**
Activity before bed						
Reading books	0.75	0.50 to 1.13	0.169	0.60	0.38 to 0.96	0.031**
Listening to music	1.29	0.85 to 1.94	0.232	1.45	0.91 to 2.29	0.114
Playing digital games	1.50	0.97 to 2.33	0.067	1.29	0.79 to 2.10	0.315
Social media	1.02	0.61 to 1.72	0.939			
TV/movies	1.03	0.68 to 1.56	0.893			

BMI=body mass index; CI=confidence interval

* By multivariable logistic regression model included academic year, gender, obesity, smoking, exercise, and bedtime behaviors such as reading books, listening to music, and playing digital games.

** Statistically significant with p<0.05 by multivariable logistic regression analysis

in learning style may help clinical students remain more alert and less drowsy during their work hours.

Interestingly, although clinical students had a slightly higher mean global PSQI score, the difference was not statistically significant. However, clinical students were significantly more likely to use sleep medication (14.6% versus 6.4%, p<0.05) and to fall asleep within 15 minutes (70.1% versus 56.8%, p=0.005). These findings suggest that clinical students may rely on pharmacological aids to manage sleep disturbances, a trend also noted in previous studies, which observed analgesic use at 57.4% among "poor sleepers"[15].

Multivariable logistic regression analysis identified several factors associated with poor sleep quality. Female students were notably less likely to report poor sleep quality in comparison to male students (AOR 0.65, p=0.011). Female students may demonstrate better sleep quality due to healthier sleep hygiene behaviors and lower prevalence of risk behaviors such as smoking. These findings contrast with previous studies, which have generally reported that male students tend to have poorer sleep quality compared to their female peers[16,17]. Conversely, LGBTQ+ students exhibited a higher risk of poor sleep quality (AOR 2.16, p=0.011), which may be attributed to additional stressors related to social acceptance and discrimination, as noted in similar studies[18].

Smoking was another factor significantly associated with poor sleep quality (AOR 2.08, p=0.049), supporting existing evidence that smoking

negatively impacts sleep due to nicotine's stimulating effects[19]. Conversely, regular exercise and engaging in relaxing activities, such as reading before bedtime, were associated with a reduced risk of poor sleep quality, consistent with studies highlighting the benefits of physical activity and relaxation techniques on sleep health[20,21].

Overall, the findings indicate that clinical medical students face significant challenges in maintaining adequate sleep. However, individual behaviors, such as smoking, exercise, and bedtime routines like reading, have a more substantial impact on sleep quality than demographic factors or the academic phase. These insights suggest that targeted interventions focusing on modifying personal habits and promoting healthier sleep hygiene could be more effective in enhancing the overall well-being of medical students.

Although this study offers valuable insights, it has limitations. The cross-sectional design limits the ability to infer causality, and self-reported data may be subject to recall bias. Additionally, the study did not explore psychological factors, such as anxiety and depression, which may further affect sleep quality. Future research should consider longitudinal designs and a more comprehensive assessment of psychological factors to better understand the complex interplay of influences on sleep quality among medical students.

Conclusion

Poor sleep quality is highly prevalent among medical students, particularly during the clinical phase of training. Although the academic stage was associated with differences in sleep duration and lifestyle patterns, multivariable analysis suggests that modifiable behavioral factors such as smoking, insufficient physical activity, and certain bedtime habits demonstrate stronger associations with poor sleep quality than demographic characteristics. These findings highlight the importance of promoting healthy sleep behaviors and lifestyle modifications within medical education environments. Interventions focusing on smoking cessation, regular physical activity, and improved sleep hygiene may help enhance sleep quality and overall well-being among medical students. Future longitudinal studies are warranted to further explore causal relationships and to inform targeted preventive strategies.

What is already known about this topic?

- Medical students often experience poor sleep quality.
- Lifestyle factors influence sleep quality.

What does this study add?

According to multivariable analysis, personal lifestyle factors, including smoking, insufficient physical activity, and inconsistent sleep schedules, demonstrate stronger associations with poor sleep quality than academic or demographic variables, thereby highlighting the potential value of behavioral interventions.

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Authors' contributions

Conceptualization: PS and LL. Methodology: PS, LL, and NT. Data collection: KW, KT, and PS. Formal analysis: PS and LL. Investigation: All authors. Writing-original draft: PS and LL. Writing-review & editing: All authors. Supervision: LL. Funding acquisition: PS. All authors have read and approved the final manuscript.

Data availability statement

The datasets generated and/or analyzed during the current study are not publicly available due to privacy and confidentiality considerations, but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Thammasat University (Approval No. MTU-EC-SA-0-132/63). Written informed consent was obtained from all participants prior to data collection. All procedures were conducted in accordance with the Declaration of Helsinki and relevant ethical guidelines.

Clinical trial registration

This study is not a clinical trial; therefore, clinical trial registration is not applicable.

Use of artificial intelligence

No artificial intelligence (AI) tools were used to generate or analyze data in this study. AI-assisted tools (e.g., language editing support) were used only to improve clarity and readability of the manuscript, without influencing the scientific content.

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Conflicts of interest

Authors have no conflicts of interest related to the submission of this paper.

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