

Association Between Sleep Quality and Quality of Life Among Medical Students in Chiang Mai University

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Objective: To explore and compare the sleep quality between pre-clinical and clinical medical students. The present study also assessed the influence of sleep quality on the quality of life in four domains, physical, psychological, social relationships, and environment.

Materials and Methods: A cross-sectional study was conducted among 261 second-year students and 241 fourth-year students from the Faculty of Medicine, Chiang Mai University as the representatives of preclinical and clinical medical students. Participants completed questionnaires consisting of the Pittsburgh Sleep Quality Index (PSQI) Thai version and WHOQOL-BREF-THAI to assess sleep quality and quality of life. The sleep quality was examined by chi-square test for the comparison between the two groups. Linear regression was used to evaluate the overall influence of sleep quality on each domain of the quality of life after adjusting for other covariates.

Results: Two hundred sixty-one participants or 46.7% had poor sleep quality with a PSQI of 6.5 or more. The sleep quality compared between the academic years had significantly worse results ($p < 0.001$) in the preclinical students. Sleep latency and sleep disturbance were the two components of sleep quality that were statistically poorer in the preclinical students ($p < 0.001$). Poor sleep was significantly associated with a poor quality of life in all domains ($p < 0.001$). Each score increased in the global PSQI score, 2.924 score of total WHOQOL-BREF-THAI would be diminished, resulting in an impaired quality of life ($p < 0.001$).

Conclusion: The prevalence of poor sleep quality was significantly higher in the preclinical year. As poorer sleep is statistically associated with the poorer quality of life, the curriculum and schedule should give consideration and provision for good sleep quality, especially in preclinical students for the improvement of medical student's well-being.

Keywords: Sleep quality; Quality of life; Medical students

Received 19 September 2022 | Revised 10 January 2023 | Accepted 7 February 2023

J Med Assoc Thai 2023; 106(3): 278-86

Website: <http://www.jmatonline.com>

Sleep problems are common in the general population. An international survey showed 49.5% of the adult population have sleep deprivation, and this is increasing⁽¹⁾. Health personnel, such as doctors, nurses, and even medical students, are careers that potentially have poor sleep quality. Medical students are vulnerable to poor sleep quality, because of long

duration and high intensity of study, clinical duties, and stressful learning environment⁽²⁾. The study of sleep quality in Thai medical students showed that nearly half of medical students have a poor quality of sleep. When compared with students in other faculties, medical students have worse sleep quality⁽³⁾ and fewer average sleep hours⁽⁴⁾.

Sleep quality affects the quality of life⁽⁵⁾, which is a subjective state of well-being that includes four domains, physical health, psychological state, social relationships, and environment^(6,7). Compared to other study profiles, medical students had the highest impact of poor sleep on the quality of life⁽⁸⁾. In addition, poor sleep quality was associated with burnout⁽⁹⁾, poor emotions⁽¹⁰⁾, conflicts in relationship⁽¹¹⁾, decrease in concentration and cognitive function^(12,13), increase in body mass index, and poor health condition.

Among medical students, there was a difference in sleep quality between academic years. The students

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How to cite this article:

Arayapitaya P, Pho-on D, Ucharattana T, Naktang N, Inchai J, Theerakittikul T. Association Between Sleep Quality and Quality of Life Among Medical Students in Chiang Mai University. *J Med Assoc Thai* 2023;106:278-86.

DOI: 10.35755/jmedassocthai.2023.03.13808

were divided into preclinical study, with are years one to three of Thai medical students, and clinical study, which are years four to six of Thai medical students. Apart from studying medical lectures like in preclinical years, clinical students must take day-night shifts and ward duties requiring more responsibility and contributing to differences in the quality of sleep. Some studies showed that clinical medical students had a higher prevalence of poor sleep quality⁽¹⁴⁻¹⁶⁾. On the other hand, one study found that preclinical medical students had poorer sleep quality due to the adjustment to the different learning systems from high school⁽¹⁷⁾. Many studies revealed that medical students had worse sleep quality when compared with other population groups that were associated with a poor quality of life. Although sleep deprivation is an important problem in medical students around the world, there are few studies regarding this issue in Thailand. The present study aimed to explore the sleep quality and its influence on each quality of life domain among medical students in Chiang Mai University Medical School, Thailand. The comparison of sleep quality between preclinical and clinical years remained inconclusive. Thus, another aim of the present study was to assess the sleep quality comparing between academic years.

Materials and Methods

The present study assessed the sleep quality and the association of sleep quality and quality of life. The target population was second-year medical students and fourth-year medical students as representatives of preclinical medical students and clinical medical students at Chiangmai University. Both target groups were medical students who were adjusting to a new learning system of medical education. The present study received approval from the Research Ethics Committees, Faculty of Medicine, Chiang Mai University (approval number: 444/2018).

The pre-clinical and clinical medical students were invited to complete self-administered questionnaires in the first week of the new subject, which was December 11 to 14, 2018, and the first week of changing rotation to a new department, which was December 24 to 30, 2018, respectively. The data sample were obtained from the whole population, which was 261 pre-clinical medical students and 241 clinical medical students. The response rate was 80% of the population, which was 209 and 193 students from the pre-clinical and clinical groups, respectively.

The self-administered questionnaires had three components, demographic data, Pittsburgh Sleep

Quality Index (PSQI) Thai version, and WHOQOL-BREF-THAI.

Demographic data included gender, age, academic year, and department rotation, day or night shift frequency, underlying disease, current medication, smoking, and alcohol consumption.

The PSQI Thai version was used to assess the sleep quality and composed of 19 self-rated questions and five questions rated by a roommate. Nineteen self-rated questions were used to indicate seven different sleep components including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. Each component is scored ranging from 0 for no difficulty to 3 for severe difficulty. The summation of all component scores is called PSQI global score and range from 0 to 21. A score greater than 6.5 suggested significant sleep disturbance. The global scores of the Thai-PSQI revealed that it had excellent internal consistency (Cronbach's alpha 0.837) and test-retest reliability (intraclass correlation coefficient 0.89)⁽¹⁸⁾.

The WHOQOL-BREF-THAI used to measure quality of life is composed of two types of questions including perceived objective and self-report subjective. These were divided into four domains of physical, psychological, social relationships, and environment. There were 23 items for positive question and three items for negative question. The score ranged from 1 (not at all) to 5 (completely), for the positive questions and 5 (not at all) to 1 (completely) for the negative question. A score of 26 to 60 suggested poor quality of life, with 61 to 95 suggesting a moderate quality of life, and a score of 96 to 130 suggested a good quality of life. The Cronbach's alpha was 0.8406 with a validity of 0.6515⁽⁷⁾.

Statistical analysis

To summarize the baseline characteristics, the present study used descriptive statistics as frequency, percentage, mean and standard deviation. Chi-square test was used to assess the sleep quality and quality of life of pre-clinical year and clinical year medical students and to compare sleep quality between two groups of medical students. Linear regression was used to assess the influence of sleep quality on the quality of life and the influence of sleep quality on four domains of quality of life which were physical, psychological, social relationship, and environment. In these regression analyses, the sleep quality was an independent variable, whereas the total quality of life

score and the scores of each quality of life domain were dependent variables. The covariates of gender, age, medical year, smoking, and alcohol consumption were inserted in the first block of regression analyses. All p-values were two-tailed, and a p-value less than 0.05 was statistically significant. All statistical analyses were performed using IBM SPSS Statistics, version 24.0 (IBM Corp., Armonk, NY, USA).

Results

Baseline characteristics

Of the 502 medical students in the target population, 405 students completed and returned the questionnaires resulting in a response rate of 80.67%. Those were 209 and 196 from preclinical and clinical medical students, respectively. Preclinical students had a mean age of 19.64 (SD 0.80), while clinical students had a mean age of 21.56 (SD 0.92). These mean ages between the two groups were significantly different ($p < 0.001$) as shown in Table 1.

Considering the controlled covariates, gender, alcohol consumption, and smoking were significantly different between the two groups of medical students ($p = 0.006$, < 0.001 , and 0.016 , respectively). There was a slightly higher proportion of women in preclinical respondents at 57.4%. On the other hand, the clinical respondents had slightly higher proportion of men at 56.1%. Most of respondents never drank alcohol or smoked. Among those who drank alcohol, habitual drinkers were mostly found in clinical students, while preclinical students drank only occasionally. To consider smoking in respondents, all smokers in preclinical year were occasional or ex-smokers, but there was a higher proportion of habitual smokers in clinical students. Respondents who had underlying disease or current medication use were not different between the two medical year. Most of them had neither underlying disease nor current variables, and 46.7% of all respondents had more than 6.5 global PSQI score, classified as poor sleep quality. To compare sleep quality between academic years, preclinical students had significantly worse results, with 55.0% of respondents classified with poor sleep quality. From seven components of the PSQI, only sleep latency and sleep disturbance were poorer in preclinical students ($p < 0.001$). Of the preclinical students, 60.7% had difficulty in falling asleep, and 90.4% faced sleep disturbance problem at least once a week. No significant differences were observed for the other components (Table 2).

The quality of life assessed by the WHOQOL-BREF-THAI showed that the total score of both

Table 1. Sociodemographic characterization of medical student at Faculty of Medicine, Chiangmai University

Variables	Years of medical students		p-value
	Pre-clinic years (n=209)	Clinical years (n=196)	
Sex; n (%)	0.006		
Male	89 (42.6)	110 (56.1)	
Female	120 (57.4)	86 (43.9)	
Age (years); mean±SD	19.64±0.80	21.56±0.92	<0.001
Underlying disease; n (%)			0.731
Yes	39 (18.7)	34 (17.3)	
• Asthma	10 (4.8)	6 (3.1)	
• Anxiety disorder	0 (0.0)	8 (4.1)	
• Depression	5 (2.4)	7 (3.6)	
• Sleep disorder	0 (0.0)	3 (1.5)	
• Others	24 (11.5)	21 (10.7)	
Current Medication; n (%)			0.279
Current users	15 (7.2)	26 (13.3)	
Alcohol consumption; n (%)			<0.001
Occasional drinkers	64 (30.6)	52 (26.5)	
Habitual drinkers	2 (1.0)	27 (13.8)	
Smoking; n (%)			0.016
Occasional smokers/ex-smokers	8 (3.8)	1 (0.5)	
Habitual smokers	0 (0.0)	3 (1.5)	

SD=standard deviation

groups had no statistical differences. The median total score was 98.0 (IQR 88.0 to 106.0). Forty-four percent of all participants were classified in the moderate to poor quality of life. Only the physical domains were significantly different between the two groups ($p = 0.004$). Good physical health had a higher score in clinical students (Table 3, 4).

The association between sleep quality and quality of life

The association between the sleep quality, independent variable, and the quality of life domains is shown in Table 5. The covariate variables are gender, age, medical years, alcohol consumption, and smoking habit.

All domains of quality of life were worsened by the decrease of sleep quality. The higher the global PSQI score was, the worse the sleep quality would be. In contrast, the higher score of WHOQOL-BREF-THAI indicated a better quality of life. For every one point of increase in the global PSQI score, 2,924 points of the total WHOQOL-BREF-THAI score would be diminished, resulting in an impaired quality of life ($p < 0.001$) when other covariate variables were constant. Particular domains of quality of life

Table 2. PSQI compartments among medical students according to medical years

PSQI Components	Medical years; n (%)		p-value
	Pre-clinical year	Clinical year	
Subjective sleep quality			0.108
Very good	28 (13.4)	37 (18.9)	
Fairly good	96 (45.9)	99 (50.5)	
Fairly bad	79 (37.8)	53 (27.0)	
Very bad	6 (2.9)	7 (3.6)	
Sleep latency			<0.001
No difficulty	82 (39.2)	130 (66.3)	
Mild difficulty	96 (45.9)	45 (23.0)	
Moderate difficulty	28 (13.4)	18 (9.2)	
Severe difficulty	3 (1.4)	3 (1.5)	
Sleep duration			0.072
>7 hours	7 (3.3)	12 (6.1)	
6 to 7 hours	38 (18.2)	35 (17.9)	
5 to 6 hours	148 (70.8)	121 (61.7)	
<5 hours	16 (7.7)	28 (14.3)	
Habitual sleep efficiency			0.334
>85%	165 (78.9)	168 (85.7)	
75% to 84%	35 (16.7)	22 (11.2)	
65% to 74%	7 (3.3)	4 (2.0)	
<65%	2 (1.0)	2 (1.0)	
Sleep disturbance			<0.001
Not during past month	20 (9.6)	48 (24.5)	
Less than once a week	162 (77.5)	133 (67.9)	
Once or twice a week	27 (12.9)	15 (7.7)	
Three or more a week	0 (0.0)	0 (0.0)	
Use of sleeping medication			0.425
Not during past month	197 (94.3)	183 (93.4)	
Less than once a week	8 (3.8)	52.6	
Once or twice a week	2 (1.0)	6 (3.1)	
Three or more a week	2 (1.0)	2 (1.0)	
Daytime dysfunction			0.416
Not during past month	20 (9.6)	28 (14.3)	
Less than once a week	80 (38.3)	73 (37.2)	
Once or twice a week	64 (30.6)	61 (31.1)	
Three or more a week	45 (21.5)	34 (17.3)	
Global PSQI			<0.001
Good	94 (45.0)	122 (62.2)	
Poor	115 (55.0)	74 (37.8)	

PSQI=Pittsburgh Sleep Quality Index

were also negatively affected by an increased global PSQI score. The physical, psychological, social, and environmental score would be decreased 0.858, 0.829, 0.196, and 0.716, respectively for every 1 global PSQI score increase ($p<0.001$).

On the other hand, alcohol consumption had a beneficial effect on the psychological domain. The

Table 3. Quality of life among medical students according to medical years

Quality of life domains	Medical years; n (%)		p-value
	Pre-clinical years	Clinical years	
Physical domains			0.004
Good	101 (48.3)	126 (64.3)	
Moderate	107 (51.2)	70 (35.7)	
Poor	1 (0.5)	0 (0.0)	
Psychological domains			0.980
Good	99 (47.4)	92 (46.9)	
Moderate	103 (49.3)	98 (50.0)	
Poor	7 (3.3)	6 (3.1)	
Social relationships			0.148
Good	120 (57.4)	122 (62.2)	
Moderate	83 (39.7)	73 (37.2)	
Poor	6 (2.9)	1 (0.5)	
Environment			0.125
Good	108 (51.7)	109 (55.6)	
Moderate	101 (48.3)	84 (42.9)	
Poor	0 (0.0)	3 (1.5)	
Total WHOQOL-BREF			0.340
Good	114 (54.5)	113 (57.7)	
Moderate	93 (44.5)	83 (42.3)	
Poor	2 (1.0)	0 (0.0)	

more frequency of increased consumption, the greater the improvement in psychological well-being.

Covariates

Considering the covariates, gender, age, medical year, and smoking had no effects on quality of life. Alcohol was the only one of these that had a positive effect on the quality of life, in the psychological domain ($p=0.038$).

Discussion

Nearly half of the medical students noted that they had poor sleep quality. Different medical years had different sleep quality. Preclinical students were more vulnerable to poor sleep quality. They had more frequent disturbed sleep and spent more time to fall asleep. The present study also found that sleep problems had negative effect on quality of life in all domains such as physical and psychological health, social relationships, and environment.

Sleep quality is a topic that numerous studies aimed to assess among a risk group like university students, especially students of the Faculty of Medicine. The prevalence of medical students with poor sleep quality assessed by PSQI questionnaire varied in many studies, ranging from 36.6% to

Table 4. Mean score of quality of life domains according to medical

Quality of life domains	Medical years						p-value
	All		Pre-clinic year		Clinic year		
	Median	IQR	Median	IQR	Median	IQR	
Physical domains	27.0	24.0 to 29.0	26.0	23.0 to 29.0	28.0	25.0 to 29.7	0.002
Psychological domains	22.0	19.0 to 25.0	22.0	19.0 to 24.0	22.0	19.0 to 25.0	0.421
Social relationships	12.0	10.5 to 13.0	12.0	10.0 to 13.0	12.0	11.0 to 13.0	0.424
Environment	30.0	27.0 to 33.0	30.0	26.0 to 32.0	30.0	27.0 to 33.0	0.181
Total WHOQOL-BREF	98.0	88.0 to 106.0	97.0	88.0 to 104.5	99.0	89.0 to 107.7	0.078

IQR=interquartile range

Table 5. The associations between quality of life domains and sleep quality, gender, age, medical year, alcohol consumption and smoking habit

Variable	Physical domains		Psychological domains		Social relationships		Environment		Total WHOQOL-BREF	
	B (95% CI)	p-value	B (95% CI)	p-value	B (95% CI)	p-value	B (95% CI)	p-value	B (95% CI)	p-value
Global PSQI score	-0.858 (-0.974 to -0.741)	<0.001	-0.829 (-0.955 to -0.703)	<0.001	-0.196 (-0.268 to -0.123)	<0.001*	-0.716 (-0.878 to -0.555)	<0.001	-2.924 (-3.353 to -2.494)	<0.001
Sex	-0.088 (-0.690 to 0.514)	0.775	-0.315 (-0.965 to 0.335)	0.341	0.020 (-0.355 to 0.395)	0.918	0.219 (-0.616 to 1.055)	0.606	-0.263 (-2.481 to 1.955)	0.816
Age	0.088 (-0.249 to 0.426)	0.607	0.214 (-0.150 to 0.579)	0.248	-0.026 (-0.236 to 0.184)	0.808	0.300 (-0.168 to 0.768)	0.208	0.614 (-0.629 to 1.856)	0.332
Medical year	0.181 (-0.702 to 1.063)	0.687	-0.894 (-1.847 to 0.059)	0.066	0.018 (-0.532 to 0.568)	0.949	-0.373 (-1.597 to 0.852)	0.550	-1.116 (-4.368 to 2.135)	0.500
Alcohol consumption	0.294 (-0.201 to 0.789)	0.243	0.340 (-0.195 to 0.875)	0.212	0.326 (0.018 to 0.635)	0.038*	-0.284 (-0.970 to 0.403)	0.418	0.457 (-1.367 to 2.281)	0.623
Smoking	-0.085 (-1.428 to 1.258)	0.901	-0.207 (-1.657 to 1.243)	0.780	-0.436 (-1.273 to 0.400)	0.306	-0.115 (-1.978 to 1.748)	0.903	-0.872 (-5.819 to 4.074)	0.729

B=standardized beta coefficient; CI=confidence interval; PSQI=Pittsburgh Sleep Quality Index

70.4%^(16,19-23). The poor sleep quality group included 46.7% of all respondents in the present study. This number was quite similar to studies done in Thailand which revealed 46.6% and 45.2% of medical students in Central and Northeastern Universities who had a poor quality of sleep. Moreover, the authors' finding was consistent with those of other studies conducted in Iran (36.6%) and Pakistan (39.5%). The prevalence of the present study was much lower than the results shown in the medical students in Tunisia (63.5%) and Saudi Arabia (70.4%).

The conclusion whether preclinical or clinical years had poorer sleep quality remains open, therefore, the present study aimed to address this question. The present results showed that preclinical students had a higher proportion of poor sleepers. This was in accordance with one study in Brazil⁽¹⁷⁾. This may be attributed to the transitional period from secondary school to undergraduate courses. University lifestyle requires more responsibility and adaptation to academic activities, intensive lectures, load of homework, and irregular daily routine. Comparing to other study profiles, medical students had higher levels of stress and anxiety⁽²⁴⁾.

Therefore, incoming medical students need to be more adaptive to the new stressful environment. A high level of stress plays important role in poor sleep quality^(24,25). This may explain the reason why preclinical students in the present study had poorer sleep quality compared to clinical ones who were accustomed to medical courses. On the contrary, one study found that clinical students were exposed more to sleep deprivation by reason of ward duties and night shifts⁽²⁶⁾. The evidence revealed that the sleep quality was worsened in persons working during the night⁽²⁷⁾. This contradictory result in clinical students can be described by the fact that only 59.2% of all clinical respondents were in ward rotations with night shifts. Thus, without night duties nor need to adapt to medical education, less clinical students in the present study had poor sleep.

The association between sleep quality and quality of life has been conducted in many allied health professions and students^(5,28), yet this relationship among medical students still remains uncertain. One study done in medical students evaluated the effect of burnout and sleep difficulties on each domain of quality of life⁽²⁹⁾. The present study

showed compelling results that poor sleep quality had negative associations with every domain of the quality of life, which was consistent with the previous studies.

In the physical domain, poor sleep was negatively associated with attention and enthusiasm in routine activities⁽³⁰⁾, academic performance⁽³¹⁾, physical fitness, body mass index⁽³²⁾, and health perception⁽³³⁾. All these results are the components of physical domains defined by WHOQOL-BREF including energy and fatigue, activities of daily life, work capacity, and pain and discomfort, respectively. The present study finding coincided with those previous studies. An increase in the PSQI score, defined as poorer sleep quality, resulted in worse scores for physical health.

In psychological well-being, a great number of studies disclosed the negative effect of sleep quality on emotional exhaustion⁽²⁹⁾, stress⁽³⁴⁾, depressed mood⁽¹⁰⁾, anxiety^(21,35), concentration⁽²⁶⁾, and updating in working memory⁽³⁶⁾. These are classified as negative feelings, concentration, and memory process in psychological domain of WHOQOL-BREF. Similarly to the as physical domain, the psychological condition score was affected by poor sleep status.

Social relationships in WHOQOL-BREF consist of personal relationships, social support, and sexual activity. From a literature review, relationship was researched in the aspect of a predictor to sleep quality. Supportive relations and social support were positively related to sleep quality, while aversive relations indicated poorer sleep^(11,37). In a different way, the present study evaluated the social relationships affected by poor sleep quality. Poorer PSQI scores resulted in diminished scores in the social relationship domain.

For the last domain, environment, one study noted that sleep deprivation was associated with accidents and falls at home or school⁽³⁸⁾. These conditions can explain the presence of physical unsafety and insecurity in environment domain of WHOQOL-BREF. Other items of this domain such as financial resource, freedom, home environment, and physical environment did not evaluate well these effects from poor sleep quality. One study found a significant association between dormitory and sleep quality in medical students⁽³⁹⁾. However, the present study disclosed quantitative effects of poor sleep quality to a decreased score in the environmental domain of quality of life.

According to the high prevalence of sleep problems in medical students, especially in preclinical years, institutional leaders should perceive the

importance and encourage medical student to be aware of poor sleep quality effects. Strategies should be created to help incoming students adjust to a new and stressful study environment. A stress management program, individual consultations, and supportive learning environment are recommended. In addition, the authors emphasized the impact of sleep on medical students' well-being. To minimize physical and psychological exhaustion or effects of sleep on the relationships and environmental dimensions, the leader should set flexible curriculum and well-organized activities schedule that provides enough time for medical students to rest and sleep well.

The present study had limitations. First, the study was cross-sectional surveyed in a single academic year of one preclinical and one clinical group. All medical years should be assessed for greater understanding and details about the characteristics effect on sleep and quality of life in each group. Second, a large sample with long-term framework should be considered to identify the causative relationship between sleep and quality of life among Thai medical students. In addition, due to being under the stressful learning environment and others causes of the poor quality of sleep such as far away from home, lack of close friends, financial constraint, and personal illness even before university enrollment may associate with sleep quality and academic performance among Thai medical students. Therefore, those interesting topic should be further explored. However, it was complicated to evaluate performance status. Some representatives, such as GPA, might be used. Considering this sensitive and invasive issue, the present study did not evaluate for that association. Moreover, other sleep problems, such as sleep deprivation and daytime sleepiness, should be studied in future work to comprehend its effect on the quality of life.

Conclusion

The present study found that nearly half of medical students had poor sleep. The prevalence was statistically higher in the preclinical year. The result highlights the fact that sleep quality significantly associated with every single part of medical students' quality of life. With these results, awareness for both academic teachers and learners may yield strategies to improve better sleep and should be proposed as highly recommended.

What is already known on this topic?

Sleep problems are common, especially in health

personnel. Nearly half of Thai medical students have a poor quality of sleep, suspected from study, duties, and learning environment. Many studies showed that medical students had worse sleep quality when compared with other population groups. Moreover, there also was a difference in sleep quality between academic years of medical student, which were divided into preclinical and clinical study. However, the results of comparison of sleep quality between medical years remained inconclusive. Some studies revealed that clinical medical students had poorer sleep quality. On the other hand, there was the study found that preclinical medical students had higher prevalence due to the adjustment to the different learning systems from high school. Because of sleep quality effects on quality of life, which is a subjective state of well-being, there were many studies evaluated the impact and association between sleep quality and quality of life. There was the study showed that medical students had the highest negative impact of sleep problem on the quality of life when compared to other study profiles.

What this study adds?

This study showed that preclinical students had a higher proportion of poor sleepers, which might be caused by stress from adaptation to new environment of study. This may be associated to the transitional period from secondary school to undergraduate system. Incoming medical students need to be more adaptive. A high level of stress from adjustment plays important role in sleep quality. In contrast with some studies that showed that clinical students had more sleep deprivation because of working during the night, this study cannot state the same, which may be due to the fact that only half of all clinical respondents were in ward rotations with night shifts. Thus, without night working nor need to adapt to medical education, less clinical students in this study had sleep problem. This study also found that poor sleep quality had negative effect in every domain of quality of life, which include physical domains, psychological domain social relationship, and environmental domain. This was consistent with the previous studies.

Acknowledgment

The authors are grateful to all participants for their contributions to this study.

Ethical approval and consent to participate

The study was conducted according to the

guidelines of the Declaration of Helsinki, and approved by Ethics Committee of Non-Invasive Clinical Research of Faculty of Medicine, Chiang Mai University (approval number: 444/2018 and date of approval: 20 November 2018). Informed consent was obtained from all participants involved in the study.

Authors' contributions

Conceptualization and Methodology, PA, PD, UT, and TT; Data curation, PA, PD, UT, NN, and JI; Formal analysis, PA and JI; Investigation, PA, PD, UT, and TT; Resources, PA, PD, UT, and NN; Supervision, JI and TT; Writing-original draft, PA, PD, UT, NN, and TT; Writing-review & editing, PA, PD, UT, NN, JI, and TT. All authors have read and agreed to the published version of the manuscript.

Funding disclosure

This research received no external funding.

Conflicts of interest

The authors declare no conflict of interest.

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