

# PREVALENCE OF POOR SLEEP QUALITY AND ITS CORRELATES AMONG HIGH SCHOOL STUDENTS IN BANGKOK, THAILAND

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## ABSTRACT:

**Background:** Sleep plays important roles in physical and mental development among adolescents. Prevalence of poor sleep quality and its correlates among high school students were investigated.

**Methods:** This study covered 1,080 high school students completing the questionnaire of Pittsburgh Sleep Quality Index (PSQI), socio-demographic characteristics, behavioral factors, and student-related factors. Multivariable logistic regression was used to calculate adjusted odds ratios (OR) and 95% Confidence intervals (CI).

**Results:** Prevalence of poor sleep quality was 32.0% (95% CI: 29.26, 34.91). Multivariable logistic regression showed that female students (OR=1.49; 95% CI: 1.12, 1.98), weekly allowance (OR=1.44; 95% CI: 1.10, 1.88), school activity  $\geq 6$  hrs./week (OR=1.68; 95% CI: 1.09, 2.59), smoking (OR=1.90; 95% CI: 1.28, 2.81) and caffeine consumption  $>1$  cup/day (OR=3.14; 95% CI: 1.47, 6.71) were associated with poor sleep quality.

**Conclusions:** In such urban and modernized environment as the Bangkok metropolitan area, the prevalence of poor sleep quality among high school students is relatively high. Also, gender, weekly allowance, school activity, smoking and caffeine consumption are associated with poor sleep quality.

**Keywords:** Prevalence, Sleep quality, Poor sleep, Adolescent health, High school student, Thailand

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## INTRODUCTION

Sleep is essential to human being in that it can properly maintain physical and mental health. A number of studies have found that poor sleep has associated with daytime sleepiness, exhaustion, weight gain [1], obesity [2], impaired glucose tolerance and diabetes [3], impaired memory [4], depression and anxiety [5], higher risk of motor vehicle accidents [6-8].

Over the past decades, socio-economic, cultural, and racial factors have been found to be related to sleep problems [8-11]. Age and gender have also been reported to be associated with sleep quality [12, 13]. It has been discovered that

academic obligation is one of the key factors impacting the sleep patterns. The findings from Taipei, Taiwan indicated that the students in more academic challenging programs reported less sleep and lower level of alertness than those in the less challenging programs [14]; in America, the students on the academic fast track were likely to sleep less [15]. Additionally, adolescents engaging in school or community-related activities were at greater risk from sleepiness [16].

The use of stimulant like caffeine generally found in coffee, tea, chocolate, and soft drinks resulted in poor sleep and daytime drowsiness which, in turn, could lead to an increasing consumption the next day [17]. The sleep quality and sleep patterns were found to be associated with caffeine consumption among Thai college students [18].

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Cigarette smoking was also associated with a higher chance of poor sleep owing to the fact that a stimulant substance has pharmacological effects on sleep quality [19]. Whereas sleep problems and alcohol consumption are common phenomena among college students, previous studies found that there was a strong relationship between poor sleep quality and alcohol consumption [20].

Poor sleep quality is currently a widespread issue in most urban societies. The prevalence of poor sleep quality in adolescents was reported as ranging from 48.1% to 62.4% [18, 21-24]; which reflected a wider range of poor sleep quality prevalence. In Thailand, the prevalence of poor sleep quality among college students was 48.1% [18].

Notably, studies on sleep quality and factors contributing to sleep quality among adolescents in Thailand seemed relatively limited [25]. One of those studies carried out by Lohsoonthorn et al. [18], an investigation on sleep quality and sleep patterns in relation to consumption of energy drinks, caffeinated beverages, and other stimulants among Thai college students, has shed some light on risk factors. Therefore, in carrying out this study, the researcher has set two main objectives: 1) to determine the prevalence of poor sleep quality among high school students in Bangkok, 2) to evaluate the association between socio-economic status, student-related activities, consumption behavior and poor sleep quality.

## MATERIAL AND METHODS

### Participants

A sample size was calculated based on the prevalence of poor sleep quality with the rate of 48% from a study of Lohsoonthorn et al. [18] with 95% CI, and 3% of poor sleep quality rate for minimum error. The formula for one sample proportion estimation derived from Lemeshow et al. [26] gives rounded up minimum sample size of 1,065 participants. This research was conducted between January–March, 2014, based on simple random sampling approach, including the participants of 10 high schools in Bangkok area which are under the supervision of the Office of the Basic Education Commission, Ministry of Education. After that, the researcher randomly selected 1 classroom each from grade 10, 11 and 12, respectively; totaling 30 classrooms, covering 1,080 subjects participating in this study.

### Instruments

The self-administered questionnaires collected information about socio-economic status, student-related activities, consumption behavior relating to

sleep quality, i.e. gender, age, educational level, weekly allowance, part-time job, physical activities, school activities, extra-curricular knowledge. Questionnaires also included history disease related sleep problems, BMI, alcohol consumption, smoking, caffeine consumption, sleep medicine use. Body mass index (BMI) was calculated as self-reported weight (in kilograms) and height (in meters), based on WHO's criteria describing BMI-for-age (5-19 years) [27].

As for caffeine consumption, the respondents were asked how many days per week they consumed caffeinated drinks (Coke/Pepsi, tea, coffee, energy drinks); how many servings per day. The respondents were required to specify each caffeinated drink consumed separately. After calculating the caffeine content in Coke/Pepsi, tea and energy drinks, the caffeine content was then compared to the caffeine content in a cup of coffee being used as a benchmarking. The comparative formula of caffeine content estimation is described as follows: 2 colas=1 tea; 2 cups of tea=1 cup of coffee (FDA data cited in the Guardian) [28]. According to the FDA's commissioned study, the Redbull energy drink has caffeine content of approximately 80 mg. per serving; whereas classic colas has about 35 mg. of caffeine content per serving [29], the researcher, therefore, estimated 2 colas = 1 energy drink.

The Pittsburgh Sleep Quality Index (PSQI): PSQI [30] is a 19-item self-rated questionnaire assessing sleep quality over the past one-month time interval. In this instrument, 19 individual items produce seven sleep components, namely, subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The score for each of these sleep components yields a score ranging from 0 to 3, while 3 being the greatest dysfunction. The sleep components are summed to yield a total score ranging from 0 to 21, with higher total score (referred to as global scores) representing poor sleep quality in the past month. Based on prior literature, participants with global score of greater than 5 were classified as poor sleepers. Those with score of 5 or less were classified as good sleepers [18, 29]. The researcher had obtained permission to use the PSQI by translating the manuscript from English to Thai language. To ensure the PSQI's validity, the back-translation was also executed. The internal consistency reliability of the PSQI in this study yielding a Cronbach's  $\alpha = .0.77$ , was conducted in high school students, rather than samples from 10 selected schools, in Bangkok, under the supervision

of the Office of the Basic Education Commission, Ministry of Education.

For poor sleep components sub-scales, specific categories were long sleep latency ( $\geq 30$  mins. vs.  $<30$  min.), poor sleep efficiency ( $<85\%$  vs.  $\geq 85\%$ ), daytime dysfunction due to sleep ( $<$ once per week vs. once per week or more), and use of sleep medication during the past month ( $<$ once per week vs. once per week or more), sleep duration was assessed by using the PSQI questionnaire asking participants regarding their actual sleep hours at night in the past 1-month time period. While previous study recommended that sleep time for adolescents should be between 8 – 9 hours per night [20]; another suggested that, based on the National Sleep Foundation, adolescents having less than 8 hour-sleep time are considered having insufficient sleep time [31]. In this research, we have classified sleep duration into 4 categories:  $\geq 6.0$ , 6.1 – 7.0, 7.1 – 8.0 and  $\geq 8.1$ .

#### Data analysis

The study of frequency distributions of participants was conducted, based on the socio-economic, student-related activities, consumption behavior in accordance with sleep quality. Then the characteristics were summarized by using mean (SD) and categorical variables using counts and percentage for univariate summaries. Later, the distribution of poor sleep quality across socio-economic status, student-related activities and consumption behavior was calculated. The distribution of PSQI scores and its components among male and female students were estimated. The odds ratio (OR) and 95% confidence intervals for the associations of sleep quality parameters with socio-economic status, student-related activities, consumption behavior were analyzed. Stepwise logistic regression modeling procedures were used to calculate odds ratio (OR). Upon completion of the univariate analyses, the variables were selected for multivariable analysis. The variables whose univariate test has a p-value  $<0.25$  would be considered as a candidate for the multivariable model (gender, weekly allowance, history disease related sleep problems, BMI, part-time job, school activities, extra-curricular knowledge, alcohol consumption, smoking, caffeine consumption, sleep medicine and smart phone use) [18, 32]. These analyses were accomplished by using Stata 12 (Statacorp LP, College Station, TX).

#### Ethical consideration

Protection of participants and procedure for data collection, approved code: COA No. 016/2014, were approved by the Ethics Review Committee for

Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (ECCU).

## RESULTS

Among the 1,080 participants, mean age was 16.8 (SD = .94) years, 483 (44.7%) were male and 597 (55.3 %) were female. The prevalence of poor sleep quality (PSQI  $>5$ ) was 346 (32.0%). The mean of PSQI total score was 4.7 (SD = 2.22); 4.5 (SD = 2.21) for male and 4.8 (SD = 2.21) for female. The socio-economic status, student-related activities, and consumption behavior in relation to sleep quality of the samples are shown in Table 1. Differences in gender, educational level, GPA, body mass index (BMI), part-time job, and physical activity were not found, but there were significant status differences in weekly allowance, history disease related sleep problems, school activity, extra-curricular knowledge, alcohol consumption, smoking, caffeine consumption and smart phone use.

Table 2 shows the distribution of the PSQI sleep component scores across gender of students. Worth noting is that 36.4% of the samples was reported having sleep time  $\leq 6$  hrs. per day; whereas 24.6% of the samples was reported having sleep latency  $>30$  mins.; while 17.2% of the samples reported having day time dysfunction due to sleepiness at least once a week; 9.1% reported having poor sleep efficiency; 23.7% reported having subjective poor sleep quality; 22.6% reported having poor sleep disturbance; 8.2% reported using sleep medicine. Differences in sleep duration, sleep latency, day time dysfunction, use of sleep medication, were not significant; however, there were significant status differences in sleep efficiency, subjective sleep quality, and sleep disturbance. Given the comparison of poor sleep quality and its components between male and female students, it was found that the prevalence of poor sleep quality was 32.0%: the prevalence of poor sleep quality of female students was higher than that of their male counterparts (34.5% vs. 29.0%). Notably, when looking into a component of sleep efficiency, female students reported having higher poor sleep efficiency than male students (10.9% vs. 6.8%). In terms of subjective sleep quality, female students reported having slightly poorer than male students (25.2% vs. 22.0%). Lastly, regarding sleep disturbance, female students reported having higher sleep disturbance than male students (27.0% vs. 17.2%).

As per Table 3, the odds ratio for poor sleep quality across characteristics achieved by using stepwise logistic regression after adjusting for

**Table 1** Characteristics according to sleep quality

| Characteristics                                                                           | All  | Poor sleep quality |      | Good sleep quality |      | <i>p-value</i> |
|-------------------------------------------------------------------------------------------|------|--------------------|------|--------------------|------|----------------|
|                                                                                           | N    | n                  | %    | n                  | %    |                |
| <b>Gender</b>                                                                             |      |                    |      |                    |      | .053           |
| Male                                                                                      | 483  | 140                | 29.0 | 343                | 71.0 |                |
| Female                                                                                    | 597  | 206                | 34.5 | 391                | 65.5 |                |
| <b>Educational level</b>                                                                  |      |                    |      |                    |      | .823           |
| Grade 10                                                                                  | 339  | 107                | 31.6 | 232                | 68.4 |                |
| Grade 11                                                                                  | 373  | 124                | 33.2 | 249                | 66.8 |                |
| Grade 12                                                                                  | 368  | 115                | 31.3 | 253                | 68.7 |                |
| <b>Grade point average (GPA)</b>                                                          |      |                    |      |                    |      | .539           |
| ≤2.70 (25 percentiles)                                                                    | 261  | 81                 | 31.0 | 180                | 67.9 |                |
| 2.71-3.12 (26-50 percentiles)                                                             | 271  | 94                 | 34.7 | 177                | 65.6 |                |
| 3.13-3.50 (51-75 percentiles)                                                             | 250  | 86                 | 34.4 | 164                | 66.7 |                |
| >3.50 (>75 percentiles)                                                                   | 259  | 77                 | 29.7 | 182                | 70.3 |                |
| <b>Weekly allowance (baht/month) <sup>a</sup></b>                                         |      |                    |      |                    |      | .003           |
| ≤ 600(50 percentiles)                                                                     | 633  | 181                | 28.6 | 452                | 71.4 |                |
| >600 (>50 percentiles)                                                                    | 432  | 161                | 37.3 | 271                | 62.7 |                |
| <b>History disease related sleep problems (depression, rhinitis, allergic, asthma...)</b> |      |                    |      |                    |      | .044           |
| No                                                                                        | 1014 | 318                | 31.4 | 696                | 68.6 |                |
| Yes                                                                                       | 66   | 28                 | 42.4 | 38                 | 57.6 |                |
| <b>Body mass index (BMI)</b>                                                              |      |                    |      |                    |      | .160           |
| Underweight                                                                               | 337  | 120                | 35.6 | 217                | 64.4 |                |
| Normal                                                                                    | 564  | 167                | 29.6 | 397                | 70.4 |                |
| Overweight/Obese                                                                          | 176  | 59                 | 33.5 | 117                | 66.5 |                |
| <b>Part-time job</b>                                                                      |      |                    |      |                    |      | .128           |
| No                                                                                        | 968  | 303                | 31.3 | 656                | 68.7 |                |
| Yes                                                                                       | 112  | 43                 | 38.4 | 69                 | 61.6 |                |
| <b>Physical activity</b>                                                                  |      |                    |      |                    |      | .538           |
| No                                                                                        | 569  | 187                | 32.9 | 382                | 67.1 |                |
| Yes (≥150 mins./week)                                                                     | 511  | 159                | 31.1 | 352                | 68.9 |                |
| <b>School activity</b>                                                                    |      |                    |      |                    |      | .015           |
| No                                                                                        | 500  | 143                | 28.6 | 357                | 71.4 |                |
| 1-5 hrs./week                                                                             | 458  | 152                | 33.2 | 306                | 66.8 |                |
| ≥6 hrs./week                                                                              | 122  | 51                 | 41.8 | 71                 | 58.2 |                |
| <b>Extra-curricular knowledge</b>                                                         |      |                    |      |                    |      | .042           |
| No                                                                                        | 210  | 72                 | 34.3 | 138                | 65.7 |                |
| 1-5 hrs./week                                                                             | 449  | 126                | 28.1 | 323                | 71.9 |                |
| 6-10 hrs./week                                                                            | 263  | 85                 | 32.3 | 178                | 67.7 |                |
| >10 hrs./week                                                                             | 158  | 63                 | 39.9 | 95                 | 60.1 |                |
| <b>Alcohol consumption</b>                                                                |      |                    |      |                    |      | .011           |
| Never                                                                                     | 508  | 141                | 27.8 | 367                | 72.2 |                |
| None over last 12 months                                                                  | 108  | 37                 | 34.3 | 71                 | 65.7 |                |
| < Once a month                                                                            | 374  | 129                | 34.5 | 245                | 65.5 |                |
| ≥ Once a month                                                                            | 89   | 39                 | 43.8 | 50                 | 56.2 |                |
| <b>Smoking</b>                                                                            |      |                    |      |                    |      | .005           |
| No                                                                                        | 928  | 283                | 30.5 | 645                | 69.5 |                |
| Yes                                                                                       | 177  | 61                 | 42.4 | 83                 | 57.6 |                |
| <b>Caffeine consumption (compared to caffeine content in coffee)</b>                      |      |                    |      |                    |      | .002           |
| No                                                                                        | 102  | 22                 | 21.6 | 80                 | 78.4 |                |
| < 0.5 cup per day                                                                         | 747  | 232                | 31.1 | 515                | 68.9 |                |
| 0.5-1 cup per day                                                                         | 181  | 67                 | 37.0 | 114                | 63.0 |                |
| > 1 cup per day                                                                           | 50   | 25                 | 50.0 | 25                 | 50.0 |                |
| <b>Mobile/smart phone used (hrs./week)</b>                                                |      |                    |      |                    |      | .050           |
| ≤ 12(25 percentiles)                                                                      | 272  | 74                 | 27.2 | 198                | 72.8 |                |
| 12.10-25.0 (26-50 percentiles)                                                            | 279  | 91                 | 32.6 | 188                | 67.4 |                |
| 25.10-30 (51-75 percentiles)                                                              | 264  | 80                 | 30.3 | 184                | 69.7 |                |
| >30 (>75 percentiles)                                                                     | 265  | 101                | 38.1 | 164                | 61.9 |                |

*P-value* from Chi-square test.<sup>a</sup> \$1 US = 32 Baht (Approx.)

**Table 2** Sleep quality and its components scores among high school students by gender

| Sleep quality components        | All, n=1,080 |      | Male, n=483 |      | Female, n=597 |      | p-value |
|---------------------------------|--------------|------|-------------|------|---------------|------|---------|
|                                 | N            | %    | N           | %    | N             | %    |         |
| <b>Sleep duration (hrs.)</b>    |              |      |             |      |               |      | .448    |
| ≤6                              | 393          | 36.4 | 177         | 36.6 | 216           | 36.2 |         |
| 6.1 - 7.0                       | 386          | 35.7 | 166         | 34.4 | 220           | 36.9 |         |
| 7.1 – 8.0                       | 264          | 24.4 | 119         | 24.6 | 145           | 24.3 |         |
| ≥8.1                            | 37           | 3.4  | 21          | 4.3  | 16            | 2.7  |         |
| <b>Sleep latency (min)</b>      |              |      |             |      |               |      | .665    |
| ≤15                             | 336          | 31.1 | 159         | 32.9 | 177           | 29.6 |         |
| 16-30                           | 478          | 44.3 | 205         | 42.4 | 273           | 45.7 |         |
| 31-60                           | 224          | 20.7 | 100         | 20.7 | 124           | 20.8 |         |
| >60                             | 42           | 3.9  | 19          | 3.9  | 23            | 3.9  |         |
| <b>Day time dysfunction</b>     |              |      |             |      |               |      | .798    |
| Never                           | 582          | 53.9 | 267         | 55.3 | 315           | 52.8 |         |
| Less than once a week           | 312          | 28.9 | 138         | 28.6 | 174           | 29.1 |         |
| 1-2 times per week              | 163          | 15.1 | 69          | 14.3 | 94            | 15.7 |         |
| ≥3 times per week               | 23           | 2.1  | 9           | 1.9  | 14            | 2.3  |         |
| <b>Sleep efficiency</b>         |              |      |             |      |               |      | .021    |
| >85%                            | 982          | 90.9 | 450         | 93.2 | 532           | 89.1 |         |
| ≤84%                            | 98           | 9.1  | 33          | 6.8  | 65            | 10.9 |         |
| <b>Subjective sleep quality</b> |              |      |             |      |               |      | .014    |
| Very good                       | 172          | 15.9 | 96          | 19.9 | 76            | 12.7 |         |
| Fairly good                     | 652          | 60.4 | 281         | 58.2 | 371           | 62.1 |         |
| Fairly bad                      | 237          | 21.9 | 97          | 20.1 | 140           | 23.5 |         |
| Very bad                        | 19           | 1.8  | 9           | 1.9  | 10            | 1.7  |         |
| <b>Sleep disturbance</b>        |              |      |             |      |               |      | <.001   |
| Very good                       | 57           | 5.3  | 31          | 6.4  | 26            | 4.4  |         |
| Fairly good                     | 779          | 72.1 | 369         | 76.4 | 410           | 68.7 |         |
| Fairly bad/ Very bad            | 244          | 22.6 | 83          | 17.2 | 161           | 27.0 |         |
| <b>Use of sleep medication</b>  |              |      |             |      |               |      | .198    |
| Not during the past month       | 992          | 91.9 | 437         | 90.5 | 555           | 93.0 |         |
| Less than once a week           | 56           | 5.2  | 27          | 5.6  | 29            | 4.9  |         |
| ≥Once a week                    | 32           | 3.0  | 19          | 3.9  | 13            | 2.2  |         |
| <b>Sleep quality score</b>      |              |      |             |      |               |      | .053    |
| Good sleep(≤5)                  | 734          | 68.0 | 343         | 71.0 | 391           | 65.5 |         |
| Poor sleep(>5)                  | 346          | 32.0 | 140         | 29.0 | 206           | 34.5 |         |

**Table 3** Odds Ratio and 95% CI for poor sleep quality

| Characteristics                                                                           | Unadjusted OR<br>(95% CI) | Adjusted <sup>b</sup> OR<br>(95% CI) |
|-------------------------------------------------------------------------------------------|---------------------------|--------------------------------------|
| <b>Gender</b>                                                                             |                           |                                      |
| Male                                                                                      | Ref                       |                                      |
| Female                                                                                    | 1.29 (.99-1.69)           | 1.49 (1.12-1.98)                     |
| <b>Educational level</b>                                                                  |                           |                                      |
| Grade 10                                                                                  | Ref                       |                                      |
| Grade 11                                                                                  | 1.08 (.78-1.50)           |                                      |
| Grade 12                                                                                  | .99 (.71-1.37)            |                                      |
| <b>Weekly allowance (baht/month) <sup>a</sup></b>                                         |                           |                                      |
| ≤ 600(50 percentiles)                                                                     | Ref                       |                                      |
| >600 (>50 percentiles)                                                                    | 1.48 (1.13-1.94)          | 1.44 (1.10-1.88)                     |
| <b>History disease related sleep problems (depression, rhinitis, allergic, asthma...)</b> |                           |                                      |
| No                                                                                        | Ref                       |                                      |
| Yes                                                                                       | 1.61 (.93-2.75)           |                                      |
| <b>Body mass index (BMI)</b>                                                              |                           |                                      |
| Underweight                                                                               | 1.31 (.98-1.77)           |                                      |
| Normal                                                                                    | Ref                       |                                      |
| Overweight/Obese                                                                          | 1.18 (.82-1.74)           |                                      |

**Table 3** Odds Ratio and 95% CI for poor sleep quality (Conts.)

| Characteristics                            | Unadjusted OR<br>(95% CI) | Adjusted <sup>b</sup> OR<br>(95% CI) |
|--------------------------------------------|---------------------------|--------------------------------------|
| <b>Part-time job</b>                       |                           |                                      |
| No                                         | Ref                       |                                      |
| Yes                                        | 1.35 (.88-2.06)           |                                      |
| <b>Physical activity</b>                   |                           |                                      |
| No                                         | Ref                       |                                      |
| Yes(≥150 mins./week)                       | .92 (.71-1.20)            |                                      |
| <b>School activity</b>                     |                           |                                      |
| No                                         | Ref                       |                                      |
| 1-5 hrs./week                              | 1.24 (.96-1.65)           | 1.35 (1.01-1.81)                     |
| ≥6 hrs./week                               | 1.80 (1.17-2.76)          | 1.68 (1.09-2.59)                     |
| <b>Extra-curricular</b>                    |                           |                                      |
| No                                         | Ref                       |                                      |
| 1-5 hrs./week                              | .75 (.52-1.08)            |                                      |
| 6-10 hrs./week                             | .92 (.61-1.37)            |                                      |
| >10 hrs./week                              | 1.27 (.81-1.99)           |                                      |
| <b>Alcohol consumption</b>                 |                           |                                      |
| Never                                      | Ref                       |                                      |
| None over last 12 months                   | 1.36 (.84-2.15)           |                                      |
| <Once a month                              | 1.37 (1.02-1.85)          |                                      |
| ≥Once a month                              | 2.03 (1.24-3.30)          |                                      |
| <b>Smoking</b>                             |                           |                                      |
| No                                         | Ref                       |                                      |
| Yes                                        | 1.68 (1.15-2.43)          | 1.90 (1.28-2.81)                     |
| <b>Caffeine consumption</b>                |                           |                                      |
| No                                         | Ref                       |                                      |
| <0.5 cup per day                           | 1.64 (.98-2.83)           | 1.45 (.87-2.41)                      |
| 0.5-1 cup per day                          | 2.14 (1.19-3.94)          | 1.95 (1.09-3.47)                     |
| >1 cup per day                             | 3.64 (1.64-8.03)          | 3.14 (1.47-6.71)                     |
| <b>Mobile/smart phone used (hrs./week)</b> |                           |                                      |
| ≤12(25 percentiles)                        | Ref                       |                                      |
| 12.1-25.0 (26-50 percentiles)              | 1.30 (.88-1.90)           |                                      |
| 25.1-30 (51-75 percentiles)                | 1.16 (.79-1.72)           |                                      |
| >30 (>75 percentiles)                      | 1.65 (1.13-2.41)          |                                      |

<sup>b</sup>Each odds ratio is adjusted for any variables whose univariate test has a *p-value*<0.25

gender, weekly allowance, history disease related sleep problems, BMI, part-time job, school activities, extra-curricular knowledge, alcohol consumption, smoking, caffeine consumption, sleep medicine and smart phone use, found that female students having higher odds of poor sleep quality than male students (OR=1.49; 95% CI: 1.12, 1.98); weekly allowance ≥600 baht/month reported having poorer sleep quality than those having weekly allowance <600 baht/month (OR=1.44; 95% CI: 1.10, 1.88). When compared to students not participating in school activities, it was discovered that those participating for 1-5 hrs. (OR=1.35; 95% CI: 1.01, 1.81) and ≥6 hrs. (OR=1.68; 95% CI: 1.09, 2.59) per week, had slightly poorer sleep quality, respectively. Likewise, students with smoking behavior were likely to have higher odds of poor sleep quality when compared to those with non-smoking behavior (OR=1.90; 95% CI: 1.28, 2.81).

In terms of caffeine consumption (see details in Instrument section on how caffeine content derived vs. caffeine in coffee) when comparing to non-consuming caffeine students; those consuming 0.5-1 cup per day were reported having 2 folds of poorer sleep quality (OR=1.95; 95% CI: 1.09, 3.47); while those consuming more than 1 cup per day were reported having approximately 3 folds of poorer sleep quality (OR=3.14; 95% CI: 1.47, 6.71).

## DISCUSSION

The prevalence of poor sleep quality among high school students, based on this study, is 32.0% when comparing with other studies using the PSQI to evaluate. However, evidences from previous studies on poor sleep quality among students in colleges showed that the prevalence of poor sleep quality was between 48.1% to 62.4% [18, 21-23]. As far as the study on the prevalence of poor sleep

quality conducted in Thailand, the result of this study is found to be consistent with the research findings of Lohsoonthorn et al. [18] derived from a survey conducted among college students in Thailand (32.0% vs. 48.1%). Nevertheless, for results discovered so far in other Asian countries, particularly in Hong Kong and Korea, it was found that the prevalence of poor sleep quality among college students are likely to be higher than that of college students in Thailand.

Given this study's gender differences in poor sleep quality; it has been found that there is no significant difference in sleep quality by gender, and this corresponds with a study by Lohsoonthorn et al. [18]. Nonetheless, according to earlier studies, it was discovered that females reported having poorer sleep quality than males, reflecting a significant association between poor sleep quality and gender [21, 33]. The study also indicated that adolescents receiving higher weekly allowance tend to be at greater risk of having poor sleep quality, which corresponds with the evidence showing that highly family income is strongly associated with insufficient sleep [34].

Besides, evidence on adolescents' use of social network applications and devices discovered that, based on the National Statistical Office, Thai adolescents' use of approximately 3.1 hrs. per day was ranked the highest, comparing to other Asian adolescents [35]. It is, therefore, possible that adolescents with high weekly allowance, living in Bangkok, were likely to get over-indulged in modern gadgets and applications which could lead to their poor sleep quality. In terms of school activity, this study discovered that those involved in school activities have poor sleep quality. The findings are consistent with Carskadon [36] that such school sport activities as music band, choir, badminton and tennis can be sources of insufficient sleep.

The findings of this study was found to be consistent with previous studies [12, 18] in that, students consuming caffeine were likely to have poor sleep quality than non-caffeine consuming students: the more caffeine they consumed, the higher chance of having poor sleep quality. This is due to the fact that caffeine consumers could not easily fall asleep since it would block the effects of adenosine, a neurotransmitter thought to promote sleep. Furthermore, caffeine can also interrupt sleep by increasing the need to urinate at night [37]. This study also suggested that students with smoking habit would have poorer sleep quality than those non-smoking students, because nicotine is a central nervous system stimulant causing insomnia and,

thus, making it more difficult to fall asleep. Also, it would speed heart rate, raising blood pressure and stimulating brain-wave activity that indicates wakefulness [37].

## LIMITATIONS

As a cross-sectional study, the findings can simply reveal the associations but cannot elaborate the causal relationship. Also, the use of self-administered questionnaire depending on subjective measures of sleep quality and other covariates may generate some extent of error in reporting. Information on weekly allowance and GPA was regarded as sensitive information, generally based on self-report. However, the researcher believes that this issue can be partly reduced by using anonymous questionnaires and validated instruments. Worth pointing out is that, the calculation of caffeine consumption varies depending on the size of caffeinated drinks container, caffeine extracting method and brands of caffeine-related products.

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