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Prevalence of insufficient sleep duration in Thai adolescents and its association with mood disorders

Rungrat Rojrattanadumrong[1], Khemika Sudnawa[1], Wiroj Areekul[1] and Rasintra Jaroenying[1,*]

[1]Department of Pediatrics, Phramongkutklao Hospital, Bangkok, Thailand
[*]Corresponding author: rasintra.pom@gmail.com

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Abstract

This research aimed to assess the prevalence of insufficient sleep duration, its associated factors, and the association between short sleep duration and daytime sleepiness, depressive symptoms, and anxiety in Thai adolescents from both urban and rural areas. Thai adolescents aged 11-19 years completed a self-administered questionnaire consisting of items from the Phramongkutklao Hospital Sleep Disorders Center Questionnaire, Pittsburg Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Children's Depression Inventory (CDI) scale, and Screen for Child Anxiety Related Emotional Disorder (SCARED). A total of 1,259 Thai adolescents with a mean age of 15.66 ± 1.82 years participated in this survey. Of those, 55.6% were living in urban areas. The average sleep time was 7.2±2.8 h. The prevalence of insufficient sleep duration was 69% overall and 80.6% in urban students. According to multivariable analysis, a high school education level (odds ratio (OR) 2.12; 95% confidence interval (CI):1.38 - 3.25), excellent academic performance (OR 2.23; 95% CI: 1.31 - 3.80), irregular wake times (OR 1.9; 95% CI:1.28 - 2.84) and living in urban areas (OR1.97; 95% CI:1.29 - 3.02) increased the risk of insufficient sleep duration (p<0.05). This study confirmed that the average sleep duration in Thai adolescents was less than the recommended amount. Interestingly, short sleep duration was significantly associated with sleep quality index, depressive symptoms, and anxiety scores but not ESS score in our sample of urban adolescents.

Keywords: Sleep insufficiency, Adolescents, Mood disorders, Depression

1. Introduction

Sleep is necessary for conserving energy, restoring normal health processes, and promoting physical growth. According to the National Sleep Foundation, teenagers should sleep 8 to 10 h per day [1]. Insufficient sleep duration in adolescents is an important public health issue and increases the risk of behavior- and health-related issues such as depression, obesity, poor academic performance, and drowsy driving accidents [2]. Hormone-based changes in the biological clock, as well as other external factors (e.g., school start times, participation in extracurricular activities, and media exposure), contribute to the high rate of insufficient sleep-in teenagers [3]. The US National Sleep Foundation found that in 2006, 45% of adolescents aged 11-17 years slept less than 8 h per night, resulting in daytime sleepiness and risk of car accidents [4]. Studies in many other countries have similarly shown sleep duration to decrease with age among adolescents. For example, studies in Northern Taiwan, Germany, India, and Japan found the average sleep duration for high school–aged students to be below 8 h [5-8].

Sleep insufficiency has long been known to increase the relative risk of developing depression. Population-based studies in adolescents (ages 11-17) have shown strong associations between chronic sleep restriction and anxiety, depression, and somatic pain [9,10]. One study in high school students found that shorter total sleep time on school nights was associated with both daytime sleepiness and depressive symptoms [11]. However, there have been few studies of sleep duration and mood disorders in Thai adolescents. This study thus aims to explore the prevalence of sleep insufficiency and factors associated with short sleep duration in this population. Moreover, we examine potential associations between short sleep duration and depressive symptoms, anxiety, and excessive daytime sleepiness.

2. Materials and methods

2.1 Study design

This was a cross-sectional, questionnaire-based study. The sample size was calculated based on 2007-2013 CDC data of US high school students [12], according to which 68.8% of adolescents reported sleeping < 8 h on average. In order to obtain a 95% confidence interval and 5% minimum error, we determined that a minimum of 929 adolescents would be needed to constitute a representative sample.

2.2 Study population and procedures

This study was conducted in 2020. Students at public schools in Bangkok represented urban adolescents and those in cities other than Bangkok represented rural adolescents in our study. The total sample consisted of 1,259 participants aged 11-19 years (777 males), with a mean age of 15.66 (standard deviation (SD) =1.82) years. Potential subjects and their caregivers were informed of the study and invited to participate. Students in grades 7-12 at public high schools in Bangkok and in Phrae, Phayao and Chachoengsao provinces were enrolled. All caregivers and participants provided written informed consent. After receiving general instructions, each participant was left to complete a Thai-language self-administered questionnaire. The questionnaires were distributed to subjects based on purposive sampling. Participants were allowed to ask any questions they had regarding the survey. After the survey was completed, questionnaires were reviewed to confirm that all essential questions had been answered.

2.3 Survey instruments

Participants answered a structured questionnaire containing questions pertaining to the following three areas:

2.3.1 Sociodemographic factors related to sleep and health including gender, age, height, body weight, class, grade point average (GPA), place of residence, parental age, and family income

Sleep-related factors based on the Phramongkutklao Hospital Sleep Disorders Center Questionnaire including sleep duration, sleep habits, sleep environment, bedtime activities, and sleep manifestations. Participants were asked about environmental factors that disturb their sleep, sleep duration per night (both weekday and weekend), their sleep schedules on weekdays and weekends, duration of sleep latency, bedtime activities (e.g., watching TV, reading, engaging with other media, and eating). Those sleeping less than 8 h/day in a bed were considered to have short sleep duration or sleep insufficiency.

2.3.2 Mood, sleep quality, and daytime sleepiness

We used the Thai version of the Pittsburg Sleep Quality Index (PSQI; [13] to evaluate sleep patterns and quality. The PSQI differentiates “poor” from “good” sleep by measuring seven domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction over the past month. Each domain is scored as: 0 (very good), 1 (good), 2 (poor), or 3 (very bad). The sum of the scores (0 to 21) determines the PSQI. A global sum of ≥5 indicates a poor sleep quality [14].

The Thai version of the Epworth Sleepiness Scale (ESS), which is known to be a valid and reliable measure of daytime sleepiness in adults, was used to assess the average daytime sleep propensity of participants [15, 16]. The ESS is a simple, validated eight-item questionnaire designed to assess subjective excessive daytime sleepiness [17,18]. ESS item-scores are recorded as numbers from 0 to 3 written in a single box for each of the eight items. The total ESS score is the sum of the item-scores and ranges between 0 and 24; the higher the score, the higher the person’s level of daytime sleepiness. A total score of 10 or more indicates excessive daytime sleepiness.

The written Thai version of the Children’s Depression Inventory (CDI) was used to assess for depressive symptoms [19,20]. Each item contains 3 sentences that describe varying degrees of symptom severity during the previous 2 weeks. Each response is then scored from 0 (least severe) to 2 (most severe) for a total possible symptom score ranging from 0 to 54. A total symptom score of 15 was considered a positive screen for possible depression. A previous study estimated that a cut-off score of 15 would provide 79% sensitivity and 91% specificity in identifying depressed Thai teens [20].

We also used the Screen for Child Anxiety Related Emotional Disorders (SCARED), a child version of the self-reported instrument to screen for anxiety disorders. The SCARED consists of 41 items with 5 factors: panic/somatic, generalized anxiety, separation anxiety, social phobia, and school phobia. A total score of 25 may indicate the presence of an anxiety disorder [21].

2.4 Statistical analysis

All statistical analyses regarding the effects of age, gender, community (urban or rural), school level (elementary, middle, or high school), and grades on sleep duration were conducted using SPSS version 23. A chi-square test was used to compare differences in PSQI, ESS, CDI scale, and SCARED scores between those with sleep duration greater than and less than 8 h in the urban and rural groups. Multiple logistic regression analysis was used to examine the association between sleep duration and factors such as age, gender, class, GPA, home environment, media use in the bedroom, PSQI score, and irregular wake times (defined as > 1 h difference in mean weekend and weekday wake times). The unadjusted and adjusted odds ratios were calculated using the full model and backward (Wald) model to quantify these associations. $p< 0.05$ were considered significant.

3. Results and discussion

3.1 The prevalence of sleep insufficiency and related factors

The mean total sleep time (time spent actually sleeping, as opposed to being awake in bed) among our 1,259 participants was 7.3 h (SD = 2.8). Seven hundred two (55.7%) subjects lived in urban areas, and 864 (68.63%) reported short sleep duration (sleep duration < 8 h). Related socio-demographic and academic factors are described in Table 1. Adolescents with good and short sleep duration differed in terms of age, gender, Body Mass Index (BMI), education level, GPA, family income, and area of residence. Factors still associated with short sleep duration after multivariable analysis were high school education level (odds ratio (OR) = 2.12, 95% confidence interval (CI): 1.38 - 3.25), GPA >3.5 (OR = 2.23, 95%CI: 1.31 - 3.80), urban residence (OR = 1.97, 95%CI: 1.29 - 3.02), and irregular wake times (OR = 1.9, 95%CI: 1.28 - 2.84). However, mean age, gender, average BMI, and family income were not associated with short sleep duration. No significant associations were observed between sleep duration and sleep latency, screens in the bedroom, or bedtime screen/computer use (p>0.05). Adjusted ORs and their 95% CIs in the final model are shown in Table 2. The prevalence of sleep insufficiency was higher in urban-dwelling adolescents (80.63%) compared to those in rural areas (53.5%). However, the urban subjects were also older, had higher levels of education, BMI, and family income, and were more likely to be male than their rural counterparts. Related socio-demographic and educational factors in urban and rural subjects are shown in Table 3.

Table 1 Socio-demographic and educational factors in the total study population.

Demographic data	Total n (%)	Sleep duration ≥ 8 h n (%)	Sleep duration < 8 h n (%)	*p*-value
n	1259	395 (31.37)	864 (68.63)	-
Gender, male	777 (61.72)	778 (61.72)	779 (61.72)	<0.001
Age				<0.001
mean±SD*	15.66 ± 1.82	15.00 ± 2.03	15.96 ± 1.64	
BMI				<0.001
mean±SD*	20.82 ± 4.44	20.33 ± 4.76	21.04 ± 4.28	
School Level				<0.001
Elementary	19 (1.51)	16 (84.21)	3 (15.79)	
Middle school	363 (28.83)	168 (46.28)	195 (53.72)	
High school	877 (69.66)	211 (24.06)	666 (75.94)	
GPA				0.007
<=2.7	182 (16.24)	71 (39.01)	111 (60.99)	
2.71-3.12	217 (19.36)	60 (27.65)	157 (72.35)	
3.13-3.5	290 (25.87)	84 (28.97)	206 (71.03)	
>3.5	432 (38.54)	109 (25.23)	323 (74.77)	
**Income				0.001
<300 USD	131 (17.99)	56 (42.75)	75 (57.25)	
≥300 USD	597 (82.01)	164 (27.47)	433 (72.53)	
Area of residence				<0.001
Urban	702 (55.76)	136 (19.37)	566 (80.63)	
Rural	557 (44.24)	259 (46.5)	298 (53.5)	

*Chi-square test, Independent t-test

BMI=Body Mass Index, GPA=Grade Point Average, USD=United States Dollar

**Income/house/month

Table 2 Factors related insufficient sleep duration in adolescents according to multivariate logistic regression analysis (n=1259).

Factors	Adjusted OR (95%CI)	*p*-value
High school	2.12 (1.38 - 3.25)	0.001
GPA >3.5	2.23 (1.31 - 3.80)	0.003
Urban area	1.97 (1.29 - 3.02)	0.002
Sleep habits		
Irregular wake times	1.90 (1.28 - 2.84)	<0.001
Sleep latency (>30 min)	1.34 (0.58 - 3.08)	0.498
Environmental factors		
Screens in the bedroom	0.79 (0.52 - 1.20)	0.268
Bedtime activities		
Reading	2.24 (0.99 - 5.09)	0.054
Screen use	0.66 (0.33 - 1.31)	0.236
Computer use	0.99 (0.54 - 1.80)	0.963

Table 3 Demographic data of urban and rural subjects.

Demographic data	Urban n (%)	Rural n (%)	*p*-value
n	702 (55.76)	557 (44.24)	-
Gender, male	629 (89.47)	149 (26.75)	<0.001
Age			<0.001
mean±SD	16.4 ± 1.36	14.71 ± 1.89	
BMI			<0.001
mean±SD	21.7 ± 4.49	19.71 ± 4.12	
Sleep < 8 h	566 (80.63)	298 (53.5)	0.002
Sleep duration			<0.001
mean±SD	6.8 ± 1.34	7.7 ± 1.13	
School Level			<0.001
Elementary	18 (2.56)	1 (0.18)	
Middle school	33 (4.69)	330 (59.25)	
High school	652 (92.75)	226 (40.57)	
GPA			0.683
<=2.7	103 (15.54)	80 (17.43)	
2.71-3.12	135 (20.36)	82 (17.86)	
3.13-3.5	170 (25.64)	120 (26.14)	
>3.5	255 (38.46)	177 (38.56)	
*Income			<0.001
<300 USD	10 (2.48)	121 (37.35)	
≥300 USD	394 (97.52)	203 (62.65)	

BMI=Body Mass Index, GPA=Grade Point Average, USD=United States Dollar
*Income/house/month

3.2 Daytime sleepiness, sleep quality, depression, and anxiety

Table 4 compares daytime sleepiness, sleep quality, and depression and anxiety scores by sleep duration. In addition to low sleep quantity, students also exhibited poor sleep quality based on their responses to individual questions on the PSQI. Those with sleep insufficiency had a significantly higher mean PSQI score, indicating poor-quality sleep (range ≥5). However, there were no significant differences in average daytime sleepiness or depression/anxiety scores between the two groups.

Table 4 Comparison of daytime sleepiness, depressive symptoms, and anxiety scores (sleep ≥ 8 h vs sleep < 8 h) in the total population.

Group	Total Mean ± SD	Sleep ≥ 8 h Mean ± SD	Sleep < 8 h Mean ± SD	*p*-value
n	1259	395	864	-
ESS ≥10, n (%)	584 ± 46.39	179 ± 30.65	405 ± 69.35	0.607
PSQI ≥5, n (%)	460 ± 36.54	95 ± 20.65	365 ± 79.35	<0.001
CDI ≥15, n (%)	626 ± 49.72	185 ± 29.55	441 ± 70.45	0.166
SCARED≥25, n (%)	653 ± 51.87	196 ± 30.02	457 ± 69.98	0.281

ESS=Epworth Sleepiness Scale, PSQI=Pittsburg Sleep Quality Index, CDI=Children's Depressive Inventory, SCARED= Screen for Child Anxiety Related Emotional Disorder.

Table 5 compares daytime sleepiness and depressive symptoms/anxiety scores between urban and rural adolescents. Poor-quality sleepers also reported significantly shorter sleep duration in both urban and rural areas.

In the urban teens, possible depression and anxiety were more common in adolescents with short sleep duration compared with those with good sleep duration (CDI ≥15, 84.38% vs 15.62% [p= 0.017] and SCARED ≥25, 84.2% vs 15.8% [p= 0.018]). However, no such difference was found in the rural teens. There was no difference in sleepiness scale between those with good and short sleep duration in either area.

Table 5 Comparison of daytime sleepiness, depressive symptoms, and anxiety scores (sleep ≥ 8 h vs sleep < 8 h) by area of residence.

Group	Sleep duration ≥ 8 h Mean ± SD	Sleep duration < 8 h Mean ± SD	p-value
Urban			
n	136	566	
ESS ≥10, n (%)	65 ± 19.06	276 ± 80.94	0.839
PSQI ≥5, n (%)	33 ± 11	267 ± 89	<0.001
CDI ≥15, n (%)	52 ± 15.62	281 ± 84.38	0.017
SCARED≥25, n (%)	55 ± 15.8	293 ± 84.2	0.018
Rural			
n	259	298	
ESS ≥10, n (%)	114 ± 46.91	129 ± 53.09	0.863
PSQI ≥5, n (%)	62 ± 38.75	98 ± 61.25	0.020
CDI ≥15, n (%)	133 ± 45.39	160 ± 54.61	0.581
SCARED≥25, n (%)	141 ± 46.23	164 ± 53.77	0.888

ESS=Epworth Sleepiness Scale, PSQI=Pittsburg Sleep Quality Index, CDI= Children's Depression Inventory, SCARED= Screen for Child Anxiety Related Emotional Disorder

3.3 Discussion

Our major findings are summarized as follows. First, we found a high prevalence of insufficient sleep among Thai adolescents. The prevalence of adolescents with insufficient sleep duration in this study (68.6%) was consistent with that found in a previous study of 14,041 American high school students (68.9%) [4]. The overall mean sleep duration found in our study (7.3 h) was comparable with that in a study from Hong Kong (7.3 h) [22] but shorter than in previous surveys in the United States, Canada, China, and New-Zealand (7.4-8.7 h) [23] and longer than those found in Japan (6.3 h) and Korea (4.9 h) [8]. These differences may be due to cultural variation.

We also found that male subjects had shorter sleep duration than female subjects, which is consistent with previous findings from Italy, Korea, China, and Thailand [24]. Similar gender differences in sleep duration have also been reported in surveys in the United States, Europe, and Taiwan. We found that the prevalence of sleep insufficiency was significantly higher in urban areas, similar to a 2015 study by Hounnaklang et al., which showed that 77.3% of urban Thai adolescents reported getting less than 8 h of sleep per night [25]. Second, we found shorter sleep durations in subjects enrolled in higher level education, with high academic performance, with irregular schedules, and who lived in urban communities. A previous survey of US adolescents (n 15,624) similarly found short sleep duration (<8 h) to be more prevalent in high school than in middle school students (72.7% vs. 57.8%) [26]. Another study in China showed that 10th-graders were approximately twice as likely to suffer from sleep insufficiency as seventh graders [27]. High GPA (greater than 3.5) was also associated with short sleep duration in our study, which is consistent with the findings of a previous study that good academic performance (GPA >3.50) is a risk factor for shorter sleep duration (OR=2.45 [95% CI=1.54-3.19]) [25] and that homework and academic stress result in delayed bedtime and sleep deprivation. Our finding that adolescents in urban areas had significantly shorter sleep duration than their rural counterparts is likely due to the fact that urban and rural lifestyles differ significantly, as do environmental characteristics, length of commute to school, exposure to social media, parental monitoring/rules about bedtimes, and school start times. We found that a difference of more than 1 hour between weekday and weekend wake times was associated with shorter sleep duration. Going to bed and waking up later on weekends may affect students' circadian rhythm and result in insufficient weekday sleep [28]. Although compensatory oversleeping on weekends provides some temporary relief from sleepiness caused by insufficient sleep on weekdays, it also leads to disruptions in the sleep–wake cycle, worsening of the normal adolescent circadian phase delay, and compromised weekday attentiveness [29]. Finally, we found a significant association between short sleep duration with sleep quality, depression, and anxiety in urban adolescents, which is consistent with the findings of several previous studies. In a recent study, adolescents with poor sleep quality were found to have difficulty falling asleep immediately compared with those who experience good sleep quality and that going to bed late and getting up early in the morning resulted in short sleep duration [30]. Additionally, sleep insufficiency has been shown to increase the relative risk of developing depression [31], anxiety, and somatic pain [9,10]. A recent meta-analysis of seventy-four studies, which included 361,505 adolescents, indicated that less sleep was associated with a 55% increase in the likelihood of mood deficits [32].

Interestingly, one meta-analysis, which included a total of 598,281 adolescents with a mean age of 15.5 yrs, found a linear relationship between sleep duration and depression with suicidal tendencies, and that for every 1 hour increase in sleep duration, there was an 11% reduction in the number of subjects with suicide plans [33]. In our sample, a high percentage of adolescents in urban areas suffered from sleep insufficiency. Subjects living in urban areas with inadequate sleep time also reported poor sleep quality, depressive symptoms, and anxiety at a greater rate than those with sufficient sleep duration. These results must be interpreted with caution, however, given the significant socio-demographic differences (older age, higher educational level, and higher family income) in urban adolescents compared to those in rural areas, which may impact sleep quality, anxiety level, and presence of depressive symptoms.

There were several limitations to this study due to its design. First, the subjects only represent two regions of the country (central and northern Thailand), meaning that our findings are not necessarily generalizable to the other populations. Second, our study used self-reported questionnaires, which may be subject to recall bias or inaccuracy. Other objective measures such as sleep logs or actigraphy data may be needed in future research. Finally, as this study consisted of a one-time survey, it is impossible to determine directionality in the relationship between poor sleep quality and mood/stress or to what extent short sleep is secondary to or predictive of stress and anxiety.

4. Conclusion

Our school-based survey found that a high prevalence of Thai adolescents had insufficient sleep duration. High school education level, high academic performance, living in urban areas, and irregular wake times were associated with sleep insufficiency. Our findings also showed linkages between sleep insufficiency and sleep quality, depressive symptoms, and anxiety. Given the close relationships between sleep duration and mental health, intervention programs for sleep disturbance in this population should be considered.

5. Ethical approval

This study was approved by the Institutional Review Board of Royal Thai Army Medical Department (No. IRB/RTA073q/2562).

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