

Correlation between Sleep Patterns, Weight, and Height Among Indonesian Female Boarding School Students

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ABSTRACT

Background: Sleep is essential for growth, development, and health, with inadequate sleep linked to risks such as obesity, hypertension, and mood disorders. Sleep patterns differ by sex, with females often experiencing poorer quality and greater susceptibility to disturbances due to factors like the menstrual cycle. Adolescents, particularly boarding students, face unique sleep challenges from academic and extracurricular demands, potentially impacting growth. This study is aimed at studying the relationship between sleep patterns and height within Indonesian female boarding school students to understand the influence of sleep on their physical development. **Methods:** This cross-sectional study was performed in a boarding school in East Java, enrolling female students aged 13-17 years. Height and weight were assessed with standard anthropometric techniques. The BMI was computed and categorized according to age-specific percentiles. An online form collected data on bedtime, wake-up time, and sleep duration. SPSS was used for data analysis and Pearson's correlation to explore relationships between sleep patterns and height. **Result:** This study included 127 female students with a mean BMI of 20.9 ± 3.31 . Mean height and weight were 154.57 ± 5.45 and $50,08 \pm 9.38$, respectively. 76% of subjects had an average of 5–5.5 hours of sleep per day. There was no significant relationship between the two (Pearson correlation = -0.009; Sig. 2-tailed = 0.0923). There was a slight tendency that less sleep was associated with a slight decrease in height, but very weak and not significant (Pearson correlation = -0.090; Sig. 2-tailed = 0.313). **Conclusion:** Although females in boarding schools experience reduced sleep duration, they maintain normal weight and height.

Keywords: sleep pattern; students; children; female; height.

INTRODUCTION

Sleep is a period characterised by physiological, periodic, and reversible changes in consciousness and behaviour [1]. Sleep is crucial for human growth and the maintenance of mental and physical well-being. Research indicates that short sleep duration (≤ 6 hours/day) is closely linked with a higher chance of negative health effects. This includes all-cause mortality, metabolic disorders, cardiovascular conditions, and mood disorders. Sleep characteristics may differ by sex [2].

Sleep signifies a phase of heightened activity that facilitates tissue repair, the process of stabilizing a memory trace after its initial acquisition, and physical growth. A variety of endocrinological variables exhibit release patterns that are linked to the circadian system's periodicity, with their activity and concentration varying based on the individual's

level of awareness or sleep. Inadequate sleep duration, particularly insomnia, can disrupt homeostasis, resulting in detrimental physiological processes [4]. Limited sleep duration correlates with reduced height in children. Walsh et al. (2021) conducted a study that correlated the duration of nighttime sleep and napping with increasing in stature. This elucidates the significance of sleep and its impact on growth in height [5].

Before puberty, males and females exhibit comparable sleep patterns; but, post-puberty, sexual variations emerge, with females often reporting reduced sleep duration, inferior sleep quality and efficiency, and challenges in initiating sleep [6].

Since menstruation, pregnancy, and menopause can disrupt sleep patterns, females are more susceptible to sleep disorders [7].

Apart from gender, changes in sleep patterns are also influenced by academic activities. Adolescents constitute the predominant demographic of school-aged boarding students. Sleep experiences developmental alterations during adolescence, characterised by reduced duration and significant delays in timing. Adolescence is additionally marked by heightened academic and extracurricular engagements (e.g., sports, employment, social activities, and community events) that may contend with and consequently influence sleep timing and duration [8]. Therefore, we aimed to analyse the correlation between sleep patterns and height among Indonesian female boarding school students.

METHODS

A cross-sectional investigation was conducted at a boarding school in East Java. This study involved female students aged 13 to 17 years. We excluded subjects with severe diseases and those unwilling to engage. This study has been approved by the Health Research and Ethics Committee of the Faculty of Medicine by the ethic number 17/EC/KEPK/FKUA/2024.

Regarding ethical clearance, we sent a separate form containing informed consent, which was filled in by the subject's parent or guardian and returned to us. Healthcare professionals evaluated height and weight utilising standard anthropometric methods. A wall-mounted tape measure (Onemed) was employed for precisely measuring the height to the nearest 0.1 cm, while the weight of the participant was measured to within 0.1 kilograms (Onemed).

BMI is calculated by dividing a person's weight in kilograms by their height in meters squared. BMI-for-age percentile growth charts classified as underweight (5th percentile), healthy weight (5th-85th percentile), overweight (85th-95th percentile), and obese (≥ 95 th percentile). An online form was created to gather information about bedtime (the time the subject goes to bed), wake-up time (the time the subject wakes up), and the average duration of sleep per night. Participants who refused to have their height and weight assessed, or failed to complete the questionnaire, were omitted.

Data analysis was conducted utilizing SPSS version 17.0 (IBM). Descriptive statistics will summarise the sleep patterns and growth measurements, presented as frequencies (n) and percentages (%). Correlations between sleep patterns and height were conducted using the Pearson test.

RESULT

A total of 127 female participants were engaged in this study. Subject demographics are shown in Table 1. The majority of subjects weigh 40-49 kg (48.82%) with a body height of 150-159 cm (68.50%). The mean BMI of all subjects was 20.9 ± 3.31 , with the majority falling into the healthy range (59.84%). The percentage of subjects who reported their bedtime around 20.00, 21.00, and ≥ 22.00 was 7.09%, 19.69%, and 73.3%. About 95% of subjects had a wake-up time of 3.00-3.59 (95%). 52 or 76% of subjects had an average of 5-5.5 hours of sleep per day.

TABLE 1: Demographic Characteristics and Sleep Patterns of Female Participants (n=127).

Characteristic	All (n=127)	%
Weight (kg)	50,08±9.38	
30-39	13	10,24
40-49	62	48,82
50-59	33	25,98
60-69	14	11,02
≥ 70	5	3,94
Height (cm)	154.57±5.45	
140-149	20	10,15
150-159	87	68,50
160-169	20	15,75
BMI (kg/m²)	20.9±3.31	
<18,5	32	25,20
18,5-24,9	76	59,84
25,0-29,9	17	13,39
30,0-34,9	2	1,57
Bedtime		
20.00-20.59	9	7,09
21.00-21.59	25	19,69
≥ 22.00	93	73,23

Characteristic	All (n=127)	%
Wake up time		6,3
<3.00	8	74,80
3.00-3.59	95	9,45
4.00-4.59	12	9,45
≥ 5.00	12	
Average duration of sleep/night	5,52 ± 0,94	
<4.00	4	3,15
4-4,5 hours	15	11,81
5-5,5 hours	67	52,76
6-6,5 hours	27	21,26
7-7,5 hours	12	9,45
≥ 8 hours	2	1,57

The link between sleep time and body weight was insignificant (Pearson correlation=-0.009; Sig. 2-tailed=0.0923). We also found that there was a very weak relationship between height and sleep time, where there was a slight tendency that less sleep was associated with a slight decrease in height, but this relationship was very weak and not significant (Pearson correlation = -0.090; Sig. 2-tailed = 0.313).

DISCUSSION

The study revealed no substantial correlation among sleep pattern and body height. The correlation between alterations in sleeping patterns and height growth remains underexplored and presents inconsistent findings. Comparable findings were observed in the study conducted by Listiana et al., study showed no link between sleep habits and stature in Malang 8–11-year-olds (p-value=0,649, p>0,05) [9]. Furthermore, sleep duration does not correlate with variations in growth rates over a one-year period in studies including adolescents aged 12 to 16 years. In this study, height was measured objectively at a single instance and self-reported by the respondent regarding initial height [10]. A negative correlation between sleep duration and height was identified in children aged 5 to 11 years in the UK [11].

In contrast, a longitudinal study in Singapore revealed a positive correlation among shorter stature at 24 months of age and sleep duration of 12 hours or less at 3 months of age[2]. Similar findings were observed in studies conducted in North America, where 23 preschool children were monitored for a duration of 2 to 17 months, indicating that extended periods of nocturnal sleep and daytime napping correlated with enhanced growth [12].

Our findings indicated that sleep patterns were unrelated to body weight. This aligns with research by Cappuccio et al. and Carter et al., which indicates a negative correlation between sleep duration and BMI as well as body fat. Child sleep length is linked to long-term effects, with reduced sleep correlating to increased BMI in older children. 5 to 11 years [13]. A meta-analysis by Cappuccio et al revealed a pooled risk ratio of 1.89 for overweight children with short

sleep duration, indicating that sleep length significantly influences metabolic processes in the body [14]. This study found no correlation between sleep duration and weight in the overall sample, likely due to the participants' advanced age.

Recent research has investigated the relationship between insufficient sleep duration and weight gain, initially concentrating on adults and subsequently including young adults, school-aged children, and infants and toddlers. Across all age demographics that were assessed, the data primarily indicate a positive correlation among insufficient sleep and the possibility of overweight and/or obese. The results of a meta-analysis that included data from over 55,000 children aged 0 to 16 years showed that those with increased periods of sleep were 76% inclined to be overweight or obese than those with shorter hours of sleep. Additionally, the study demonstrated a greater annual increase in BMI. The incidence of overweight was reduced by 21% as a consequence of a one-hour increase in the total sleep duration [15]. Sleep deprivation may directly affect metabolism by activating the hypothalamic-pituitary-adrenal (HPA) axis, raising catecholamine levels, and activating the inflammatory cascade to increase interleukins and TNF. These processes increase insulin resistance and pancreatic β -cell malfunction [16]. Additionally, sleep deprivation may lead to weight gain by affecting appetite regulation, likely due to decreased leptin levels and increased ghrelin. [17].

The lack of a correlation in our study, despite general findings of a positive association in broader populations, can be attributed to the highly controlled and structured environment in boarding school. Their students have highly regimented daily schedules, including set times for meals. Meals are typically provided in a cafeteria setting with balanced options, reducing the impact of poor dietary habits on weight gain. Additionally, many boarding schools mandate regular physical activity, which could buffer the negative effect of irregular sleep on weight. It is important to note, this study's evaluation of sleep habits was subjective and solely reliant on information supplied by the participant.

CONCLUSION

The results of our investigation reveal that a significant proportion of female students in a boarding school maintained a healthy weight status, albeit accompanied by suboptimal sleep patterns. Further investigation is advisable to examine the biological determinants affecting growth, including heredity, sex, and nutrition.

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