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Does quality of sleep determine the menstrual cycle? A cross-sectional study on teenager

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Abstract

Background: Irregularities in the menstrual cycle are a frequent occurrence and may negatively impact daily productivity. In Indonesia, approximately 32% of women aged 17–29 report experiencing irregular menstruation. Disturbances in sleep quality can interfere with melatonin and estrogen regulation, thereby contributing to menstrual cycle disruption.

Purpose: To investigate the association between sleep quality and menstrual cycle regularity.

Methods: A cross-sectional design was employed involving 111 female students who met the inclusion criteria: maintaining records of the first day of menstruation between December 2024 and February 2025 and having no diagnosed reproductive system disorders. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), while menstrual cycle data were obtained through questionnaires. Statistical analysis was performed using the chi-square test.

Results: Among the respondents, 37 students (33.3%) with good sleep quality reported regular menstrual cycles, whereas 40 students (36%) with poor sleep quality experienced irregular cycles. The analysis yielded a p-value of 0.001, indicating statistical significance.

Conclusion: Sleep quality was found to be significantly associated with menstrual cycle regularity.

Keywords: Menstrual Cycle; Quality of Sleep; Teenager.

INTRODUCTION

Many women experience menstrual-related health problems during their reproductively fertile years, such as menstrual cycle irregularity, menstrual pain, heavy menstrual bleeding, and premenstrual syndrome (He, Yu, Chen, Yang, Zhang, & Ge, 2021). The prevalence of menstrual cycle irregularities among women ranges from 5% to 35.6%, depending on age, country of residence, and occupation (Attia, Alharbi, & Aljohani, 2023). While 32% of women aged 17-29 in Indonesia experienced irregular menstruation, which leads to work productivity loss (Ministry of Health of the Republic of Indonesia, 2018).

Menstrual cycle, of 21 to 30 days span is controlled by several hormones like gonadotrophin releasing hormone, follicle stimulating hormone, luteal hormone, progesterone and estrogen (Barrett, Barman, Boitano, & Brooks, 2019). Menstrual irregularity has been found to be associated with various diseases and medical conditions, such as metabolic syndrome, coronary heart disease, type 2 diabetes mellitus, rheumatoid arthritis, anemia, osteoporosis, psychological problems, impaired quality of life, and infertility. Therefore, irregular menstruation is considered an important health indicator among women (Attia et al., 2023).

Age at menarche, childbirth experience, body mass index, education level, work schedule, body mass index, sleep quality, and stress conditions were found to be related to menstrual regularity (Fitriani, Probandari, & Wiboworini, 2019; Shim, Han, & Baek, 2024).

Good quality sleep is essential for our optimal daytime performance of various daily tasks, whereas inadequate sleep causes daytime malfunctioning, psychological and behavioral problems, and physical disorder (He et al., 2021). Sleep disorders have been associated with menstrual disorder in adults. It can cause hormonal imbalances and leads to irregular menstrual cycles (Botutihe, Sunti, & Tiala, 2022). Poor sleep quality can decrease melatonin production which regulates the secretion of FH and FSH hormones, which in turn affect estrogen production. Melatonin inhibits estrogen production which serves to control the balance of reproductive hormones in the body. Suboptimal melatonin production will decrease the inhibitory function of estrogen, causing estrogen levels to rise excessively, and directly disrupting the menstrual cycle (Nam, Han, & Lee, 2017; Yu & Reiter, 2020).

In the three UK National Psychiatric Morbidity Surveys, poor sleep-in women were linked to some factors such as increased age, lower educational attainment, depression, unemployment, economic inactivity, and widowed, divorced, or separated status (Calem, M., Bisla, J., Begum, A., Dewey, M., Bebbington, P. E., Brugha, T., & Stewart, 2012). Similarly, insomnia in female in Hong Kong were identified with psychiatric disturbance, older age, unemployment-low socioeconomic status, alcohol, medication, and for women only, marital status and a noisy sleep environment (Li, Chen, Overstreet, Nakajima, & Lasley, 2002). Researchers are interested in examining the correlation between quality of sleep and menstrual cycle. This study distinguishes itself from most of the previous in its population and samples.

RESEARCH METHOD

This cross-sectional study was conducted at the Health Polytechnic of the Ministry of Health Surakarta in April 2025. The target population comprised 122 second-year midwifery students, from which 111 respondents were selected through purposive sampling based on predetermined inclusion and exclusion criteria. Eligible respondents were active students who consented to join the study and had documented records of their menstrual cycle start dates between December 2024 and February 2025. Students with reproductive system disorders—including Polycystic Ovary Syndrome (PCOS), Pelvic Inflammatory Disease (PID), fibroids, cancer, endocrine disorders, or bleeding disorders—were excluded.

The independent variable was sleeping quality, encompassing aspects such as sleep latency, duration, efficiency, disturbances, use of sleep medication, and daytime dysfunction. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), with scores categorized as good (≤ 5) or poor (6–21). The dependent variable was menstrual cycle regularity, measured via questionnaire over the preceding three months. Cycles were classified as regular if they did not deviate by more than four days from the expected date, and irregular if they advanced or were delayed by more than four days.

Data analysis included univariate methods to describe variable characteristics using frequencies and percentages, and bivariate analysis to examine the relationship between sleep quality and menstrual cycle regularity using the chi-square test at a 95% confidence level. Statistical processing was performed with SPSS Statistics version 21.

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RESEARCH RESULTS

Table Characteristics of the Respondents (N=111)

Variable	Results	ρ
Age (n/%) (Mean $\pm$ SD)(Range)(Year)	(19.33 $\pm$ 0.75)(18–21)	
18	1/0.9	
19	62/55.9	
20	46/41.4	
21	2/1.8	
Quality of Sleep (n/%)		
Good	52/46.8	
Poor	59/53.2	
Menstrual Cycle (n/%)		0.001
Regular	56/50.5	
Irregular	55/49.5	

The table above presents the respondents' age distribution, with a mean of 19.33 years (SD = 0.75) and an overall range of 18 to 21 years. The majority were 19 years old, accounting for 62 individuals (55.9%). In terms of sleep quality, 59 respondents (53.2%) reported poor sleep, while 56 respondents (50.5%) experienced regular menstrual cycles.

Results of a bivariate analysis examining the relationship between sleep quality and menstrual cycle regularity. A total of 37 respondents (33.3%) with good sleep quality reported regular menstrual cycles, whereas 40 respondents (36.0%) with poor sleep quality experienced irregular cycles. The chi-square test yielded a p-value of 0.001, which is below the 0.05 threshold, indicating a statistically significant association between sleep quality and menstrual cycle regularity.

DISCUSSION

This study found that majority of respondents were 19 years old. It is in line with World Health Organization (WHO) statement that adolescent is the phase of life between childhood and adulthood, from ages 10 to 19 years old. There are three stages of adolescence: early adolescence (11–13 years), middle adolescence (13–17 years), and late adolescence (17–19 years) (Salmela-Aro, 2011). Early adolescents who are still under the age of 18 will

experience more frequent menstrual cycle irregularities because they are still in the adaptation and maturation stage. Many adolescents under the age of 18 still experience amenorrhea or menstrual delays of more than 3 consecutive months. Menstruation in women will become regular and observable after reaching the age of 18 or older (Manuaba, Manuaba, & Manuaba, 2010).

Sleep quality on the PSQI questionnaire is divided into two categories. Sleep quality is good if the total score is ≤ 5 . While sleep quality is poor if the total score is > 5 . This study showed that 59 respondents (53.1%) experienced poor sleep quality. Poor sleep quality can be determined from the total score of all questions with seven components of sleep quality, including lack of sleep duration at night, daytime dysfunction, the need for a long time to fall asleep after lying down (sleep latency), and other sleep problems.

There were 54 respondents (48.6%) provided additional answers (in question 5J) regarding the reasons or causes of sleep disturbances in the past month. Half of them, 54 respondents (50%) said that their sleep time was reduced or delayed due to using gadgets before sleep, whether for social media (Instagram and TikTok), playing online games, or watching movies or dramas. The exposure of devices induces statistically significant changes in the

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electroencephalography or EEG during Non-Rapid Eye Movement (NREM) sleep and may have a clinically important adverse effect on sleep (Bijlsma, Conduit, Kennedy, & Cohen, 2024).

Circadian rhythms in sleep patterns can be altered by radiation from gadget screens. The Light Emitting Diode (LED) screens on gadgets emit blue light with a wavelength of approximately 400-490 nm, which affects neurobehavioral functions and causes sleep difficulties. It also affects melatonin photopigment, the part of the eye that is sensitive to blue light waves. This can inhibit the synthesis of melatonin (the sleep-regulating hormone) and cause wakefulness (Lopez-Minguez, Gómez-Abellán, & Garaulet, 2016).

This study showed that 56 respondents (50.5%) experienced regular menstrual cycles with an interval of ≤ 4 days. The regularity of the menstrual cycle can be determined by calculating the interval between the current menstrual cycle and the previous one. Normal menstruation lasts 2 to 7 days and occurs every 21-35 days. Menstrual irregularity also includes having a period for 3-6 months (Attia et al., 2023).

Chi square test shows that p value was 0.001. It means that the quality of sleep influenced teenager's menstrual cycle. Sleep quality is influenced by the pineal gland, which secretes melatonin hormone and induces sleepiness, thereby affecting the quality and quantity of a person's sleep. Melatonin acts as an antioxidant, antimitotic, anti-metastatic, immune system modulator, regulates sleep rhythms and circadian rhythms, regulates the synthesis of estrogen hormone, and regulates the maturation of the reproductive system (Sánchez-Barceló, Cos, Mediavilla, Martínez-Campa, González, & Alonso-González, 2005). Besides, the melatonin also plays a role in the menstrual cycle. Through the supraoptic nucleus in the hypothalamus, it affects the hypothalamic GnRH in the formation of FSH-LH. This relationship is very important because melatonin plays a role in ovarian growth, cAMP production, and estrogen hormone synthesis in the menstrual cycle (Yu & Reiter, 2020).

Melatonin hormone is affected by sleep quality. Poor sleep quality can inhibit this hormone production. The function of melatonin in the reproductive system is to regulate estrogen by inhibiting its production or synthesis so that it remains at normal levels. Therefore, it is called as a natural estrogen inhibitor. Suboptimal melatonin production causes excessive

estrogen levels in the body, which can disrupt the menstrual cycle, like oligomenorrhea or polymenorrhea, depending on the amount of estrogen produced (Arendt & Aulinas, 2000).

This result is in line with study which analysed 213 female nurses and found that nurses who had poor sleep quality were more likely to have irregular menstrual cycles with p value 0.001. Poor sleep quality effect the physiological health and impact the neuroendocrine system, particularly the hypothalamic-pituitary-ovarian axis, causing unstable estrogen secretion and affecting normal menstrual operations (Peng & Chang, 2024).

Sleep quality is influenced by the pineal gland which secretes melatonin hormone and provides a drowsy effect that will affect the quality and quantity of a person's sleep. Poor sleep patterns will cause disturbances in physiological and psychological balance. Melatonin also plays a role in the menstrual cycle. Poor sleep quality can reduce melatonin production. The hormone melatonin functions as an inhibitor that inhibits steroid production by reducing the expression of Steroidogenic Acute Regulatory (StAR), P450 side chain cleavage (P450 scc), 3β -Hydroxysteroid Dehydrogenase (3β -HSD), and 17β -Hydroxysteroid Dehydrogenase (17β -HSD) which are known as steroidogenic proteins and enzymes and have an important role in the production of cAMP and steroids, especially estrogen which is a hormone that regulates the menstrual cycle. High levels of estrogen can cause menstrual cycle disorders. (Ernawati, Ekawati, Gumelar, & Rahmadani, 2024).

There was significant relationship between quality of sleep and menstrual cycle in 109 students in Islamic University of North Sumatra with p value was 0.005. There were 52.6% students with poor sleep quality and 22.9% of them had irregular menstrual cycle. This study showed that the odds ratio was 4.773. The probability of female teenagers having irregular menstrual cycles increases 4.773 times for those with poor sleep quality (Siregar, Pane, Mustika, & Wardani, 2022).

The regularity of the menstrual cycle is multifactorial. It means that there are many other factors that can affect the menstrual cycle, such as stress, body mass index (BMI), medical history, physical activity, consumption of certain medications, and others. Preventive interventions are very important and should be carried out by providing

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health education to all female teenagers by identifying the factors that influence irregular menstrual cycles to develop good behavior (Botutihe et al., 2022).

CONCLUSION

A significant association was identified between sleep quality and menstrual cycle regularity among second-year students. These results highlight the importance of promoting better sleep practices as a key strategy to enhance reproductive health in adolescent females.

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