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Factors related to menstrual cycle irregularity in adolescent females

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Abstract

Background: Adolescence is an important transitional phase marked by physiological and psychological changes, including the onset of menstruation. Menstrual cycle irregularities in adolescents are a common reproductive health problem, and are influenced by various factors such as physical activity, stress levels, sleep quality, and body mass index (BMI).

Purpose: This study aims to analyze factors associated with menstrual cycle irregularities in female adolescents.

Method: This study uses an analytical quantitative design with a cross-sectional approach. The study population was all female students of SMA Negeri 4 Jambi City. A total of 87 respondents were selected using a stratified random sampling technique. Data were collected using the International Physical Activity Questionnaire (IPAQ), Perceived Stress Scale-10 (PSS-10), Pittsburgh Sleep Quality Index (PSQI), and menstrual cycle observation sheets. Data analysis was performed univariately and bivariately using the Chi-Square test ($\alpha = 0.05$).

Result: The study showed a significant association between physical activity ($p=0.035$), stress levels ($p=0.038$), sleep quality ($p=0.049$), and BMI ($p=0.028$) and menstrual cycle irregularity.

Conclusion: The conclusion of this study is that Physical activity, stress, sleep quality, and BMI were significantly associated with menstrual cycle irregularity. Promotive-preventive interventions through reproductive health education and strengthening the PIK-R or GENRE program in schools are needed to increase awareness and healthy lifestyle behaviors among adolescents.

Keywords: BMI; Menstrual Cycle; Physical Activity; Sleep Quality; Stress.

INTRODUCTION

Adolescent reproductive health is a crucial aspect of public health because it directly impacts the quality of future generations. One crucial aspect of reproductive health is the regularity of the menstrual cycle (World Health Organization, 2022). Irregular menstrual cycles can indicate hormonal or physiological disorders that require attention because they impact fertility, psychological health, and the quality of life of adolescent girls.

According to the Basic Health Research (Riskesdas) (2018), approximately 11.7% of adolescent girls in Indonesia experience irregular menstruation. In other countries, such as Korea, the prevalence reaches 19.4%, while in the United States it reaches almost 95% in women aged 12–17 years. This disorder can cause long-term effects such as

anemia, polycystic ovary syndrome (PCOS), fertility disorders, and emotional and concentration problems (Klukas, & Schotanus-Dijkstra, 2025). Furthermore, according to the 2020 SDKI data, more than 60% of Indonesian adolescent girls still have poor menstrual health practices. Menstrual cycle disorders such as oligomenorrhea (cycles >35 days) or polymenorrhea (cycles <21 days) can impact adolescent fertility, productivity, and quality of life.

Several factors have been shown to be associated with menstrual cycle irregularities, including unbalanced physical activity, high stress levels, poor sleep quality, and an abnormal BMI. Explains that stress can trigger an increase in the hormone cortisol, which inhibits GnRH secretion, resulting in ovulation disorders (Attia, Alharbi, & Aljohani, 2023). On the

Factors related to menstrual cycle irregularity in adolescent females

other hand, extreme physical activity and poor sleep quality can also disrupt the hormonal balance of estrogen and progesterone (Klukas & Schotanus-Dijkstra, 2019).

Over 50% of the world's population will menstruate, and menstrual disorders are very common and debilitating. Menstrual disorders can lead to anemia, diabetes mellitus, heart disease, chronic kidney failure, and infertility, have a significant negative impact on quality of life, and constitute a significant socioeconomic burden for women, their families, health services, and society (Sequeira, Suryantara, & Sari, 2024).

One of the changes that occur in women is menstruation. Menstruation is bleeding from the uterus that occurs periodically and cyclically. This is the result of the shedding (desquamation) of the endometrium due to changes in ovarian hormones (estrogen and progesterone) at the end of the ovarian cycle, usually starting on the 14th day after ovulation (Lestari & Amal, 2019).

The regularity of the menstrual cycle is influenced by several factors, namely excess weight, nutritional deficiencies, diseases related to reproduction, the influence of smoking, psychosocial factors, genetic disorders, heavy exercise, and consumption of certain drugs such as hormonal contraceptives (Ginting, Prastiwi, & Iskandar, 2020).

Reproductive health education programs for adolescents are crucial and must be considered. This is because they are part of the government's efforts to provide adolescents with additional knowledge about reproductive health. One study showed that 84% of adolescent participants expressed a need for reproductive health training. However, only around 48.3% of them had received such training. Therefore, the government should continue its efforts to promote reproductive health education programs in schools through reliable sources (Latifah & Sholihah, 2017).

Adolescence is a transitional period from childhood to adulthood, marked by bodily changes that can lead to reproductive issues, one of which is menstrual cycle disorders. A crucial aspect of menstruation is the menstrual cycle. Every woman's menstrual cycle is not always regular. Menstrual cycle changes are a fairly common problem, with a prevalence of 75% in adolescents (Widiasari, Rokhanawati, & Kurniawati, 2020).

Every woman can experience various menstrual disorders, ranging from too little or too much menstrual flow, menstrual pain, to premenstrual depression (PDM). A normal menstrual cycle occurs every 21-35 days, with periods lasting approximately 4-7 days. Diet is the factor most associated with menstrual disorders in female students (Risna, 2024).

RESEARCH METHOD

This analytical observational study used a quantitative approach, employing a cross-sectional design. This method was used to simultaneously evaluate the relationship between independent and dependent variables, with the aim of identifying factors associated with the menstrual cycle in adolescent girls. The study was conducted at SMA N 4 Jambi City from August 2024 to February 2025.

The sample consisted of 87 female students in grades 10 and 11. The sample size was determined using the Lemeshow formula. Sampling is a crucial step in the observation process, aiming to select a representative sample. This study employed probability sampling with a stratified random sampling approach. Probability sampling is a sampling technique in which every individual in the population has an equal chance of being selected. Stratified random sampling, on the other hand, divides the population into several strata or small groups, formed based on specific criteria relevant to the research objectives. After the population is divided into these strata, samples are taken randomly from each group.

The inclusion criteria were female students of SMA N 4 Jambi City in grades X and XI who had experienced menstruation for at least the last 3 months and were willing to be respondents in the research. Exclusion criteria were female students who had reproductive diseases such as sexually transmitted infections (STIs), polycystic ovary syndrome (PCOS), uterine fibroids or other reproductive disorders and female students who were not present in the study.

The instrument used in the study was informed consent or respondent consent sheet, Respondent identity questionnaire containing name, class, age, and active cellphone/WhatsApp number, International Physical Activity Questionnaire (IPAQ) is a tool used to measure a person's level of physical activity over the past seven days, Stress level

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Factors related to menstrual cycle irregularity in adolescent females

questionnaire using Perceived Stress Scale (PSS), There are 10 items, in each question is scored with the provisions "never" is given a score of 0, "almost never" is given a score of 1, "sometimes" is given a score of 2, "quite often" is given a score of 3, and "often" is given a score of 4 and Pittsburgh Sleep Quality Questionnaire Sleep Quality Index (PSQI)

which is given a score of good sleep quality if the score is ≤ 5 poor sleep quality if the score is >5 , Underweight (underweight <18.5 normal $18.5-22.9$ overweight (overweight) ≥ 23 , Menstrual cycle questionnaire 21-35 days abnormal <21 days or >35 days.

RESEARCH RESULTS

Table Frequency Distribution of Respondents (N=87)

Variable	Results	p-value	PR (95% CI)
Age (Mean$\pm$SD) (Range) (Year)	(15.89 $\pm$.754) (14-17)		
14	1/1.1		
15	27/31.0		
16	41/47.1		
17	18/20.7		
Class (n/%)			
X	42/48.3		
XI	45/51.7		
Body Weight (kg)			
36 - 45 kg	25/28.7		
46 - 55 kg	42/48.3		
56 - 65 kg	17/19.5		
66 - 75 kg	2/2.3		
>75 kg	1/1.1		
Height (cm)			
141 - 150 cm	20/23.0		
151 - 160 cm	51/58.6		
161 - 170 cm	16/18.4		
Activity Physique			
Heavy	34/39.1	1,000	0.955 (0.675-1.350)
Currently	24/27.6	Ref	-
Light	29/33.3	0.035	1,867 (1,097-3,178)
Stress Level			
Heavy	25/28.7	0.482	0.832 (0.558-1.239)
Currently	49/56.3	0.038	2.189 (0.946-5.062)
Light	13/14.9	Ref	-
Sleep Quality		0.049	1.677 (0.978-2.877)
Bad	64/73.6		
Good	23/26.4		

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Body Mass Index			
Underweight	21/24.1	0.182	1.467 (0.942-2.284)
Normal	44/50.6	Ref	-
Overweight	22/25.3	0.028	0.588 (0.396-0.873)
Cycle Menstruation			
Abnormal	51/58.6		
Normal	36/41.4		

The table above shows that the average age of respondents and standard deviation is (15.89±.754) with an age range of 14-17 years, with the majority of respondents being in grade XI and the majority having a body weight of 46-55 kg. based on height, the majority of respondents have a height of 151-160 cm with the majority having heavy physical activity, namely 34/39.1%, the majority have a current stress level of 49 respondents (56.3%), the majority of respondents have bad sleep quality, namely 64 (73.6%) with the majority of respondents having a normal BMI, namely 44 (50.6%) and the majority have an abnormal cycle of 51 respondents (58.6%)

The results of the statistical test using *Chi-Square* showed a P value of 0.035 ($p < 0.05$), indicating a significant relationship between physical activity and menstrual cycle disorders. The *Prevalence Ratio* (PR) value was 1.867 with a 95% confidence interval (1.097 – 3.178). This indicates that respondents with light physical activity had a 1.867 times greater chance of experiencing a normal menstrual cycle compared to respondents with moderate physical activity. The results of the statistical test using *Chi-Square* showed a P Value of 0.038 ($p < 0.05$), which indicates a significant relationship between severe and moderate stress levels and menstrual cycle disorders. The *Prevalence Ratio* (PR) value was 2.189 with a 95% confidence interval (0.946 – 5.062). This indicates that respondents with moderate stress levels had a 2.189 times greater chance of experiencing menstrual cycle disorders compared to respondents with mild stress. The results of the statistical test using *Chi-Square* showed a P Value of 0.049 ($p < 0.05$), indicating a significant relationship between stress levels and menstrual cycle irregularities. The *Prevalence Ratio* (PR) value was 1.677 with a 95% confidence interval (0.978 – 2.877). This indicates that respondents with poor sleep quality were 1.677 times more likely to experience menstrual cycle disorders compared to respondents

with good sleep quality and the analysis results using the Chi-Square test showed a P value of 0.028 ($p < 0.05$), indicating a significant relationship between sleep quality and menstrual cycle irregularities. The *Prevalence Ratio* (PR) value was 0.588 with a 95% confidence interval (0.396 – 0.873). This indicates that respondents with an overweight BMI were 0.588 times more likely to experience menstrual cycle disorders compared to respondents with a normal BMI.

DISCUSSION

The results of the study showed a significant relationship between physical activity and menstrual cycles in adolescent girls ($p = 0.036$; PR = 1.867; 95% CI: 1.097–3.178). Adolescents with moderate to heavy physical activity experienced more irregular menstrual cycles compared to those with light physical activity. This supports the theory that excessive physical activity can cause metabolic stress and energy imbalance, which reduces the secretion of the GnRH hormone in the hypothalamus and has an impact on decreasing the LH and FSH hormones, so that the ovulation process is disrupted and the menstrual cycle becomes irregular.

These findings align with previous research that found that increased training volume in young athletes was associated with a higher prevalence of menstrual disorders due to energy deficiency and hypothalamic dysfunction (Passoni, Inzoli, De Ponti, Polizzi, Ceccherelli, Fantauzzi, & Fruscio, 2024). However, these results differ from those that reported no significant association between physical activity and the menstrual cycle (Winarno, Putri, & Ningtyas, 2022). This difference is likely due to variations in respondent characteristics, measurement methods, and the physical activity assessment instruments used.

Physiologically, balanced physical activity plays a crucial role in maintaining fitness and stable

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Factors related to menstrual cycle irregularity in adolescent females

reproductive hormones. Light activities such as walking or stretching still provide benefits in improving blood circulation and reducing stress. Conversely, excessively strenuous activity without adequate energy intake and rest can trigger endocrine dysfunction and menstrual cycle disorders. In the modern context, decreased physical activity due to a sedentary lifestyle and the use of technology can also affect adolescent hormonal balance. Therefore, maintaining a balance between physical activity, diet, and rest is a crucial factor in maintaining a regular menstrual cycle in adolescent girls.

The results showed a significant relationship between stress levels and menstrual cycles in adolescent girls ($p = 0.038$; $PR = 2.786$; 95% CI: 0.946–5.062). Most respondents with moderate to severe stress levels experienced irregular menstrual cycles, while respondents with mild stress levels tended to have normal menstrual cycles. These findings suggest that increased stress levels are associated with an increased risk of menstrual cycle irregularities, thus stress can be considered a factor influencing the reproductive function of adolescent girls.

Physiologically, chronic stress activates the hypothalamic-pituitary-adrenal (HPA) axis, which plays a role in the body's response to psychological stress. Excessive activation of this system increases the secretion of the hormone cortisol by the adrenal glands. High cortisol levels provide negative feedback to the hypothalamus, thereby decreasing the secretion of gonadotropin-releasing hormone (GnRH). Decreased GnRH levels result in decreased production of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) in the anterior pituitary, both of which play a crucial role in follicle maturation and ovulation. This hormonal imbalance can lead to menstrual cycle disorders such as oligomenorrhea, polymenorrhea, and functional amenorrhea.

The results of this study align with other research reporting that adolescent girls with high stress levels have almost twice the risk of experiencing irregular menstrual cycles compared to those with low stress levels (Nuvitasari et al., 2020). Other research also shows a significant association between academic stress and menstrual disorders in high school students, particularly during exams (Nuvitasari, Susilaningih, & Kristiana, 2020). Furthermore, research conducted in Japan corroborates these

findings by showing that emotional stress due to academic and social demands contributes to an increased incidence of oligomenorrhea and dysmenorrhea in adolescent girls (Matsumoto, Egawa, Kimura, & Hayashi, 2021).

The ideal menstrual cycle is regular, lasting 21-35 days. Stress can affect menstrual cycle disorders. This study aims to determine the relationship between stress and menstrual cycle disorders. Menstrual cycle disorders are menstrual disorders that occur outside the normal menstrual cycle interval. Stress is a change in the body's reactions, both physically and emotionally. The type of research is correlational (Amalia, Budhiana, & Sanjaya, 2023).

The results showed a significant association between sleep quality and menstrual cycle regularity in adolescent girls ($p = 0.049$; $PR = 1.677$; 95% CI: 0.978–2.877). Sixty-five percent of respondents with poor sleep quality experienced irregular menstrual cycles, while 60.9 percent of respondents with good sleep quality experienced normal menstrual cycles. These findings indicate that poor sleep quality can potentially increase the risk of menstrual cycle disorders.

Adequate and quality sleep plays a crucial role in maintaining endocrine system stability, particularly in regulating melatonin secretion and maintaining the body's circadian rhythm. Melatonin, produced at night, functions as a biological time regulator that influences the reproductive system through its interaction with the hormones estrogen and progesterone. This hormone also modulates the release of gonadotropin-releasing hormone (GnRH), luteinizing hormone (LH), and follicle-stimulating hormone (FSH), which play a crucial role in ovulation and regulating the menstrual cycle.

This research aligns with previous studies that found that adolescents with low sleep quality have a higher risk of menstrual irregularities due to circadian rhythm disruption and decreased levels of the hormone's melatonin, estrogen, and progesterone (Efendi, Latifah, Lestari, & Basit, 2024). However, a different finding was found in a study at SMA Negeri 98 Jakarta, which reported no significant relationship between sleep quality and menstrual cycles ($p = 0.136$) (Moulinda, Imrar, Puspita, & Amar, 2023). This difference may be due to variations in respondent characteristics, measurement methods, and external factors such as academic stress, electronic device

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Factors related to menstrual cycle irregularity in adolescent females

use, and late-night sleeping habits that affect adolescents' sleep patterns.

Overall, the overwhelming scientific evidence suggests that sleep quality is a crucial factor in maintaining reproductive hormone balance. Persistent sleep disturbances not only affect the endocrine system but also increase psychological stress, which synergistically exacerbates menstrual cycle disorders. Therefore, promotional and preventive efforts are needed to raise adolescents' awareness of the importance of healthy sleep habits, such as maintaining 7–9 hours of sleep per night, reducing screen time before bed, and maintaining a regular sleep routine. Implementing good sleep habits is expected to help maintain hormonal balance and support menstrual cycle regularity in adolescent girls.

The menstrual cycle signifies the maturation of the reproductive organs and is related to a woman's fertility. Sleep quality and estrogen levels influence the menstrual cycle. Poor sleep quality can reduce melatonin production and lead to increased estrogen levels, thus affecting the menstrual cycle. The heavy academic load of medical students can potentially lead to lower sleep quality compared to the general population, which can lead to menstrual cycle disruptions (Siregar, Mustika, & Wardhani, 2022).

The results showed a significant relationship between body mass index (BMI) and menstrual cycles in adolescent girls ($p = 0.028$; $PR = 0.588$; 95% $CI: 0.396–0.873$). A total of 77.3% of respondents with an overweight BMI and 66.7% of respondents with an underweight BMI experienced irregular menstrual cycles, while 54.5% of respondents with a normal BMI had regular menstrual cycles. These findings confirm that weight balance plays an important role in maintaining menstrual cycle regularity.

Physiologically, adipose tissue not only functions as an energy storage site but also as an endocrine organ that actively produces hormones and enzymes, including aromatase, which plays a role in converting androgens to estrogens. Estrogen produced by adipose tissue influences the feedback mechanism in the hypothalamic-pituitary-ovarian (HHO) axis, which regulates the secretion of gonadotropin-releasing hormone (GnRH), luteinizing hormone (LH), and follicle-stimulating hormone (FSH). An imbalance in the amount of adipose tissue, whether too little or too much, can disrupt the function of the HHO axis and

cause ovulation disorders, resulting in irregular menstrual cycles.

The results of this study are consistent with other findings explaining that extreme BMI, both low and high, can affect hormonal balance through changes in leptin and estrogen levels produced by fat tissue. Individuals with a high BMI tend to have excess peripheral estrogen levels that suppress GnRH secretion and inhibit ovulation. Conversely, individuals with a low BMI have decreased leptin levels, so that signals to the hypothalamus to activate reproductive function are disrupted, which can cause amenorrhea or prolonged menstrual cycles (Purwati & Rahmi, 2023). However, different results were reported by a study at Sam Ratulangi University which found no significant relationship between BMI and menstrual cycles ($p = 0.667$) (Hasibuan, Pangkahila, & Doda, 2026). This difference is likely due to variations in population characteristics, stress factors, physical activity levels, or genetic differences that affect hormone sensitivity to changes in body weight.

Further analysis showed that respondents with a high BMI were more likely to experience disorders such as polymenorrhea or oligomenorrhea, indicating hormonal dysfunction due to excess fat accumulation. Weight loss of 5–10% of baseline body weight has been shown to improve insulin sensitivity, normalize reproductive hormone levels, restore ovulation, and stabilize menstrual cycles, especially in individuals with obesity or polycystic ovary syndrome (PCOS). Conversely, increasing calorie intake in individuals with a low body weight can help improve GnRH secretion in the hypothalamus and restore a normal menstrual cycle.

CONCLUSION

Based on a study of 87 female students, it was found that the majority of respondents experienced irregular menstrual cycles (58.6%), while 41.4% of female students had normal cycles. The analysis results showed a relationship between several factors and menstrual cycle regularity. Physical activity was significantly related to menstrual cycles ($p = 0.035$), where female students with light activity were more likely to have regular cycles compared to those with moderate or heavy activity. Stress levels also showed a significant relationship ($p = 0.038$), where high stress increased the risk of menstrual disorders.

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Sleep quality had a significant influence ($p = 0.049$), with female students with poor sleep quality being at greater risk of experiencing irregular cycles. In addition, body mass index (BMI) was related to cycle regularity ($p = 0.028$), where female students with underweight or overweight BMI were more susceptible to menstrual disorders compared to female students with normal BMI.

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