

Association of Physical Activity, Depression, Anxiety, and Stress with Menstrual Cycle Regularity among Adolescents: A Cross-Sectional Study

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ARTICLE INFO

Article History:

Received: 2025-09-11
Accepted: 2026-01-05
Published: 2026-03-30

Keywords:

Anxiety;
Depression; Menstrual
cycle; Physical activity;
Stress

ABSTRACT

Background: A regular menstrual cycle is an important indicator of adolescent reproductive health. Menstrual irregularities may reflect underlying physical and psychological problems. Evidence regarding the influence of physical activity and psychological factors on menstrual cycle regularity among adolescents remains inconsistent. This study aimed to examine the association of physical activity, depression, anxiety, and stress with menstrual cycle regularity among adolescents.

Methods: A quantitative cross-sectional study was conducted among 74 female adolescents selected through purposive sampling. Inclusion criteria were post-menarche adolescents who consented to participate, while those with a history of congenital gynecological disorders were excluded. Physical activity was measured using the International Physical Activity Questionnaire–Short Form (IPAQ-SF), while depression, anxiety, and stress were assessed using the Depression Anxiety Stress Scale (DASS-42). Menstrual cycle regularity was defined as a cycle length of 21–35 days with ≤ 7 days variation. Data were analyzed using chi-square tests and odds ratios (OR).

Results: Most respondents (71.6%) had a regular menstrual cycle. Physical activity was significantly associated with menstrual cycle regularity ($p = 0.001$). Depression, anxiety, and stress were also significantly associated with menstrual cycle regularity ($p < 0.05$), with anxiety showing the strongest association ($OR = 9.444$).

Conclusion: Physical activity and psychological factors were significantly associated with menstrual cycle regularity among adolescents, with anxiety as the strongest factor. School-based physical activity and mental health support may help promote menstrual health. Longitudinal studies are needed to confirm causal relationships.



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INTRODUCTION

The female reproductive system is characterized by regular cyclical changes known as the menstrual cycle. Menarche generally occurs at an average age of 13 years (range 11–15 years) (Mohebi et al., 2018), and a normal menstrual cycle occurs regularly every 21–35 days (Amalia et al., 2023). This regularity is maintained by the hypothalamic-pituitary-ovarian (HPO) axis with hormonal feedback loops, leading to ovulation and, in the absence of fertilization, shedding of the endometrial lining (Itriyeva, 2022). Menstruating regularly is an important health sign among adolescents, and recognizing abnormal patterns may enable early detection of anovulatory cycles, polycystic ovary syndrome (PCOS), and infertility (Gruber & Modan-Moses, 2021).

The menstrual cycle is influenced by various factors, including serious medical conditions, body mass index (BMI), psychological disorders, metabolic disorders such as diabetes mellitus,

hormonal imbalances, and abnormalities in the central nervous system–hypothalamus–pituitary axis (Sartika et al., 2024). Adolescents experiencing psychological impacts may suffer from anxiety, depression, and stress. These conditions, along with nutritional status and lifestyle factors, can disrupt FSH, estrogen, and progesterone levels, resulting in irregular menstruation (Sopha et al., 2021). Anxiety, as a form of psychological stress, affects the nervous system and endocrine glands, leading to altered gonadotropin hormone secretion that impacts the menstrual process (Abeputri et al., 2023).

Environmental and lifestyle factors, such as age, weight, physical activity, diet, caffeine consumption, smoking, exposure to organic solvents, occupation, and sleep duration, can affect menstrual flow, integrity, and regularity (Attia et al., 2023). Research indicates that BMI, nutritional status, sleep, hormonal disorders, physical activity, and mental health issues, including mood changes, depression, and stress, can contribute to menstrual cycle disorders (Park & Jung, 2021; Distyvanya et al., 2024).

Although numerous studies on menstrual disorders have been conducted globally, evidence on how psychological factors and lifestyle collectively influence the regularity of menstrual cycles among Indonesian adolescents remains limited. Addressing this research gap is essential for developing effective interventions to improve reproductive health in this population.

To date, the city of Bandar Lampung lacks official data on menstrual cycles among adolescents. Preliminary data from a survey at SMP 10 and SMK 4 Bandar Lampung involving 20 menstruating students showed that nearly 50% of adolescents reported experiencing irregular menstrual cycles. Among them, six students rarely engaged in physical activity, and four experienced irregular cycles during stress and anxiety, particularly around exams. Considering the potential health impacts of menstrual irregularities, studying menstrual cycles in Indonesian adolescents and their influencing factors is important. Considering the various potential impacts that may arise from menstrual irregularities, this study aims to examine the association of physical activity, depression, anxiety, and stress with menstrual cycle regularity among adolescent girl

METHODS

The type of research conducted was quantitative with a cross-sectional approach. We analyzed the menstrual cycles of students at Public Junior High School (SMP) 10 and Public Vocational High School (SMK) 4 from October to December 2024 with a total of 74 students. In this study, we employed purposive sampling, which is a non-probability sampling method where participants are selected based on specific inclusion criteria. Therefore, a formal statistical calculation for minimum sample size was not performed. All students who met the eligibility criteria during the study period were invited to participate, resulting in a total of 74 students. The inclusion criteria in this study were all students who had experienced menstruation and were willing to participate as respondents.

The exclusion criteria included students who had not yet experienced their first menstruation and those with a history of congenital gynecological conditions. The independent variables were physical activity, depression, anxiety, and stress, while the dependent variable was the menstrual cycle regularity. Operational definitions were applied as follows: a “regular” menstrual cycle was defined as occurring every 21–35 days with a variation of ± 7 days between cycles, while an “irregular” cycle was defined as < 21 days, > 35 days, or a variation > 7 days between cycles. Menstrual patterns were assessed based on self-reported data from the past three months to minimize recall bias.

Data collection was carried out using a questionnaire containing respondent characteristics, including age (Sulaeman, R., Purnamawati, D., Kep, M., Purwana, E. R., & ST, 2022), age at menarche (Octavia, Y. T., Astyandini, B., SiT, S., Fitria, N. E., ST, S., Kusumawardani, E., & ST, 2023), and nutritional status measured through height and weight, physical activity assessed using the International *Physical Activity Questionnaire* (IPAQ short) (Edwards & Loprinzi, 2019), depression, anxiety and stress assessed with the *Depression Anxiety Stress Scale* (DASS-

42)(NovoPsych, 2018), and menstrual cycle. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0.

Descriptive statistics were presented as frequencies and percentages. Bivariate analysis was conducted using the chi-square test to examine the associations between physical activity, depression, anxiety, stress, and menstrual cycle regularity. The study employed only the chi-square test to assess bivariate associations between categorical variables. Multivariate analysis was not conducted because the primary objective of the study was exploratory, focusing on direct associations rather than controlling for confounding variables or identifying dominant predictors. The strength of associations was quantified using odds ratios (OR) with 95% confidence intervals (CIs), which were calculated to estimate the likelihood of menstrual cycle irregularity associated with each independent variable. A p-value of <0.05 was considered statistically significant.(IBM, 2018)(Lolombulan, 2020). In the bivariate analysis, the researchers simplified emotional status into two categories: normal and depressed (mild, moderate, severe, and very severe), anxious (mild, moderate, severe, and very severe), and stressed (mild, moderate, severe, and very severe). Psychological variables (depression, anxiety, and stress) were dichotomized based on established cutoff scores to categorize respondents into normal and elevated levels, facilitating interpretation and statistical comparison. Ethical statement This research obtained ethical clearance from the Health Research Ethics Committee of Malahayati University at Lampung, Indonesia, and has been issued an ethical clearance letter with the number: 4558/EC/KEP-UNMAL/IX/2024

RESULTS

Table 1. Frequency Distribution of Respondent Characteristics

Variables	n	%
Age		
11 – 14 years	35	47.3
15 – 17 years	39	52.7
Age at menarche		
Early < 12 years	33	44.6
Normal 12 – 16 years	41	55.4
Nutritional status		
Underweight	24	32.4
Normal	40	54.1
Overweight	10	13.5

Tabel 1 Based on the distribution of respondent characteristics 39 (52.7%) respondents were aged 15–17 years, 41 (55.4%) experienced menarche at a normal age of 12–16 years, and 40 (54.1%) respondents had normal nutritional status.

Table 2. Univariate Analysis of Factors Associated with the Menstrual Cycle

Variables	n	%
Physical Activity		
Light (MET < 600 MET-min/week)	39	52.7
Moderate (≥ 600 MET-min/week)	23	31.1
Heavy (≥ 3000 MET-min/week)	12	16.2
Depression		
Normal (0–9)	55	74.3
Mild (10–13)	9	12.2
Moderate (14–20)	5	6.8
Severe (21–27)	4	5.4
Very Severe (28+)	1	1.4
Anxiety		
Normal (0–7)	18	24.3
Mild (8–9)	5	6.8
Moderate (10–14)	24	32.4
Severe (15–19)	17	23.0

Variables	n	%
Very Severe (20+)	10	13.5
Stress		
Normal (0-14)	39	52.7
Mild (15-18)	10	13.5
Moderate (19-25)	15	20.3
Severe (26-33)	9	12.2
Very Severe (34+)	1	1.4
Menstrual Cycle		
Regular (21-35 days)	53	71.6
Irregular (<21 and >35 days)	21	28.4

The univariate analysis showed that 39 (52.7%) adolescents had light physical activity (MET < 600 MET-min/week), 55 (74.3%) did not experience depression (normal), 24 (32.4%) adolescents experienced moderate anxiety (score 10-14), 39 (52.7%) did not experience stress (normal, score 0-14), and 53 (71.6%) adolescents had a regular menstrual cycle (21-35 days).

Table 3. Bivariate Analysis of Factors Associated with the Menstrual Cycle

Variable	Menstrual Cycle						p-value	OR (95%CI)
	Regular		Irregular		Total			
	n	%	n	%	n	%		
Physical Activity								
Light	36	92.3	3	7.7	39	100	0.001	
Moderate	12	52.2	11	47.8	23	100		
Heavy	5	41.7	7	58.3	12	100		
Depression							3.225 (1.068-9.734)	
Normal	43	78.2	12	21.8	55	100		
Depressed	10	52.6	9	47.4	19	100		
Anxiety							9.444 (1.169-76.323)	
Normal	17	94.4	1	5.6	18	100		
Anxious	36	64.3	20	35.7	56	100		
Stress							4.125 (1.376-12.363)	
Normal	33	84.6	6	15.4	39	100		
Stress	20	57.1	15	42.9	35	100		

The findings indicate that physical activity was significantly associated with menstrual cycle regularity ($p = 0.001$). A substantial proportion of respondents who engaged in physical activity exhibited a regular menstrual cycle, suggesting that physical activity may play a role in maintaining menstrual regularity. Psychological factors also demonstrated significant associations with menstrual cycle regularity. Adolescents who did not experience depression were more likely to have a regular menstrual cycle compared to those who experienced depressive symptoms ($OR = 3.225$; $p = 0.033$), indicating that depression increased the likelihood of menstrual cycle irregularity. A stronger association was observed for anxiety, where adolescents without anxiety were markedly more likely to have a regular menstrual cycle ($OR = 9.444$; $p = 0.014$), suggesting that anxiety had the greatest impact among the psychological variables examined. Similarly, stress was significantly associated with menstrual cycle irregularity ($OR = 4.125$; $p = 0.011$), with a higher proportion of stressed adolescents experiencing irregular menstrual cycles. Comparatively, anxiety showed the highest odds ratio, followed by stress and depression, indicating varying magnitudes of psychological influence on menstrual cycle regularity. These findings underscore the importance of psychological well-being in adolescent menstrual health.

DISCUSSION

This study demonstrated significant associations between physical activity, depression, anxiety, and stress with menstrual cycle regularity among adolescents. These findings indicate that both lifestyle and psychological factors play important roles in menstrual health.

Physical activity was found to be significantly associated with menstrual cycle regularity. Adolescents who engaged in physical activity tended to have more regular menstrual cycles. However, previous studies have shown that excessive or intense physical activity may lead to hypothalamic dysfunction due to energy imbalance, which disrupts gonadotropin-releasing hormone (GnRH) pulsatility and subsequently affects menstrual regulation (Bakhri & Wijayanti, 2021).

This study is in line with the research entitled *Physical Activity and the Menstrual Cycle: A Mixed-Methods Study of Women's Experiences*, From the questionnaire data, 44 participants were categorized as avoiders and 84 as nonavoiders of physical activity due to menstrual events. Avoiders of physical activity reported longer periods, heavier menstrual flow, and higher levels of fatigue and pain compared with nonavoiders. which reported that women who avoided physical activity during menstruation experienced longer menstrual periods, heavier bleeding, and greater fatigue compared to non-avoiders. These results suggest that while physical activity is generally beneficial, its intensity and individual adaptation play a crucial role in maintaining menstrual regularity (Kolić et al., 2021).

Psychological factors also showed significant associations with menstrual cycle regularity. Adolescents who did not experience depression were more likely to have regular menstrual cycles, indicating that depressive symptoms may increase the risk of menstrual irregularities. This finding is supported by previous research showing that depression and menstrual cycle disturbances are interconnected through hormonal changes and dysregulation of the hypothalamic–pituitary axis (Maurya et al., 2022). Although the association between depression and menstrual cycle irregularity was significant, the odds ratio was lower compared to anxiety and stress, which may reflect the relatively mild levels of depressive symptoms among most respondents.

Among the psychological variables examined, anxiety demonstrated the strongest association with menstrual cycle irregularity, as indicated by the highest odds ratio. Anxiety has been associated with physiological, emotional, and metabolic changes during puberty that may disrupt menstrual regulation (Silalahi, 2021). Emotional tension and anxiety can affect the brain centers responsible for stress and reproductive hormone regulation, thereby increasing the likelihood of irregular or temporarily absent menstrual cycles (Baadiyah et al., 2021). These findings suggest that anxiety may exert a more immediate or intense neuroendocrine impact on menstrual function compared to depression.

Stress was also significantly associated with menstrual cycle irregularity. Psychological stress has been linked to alterations in cycle length, variability, and menstrual pain through dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis (Attia et al., 2023). In adolescent females, psychological stress caused by studies and high-stakes exams may lead to prolonged activation of the HPA axis, resulting in menstrual cycle irregularities (Gao et al., 2025). Mechanistically, activation of the HPA axis increases cortisol secretion, which can suppress hypothalamic gonadotropin-releasing hormone (GnRH) secretion. This suppression subsequently reduces luteinizing hormone (LH) and follicle-stimulating hormone (FSH) secretion from the pituitary, leading to hormonal imbalances that disrupt ovulation and normal menstrual cycles (Phumsatitpong, C., Wagenmaker, E. R., & Moenter, 2021). This mechanism may explain the relatively high proportion of irregular menstrual cycles observed among respondents experiencing stress.

Despite relatively normal levels of depression among participants, irregular menstrual cycles were still common, suggesting that menstrual irregularity is a multifactorial condition influenced by the interaction of physical activity and psychological stressors rather than a single factor alone. Although other factors such as hemoglobin levels, sleep quality, and moringa leaf tea consumption have been reported to influence the menstrual cycle (Naila Fauziah, 2022; Siregar et al., 2022). These variables were not measured in the present study and therefore could not be analyzed further.

This study provides valuable insights into the combined influence of physical activity and psychological factors on menstrual cycle regularity among Indonesian adolescent girls. Unlike previous research that often examined these factors separately, this study highlights the

interaction between lifestyle and mental health in menstrual regulation. By identifying anxiety as the strongest psychological predictor, alongside physical activity, the findings offer a foundation for targeted interventions to support adolescent reproductive health. Furthermore, the study addresses a research gap in Bandar Lampung, providing evidence that can inform school-based health programs and public health policies aimed at promoting menstrual well-being.

This study has several limitations. The use of self-reported data may have introduced recall bias, and the purposive sampling method limits the generalizability of the findings. Additionally, potential confounding factors were not fully assessed. Future studies with larger sample sizes and more comprehensive analytical approaches are recommended to further clarify the complex relationships between physical activity, psychological factors, and menstrual cycle regularity.

CONCLUSION

The menstrual cycle is ideally regular, occurring every 21–35 days. This study demonstrates significant associations between physical activity, depression, anxiety, and stress with menstrual cycle regularity ($p < 0.05$), with anxiety showing the strongest association. These findings highlight the importance of integrating mental health assessment into adolescent reproductive health programs. School-based health counseling, including routine screening for anxiety, stress, and menstrual problems, may contribute to early detection and effective management of menstrual disorders. Further longitudinal studies are needed to clarify causal relationships and temporal changes in menstrual cycle patterns.

Author's Contribution: **Sunarsih:** Conceptualization and Methodology, **Ana Mariza:** investigation, writing-review and editing, **Susilawati:** investigation, writing-review and editing

Acknowledgments: The authors would like to thank Universitas Malahayati for granting permission and assisting in the ethical clearance process, as well as for their support in this research, which is part of the Tri Dharma of Higher Education program. We also express our gratitude to the principals of SMPN 10 and SMKN 14, and we extend our thanks to the entire team for their participation and collaboration.

Source of Funding: This research received no external funding.

Conflicts of Interest: The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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