

Lifestyle Factors Associated with Premenstrual Syndrome among Female Students Islamic Boarding School

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ABSTRACT

Background: Premenstrual syndrome (PMS) is one of the most common reproductive health problems among female adolescents. Lifestyle-related factors, including dietary habits, physical activity, sleep quality, and psychological stress, are considered modifiable determinants of PMS. This study aims to analyze the association between these lifestyle-related factors and PMS among female adolescents in an Indonesian Islamic boarding school, which remains underexplored in previous research.

Method: This quantitative cross-sectional study involved 90 female adolescents residing at Al-Amin Islamic Boarding School, Banyumas Regency, Indonesia. Respondents were selected using simple random sampling. PMS was assessed using the Shortened Premenstrual Assessment Form (SPAF), while lifestyle variables (fast-food consumption, physical activity, sleep quality, and perceived stress) were measured using standardized questionnaires. Data analyses employed descriptive statistics, Chi-square tests, and multiple logistic regression, with statistical significance determined at $p < 0.05$.

Result: The findings showed a high prevalence of severe PMS at 55.6%. Bivariate analysis indicated significant associations between fast-food consumption ($p=0.040$), sleep quality ($p=0.001$), stress level ($p<0.001$), and PMS, whereas physical activity was not significantly related to PMS ($p=0.508$). Multiple logistic regression identified poor sleep quality ($AOR=3.867$; $95\%CI:1.465-10.204$) and high stress level ($AOR=6.468$; $95\%CI:1.883-22.223$) as independent predictors of PMS, with stress representing the strongest determinant. These findings suggest that interventions focusing on stress management and sleep improvement should be incorporated into adolescent reproductive health promotion programs, particularly in Islamic boarding school settings.

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INTRODUCTION

Adolescence is a critical developmental period marked by profound changes in physical, psychological, emotional, and social aspects of life. Menstruation represents an important milestone of reproductive maturation for female adolescents, yet many suffer from menstrual-related problems that adversely affect their quality of life, school attendance, academic performance, and psychosocial well-being.(1) According to the American College of Obstetricians and Gynecologists (ACOG, 2023), premenstrual Syndrome (PMS) is one of the most common menstrual health problems among adolescents, characterized by recurrent physical, emotional, cognitive, and behavioral symptoms occurring during the luteal phase of the menstrual cycle and resolving shortly after menstruation begins. As a consequence, PMS has become an important public health concern because it may impair

adolescents' educational achievement, emotional well-being, social participation, and overall quality of life.(2-4)

Globally, 50-90% of women experience at least one premenstrual symptom during their reproductive years, while approximately one-third of this population report symptoms severe enough to interfere with their daily activities.(5)(6) According to a recent systematic review, the prevalence of PMS among adolescents exceeds 60%, although considerable variation exists across countries due to differences in diagnostic criteria, sociocultural characteristics, and population profiles.(7) Similarly, studies conducted in Indonesia have reported a prevalence of 60-85% among female adolescents.(8-10) Despite this substantial burden, menstrual health literacy among Indonesian adolescents remains inadequate. Many adolescents in this country perceive PMS as a normal part of menstruation rather than a condition that requires proper management. Consequently, reproductive health education

and healthcare utilization for menstrual problems remain suboptimal. This emphasizes the need for strengthening school-based reproductive health promotion programs.

The development of PMS is multifactorial, involving complex interactions among biological, psychological, behavioral, and environmental aspects. Besides hormonal fluctuations, several modifiable lifestyle factors—including dietary habits, physical activity, sleep quality, and psychological stress—may influence the occurrence and severity of PMS symptoms during adolescence.(11)(12) Since these elements can be addressed through health promotion and behavioral interventions, determining the most contributing lifestyle-related factors is essential for designing evidence-based strategies to improve adolescent reproductive health. Nevertheless, previous studies have reported inconsistent findings regarding how these lifestyle factors contribute to PMS, suggesting that these associations may vary across populations and living environments.(7)(13)

Female adolescents living in Islamic boarding schools (pesantren) represent a population that deserves particular attention. Unlike those attending conventional schools who live with their families, boarding school students live in structured residential environments with intensive academic schedules, religious obligations, communal living, and limited personal space, all of which may influence their lifestyle behaviors, psychological well-being, sleep patterns, and menstrual health.(14–18) Since their students share similar environmental exposures and daily routines, boarding schools provide a crucial setting for the implementation of comprehensive health promotion programs.

While PMS among female adolescents in Indonesian Islamic boarding schools has been investigated in prior research, most studies only examine the prevalence of PMS or focus solely on a single contributory factor, e.g., stress, sleep quality, nutritional status, menstrual characteristics, or menstrual hygiene.(16)(19–22) In addition, many related studies rely primarily on bivariate analyses and rarely evaluate multiple modifiable lifestyle factors simultaneously. Consequently, there is scant evidence on lifestyle-related factors independently associated with PMS among adolescents living in Islamic boarding schools. Moreover, limited studies have explored PMS from a public health promotion perspective by identifying modifiable behavioral determinants that may inform comprehensive school-based reproductive health interventions. Therefore, to develop context-specific health promotion strategies tailored to the unique boarding school environment, it is essential to address these gaps.

This study analyzes the association between multiple lifestyle factors—i.e., fast-food consumption, physical activity, sleep quality, and perceived stress—and Premenstrual Syndrome (PMS) among female adolescents residing in an Islamic boarding school in Banyumas Regency, Indonesia. By simultaneously evaluating several modifiable behavioral factors using multivariable analysis within a boarding school setting, this study extends the existing literature and provides valuable evidence to support the development of comprehensive reproductive health promotion programs aimed at improving adolescents' menstrual health and overall well-being.

METHOD

This analytical observational study employed a cross-sectional design to examine the association between lifestyle factors and Premenstrual Syndrome (PMS) among female adolescents. Data collection was carried out between February and March 2026 at Al-Amin Islamic Boarding School, Pabuwaran Village, Banyumas Regency, Central Java, Indonesia. This boarding school provides a relatively homogeneous residential environment in which students share similar academic schedules, dietary patterns, daily routines, and living conditions, allowing a more thorough assessment of lifestyle-related factors affecting PMS. The boarding school accommodates both senior high school students and university students who continue to reside in the boarding school while pursuing higher education.

Prior to data collection, ethical approval was obtained from the Health Research Ethics Committee, Faculty of Health Sciences, Universitas Jenderal Soedirman (Approval No. 2179/EC/KEPK/I/2026), and permission to conduct the study was gained from the Principal of Al-Amin Islamic Boarding School. Before giving written informed consent in accordance with the procedures approved by the Ethics Committee, all eligible respondents were provided with a complete explanation of the study objectives, procedures, confidentiality, and the voluntary nature of participation. They were also informed that they could decline or withdraw from the study at any time without any consequences. All study procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki.

The study population is unmarried female adolescents living in the same residential environment, consisting of 174 female adolescents residing at Al-Amin Islamic Boarding School who have experienced menarche. Sample size was calculated using the formula for comparing two population proportions in an analytical cross-sectional study, assuming a 95% confidence level

and 80% statistical power, with an additional 10% allowance for possible non-response. This results in a minimum required sample of 90 respondents. Respondents were selected using simple random sampling, ensuring that each eligible student had an equal probability of selection. Inclusion criteria were female adolescents who had experienced menstruation for at least two years, were willing to participate in this study, and completed all study questionnaires. Adolescents with chronic diseases, endocrine disorders, hormonal therapy, and/or diagnosed gynecological disorders affecting menstrual cycles, as well as incomplete questionnaire responses, were excluded.

In this study, the dependent variable was Premenstrual Syndrome (PMS), while the independent variables were fast-food consumption, physical activity, sleep quality, and perceived stress. Respondents' characteristics, including age, educational level, monthly allowance, and age at menarche, were collected as descriptive variables. Operational definitions and categorizations were established before data collection. Age was distinguished into early (10–14 years), middle (15–17 years), and late adolescence (18–24 years) based on the classification from the Indonesian National Population and Family Planning Agency (Badan Kependudukan dan Keluarga Berencana Nasional/BKKBN), which defines adolescents as unmarried individuals aged between 10 and 24 years. Monthly allowance was categorized using the sample mean ($< \text{IDR } 998,667$ and $\geq \text{IDR } 998,667$), whereas age at menarche was classified as early (< 12 years), normal (12–14 years), and late (> 14 years). Furthermore, PMS severity was categorized as mild (SPAF score < 30) and severe (SPAF score ≥ 30). Fast-food consumption was categorized into low and high groups. The categorization for this variable used the sample median because the distribution of scores was non-normal. Meanwhile, physical activity was classified as low (< 600 MET-min/week), moderate (600–3000 MET-min/week), and high (> 3000 MET-min/week); sleep quality was distinguished as good (PSQI ≤ 5) or poor (PSQI > 5); whereas perceived stress was categorized as low (0–13), moderate (14–26), and high (27–40) according to the respective instrument guidelines.

Premenstrual Syndrome was assessed using the Indonesian version of the Shortened Premenstrual Assessment Form (SPAF), a validated screening instrument developed by Allen et al. consisting of 10 items that represent affective symptoms, pain symptoms, and water-retention symptoms. Each item was scored on a six-point Likert scale ranging from 1 (no symptoms) to 6 (very severe symptoms), with higher scores indicating greater symptom severity. Respondents with a total score of ≥ 30

were classified as having severe PMS. Since this study employed a cross-sectional design, PMS symptoms were assessed retrospectively using a single administration of the SPAF questionnaire and were not prospectively recorded across consecutive menstrual cycles. Therefore, SPAF was used to identify probable PMS symptoms rather than to establish a clinically confirmed diagnosis of PMS. In this study, the instrument demonstrated excellent internal consistency (Cronbach's $\alpha = 0.897$).

Fast-food consumption was evaluated using a Food Frequency Questionnaire (FFQ) consisting of 10 food items, namely sugar-sweetened beverages, commercially prepared sugar-sweetened coffee beverages, fried fast foods, instant noodles, hamburgers, pizza, sausages or hotdogs, fried chicken, French fries, and commercially prepared desserts. The questionnaire had good internal consistency (Cronbach's $\alpha = 0.854$). Respondents reported the frequency of consumption during the previous seven days. For this variable, the distribution of total scores was non-normal. Thus, respondents were categorized into low and high fast-food consumption groups using the sample median as the cut-off point.

Physical activity was estimated using the International Physical Activity Questionnaire–Short Form (IPAQ-SF), which comprises seven items measuring vigorous-intensity activity, moderate-intensity activity, walking, and sedentary behavior during the previous seven days. Activity levels were converted into Metabolic Equivalent of Task (MET)-minutes per week according to the official IPAQ scoring protocol and categorized as low, moderate, or high physical activity. The IPAQ-SF has been widely recommended for population-based physical activity assessment due to its satisfactory validity and reliability across multiple populations.

Sleep quality was assessed using the Indonesian-adapted Pittsburgh Sleep Quality Index (PSQI), comprising 19 items that evaluate seven components of sleep quality: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Global scores range from 0 to 21, with higher scores indicating poorer sleep quality. Respondents with a global score > 5 were categorized as having poor sleep quality. In this study, the PSQI showed acceptable internal consistency (Cronbach's $\alpha = 0.725$).

Lastly, perceived stress was measured using the Indonesian version of the Perceived Stress Scale (PSS-10), a standardized instrument consisting of 10 items scored on a five-point Likert scale ranging from 0 (never) to 4 (very often). Four positively worded items were reverse-scored

before calculating the total score. Higher scores indicate greater perceived stress. Respondents were categorized into low, moderate, and high stress according to the standard PSS classification. In this study, the PSS demonstrated excellent internal consistency (Cronbach's $\alpha = 0.925$). For this variable, only 14 respondents were classified as having high stress, resulting in a small cell size. Thus, for the logistic regression analysis, respondents with moderate and high perceived stress were combined into a single category. Combining these categories improved the stability of the regression estimates while preserving the ordinal interpretation of stress severity.

Before carrying out the main survey, all questionnaires were pilot-tested among 30 female adolescents from another Islamic boarding school with characteristics comparable to the study population. Pearson's correlation analysis was employed to assess item validity. The results showed that all questionnaire items had correlation coefficients exceeding the critical value ($r > 0.361$). Furthermore, reliability testing results indicated that all study instruments achieved Cronbach's alpha coefficients above the acceptable threshold, confirming their suitability for data collection.

Data were collected using anonymous self-administered questionnaires completed during scheduled sessions at the boarding school. To facilitate participant attendance and stick to the regular boarding school schedule, the data collection process was coordinated with boarding school administrators, who provided their assistance only in organizing respondents; they were not involved in explaining the questionnaires, influencing respondents' responses, or accessing completed questionnaires. Completed questionnaires were returned directly to the research team, checked for completeness before data entry, and stored securely to maintain confidentiality.

Statistical analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Respondents' characteristics and study variables were summarized using descriptive statistics. A chi-square test was used to examine the associations between the independent variables and PMS. To identify factors independently linked to severe PMS, variables with p -values < 0.25 in the bivariate analysis were assessed using a multiple logistic regression model with the backward likelihood ratio method to establish the final model by

sequentially removing variables that did not contribute significantly to model fit. The strength of associations was expressed as adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs). Statistical significance was established at $p < 0.05$. The multivariable model only included variables that met the predefined selection criterion ($p < 0.25$). Therefore, the adjusted estimates should be interpreted within the context of the variables included in the analysis.

RESULT AND DISCUSSION

A total of 90 unmarried female adolescents participated in this study, with a mean age of $19.87 \pm X.XX$ years (ranging between 15 and 23 years). According to BKKBN's age classification, most respondents were categorized as late adolescents (91.1%). More than half of them experienced menarche at the normal age (53.3%), whereas 32.2% reported early menarche. The majority of respondents were university students residing at the Islamic boarding school (83.3%) and received a monthly allowance of at least IDR 998,667 (64.4%). Regarding the study variables, more than half of the respondents (55.6%) experienced severe Premenstrual Syndrome (PMS) and reported high fast-food consumption (53.3%), moderate physical activity (56.7%), poor sleep quality (57.8%), and moderate perceived stress (71.1%). The sociodemographic characteristics of research respondents and distribution of study variables are presented in Table 1.

Factors associated with premenstrual syndrome

Bivariate analysis indicated that fast-food consumption, sleep quality, and perceived stress were significantly associated with PMS severity. Severe PMS mostly occurred in adolescents with high fast-food consumption, compared to those with low consumption (66.7% vs. 42.9%; $p = 0.040$). Similarly, severe PMS was more prevalent in respondents with poor sleep quality than in those with good sleep quality (71.2% vs. 34.2%; $p = 0.001$). Perceived stress also showed a clear dose-response pattern, with the proportion of severe PMS increasing from 8.3% among respondents with low stress to 85.7% among those with high stress ($p < 0.001$). Conversely, in contrast to other variables, physical activity was not significantly associated with PMS severity ($p = 0.508$). The results of the bivariate analyses of research variables are displayed in Table 2.

Table 1. Sociodemographic characteristics and distribution of study variables among female adolescents (n = 90)

Category	f	%
Age		
Middle adolescence	8	8.9
Late adolescence	82	91.1
Age at menarche		
Early	29	32.2
Normal	48	53.3
Late	13	14.4
Education		
Junior high	2	2.2
Senior high	13	14.4
College	75	83.3
Monthly allowance		
Low	32	35.6
High	58	64.4
Premenstrual syndrome		
Mild	40	44.4
Severe	50	55.6
Fast-food consumption		
Low	42	46.7
High	48	53.3
Physical activity		
Low	21	23.3
Moderate	51	56.7
High	18	20.0
Sleep quality		
Good	38	42.2
Poor	52	57.8
Perceived stress		
Low	12	13.3
Moderate	64	71.1
High	14	15.6

Table 2. Bivariate analysis of lifestyle factors associated with premenstrual syndrome among female adolescents

Variables	Mild PMS		Severe PMS		Total		P-value
	n	%	n	%	n	%	
Fast-food Consumption							
Low	24	57.1	18	42.9	42	100	0.040
High	16	33.3	32	66.7	48	100	
Physical Activity							
Low	9	42.9	12	57.1	21	100	0.508
Moderate	25	49.0	26	51.0	51	100	
High	6	33.3	12	66.7	18	100	
Sleep Quality							
Good	25	65.8	13	34.2	38	100	0.001
Poor	15	28.8	37	71.2	52	100	
Perceived Stress							
Low	11	91.7	1	8.3	12	100	<0.001
Moderate	27	42.2	37	57.8	64	100	
High	2	14.3	12	85.7	14	100	

Table 3. Multiple logistic regression analysis of factors associated with premenstrual syndrome

Variable	B	SE	Wald	AOR	95% CI	P-value
Poor sleep quality	1.352	0.495	7.463	3.867	1.465–10.204	0.006
Moderate/High perceived stress	1.867	0.630	8.789	6.468	1.883–22.223	0.003

Multivariable analysis

Following the bivariate analyses, variables with $p < 0.25$ (fast-food consumption, sleep quality, and perceived stress) were further examined using the initial multivariable logistic regression with the backward likelihood ratio method. During model selection, the variable of fast-food consumption did not remain statistically associated with severe PMS, thus being excluded from the analysis. Therefore, the final model only included poor sleep quality and perceived stress as factors independently associated with severe PMS. Compared to adolescents with good sleep quality, those with poor sleep quality were 3.87 times more likely to experience severe PMS (AOR = 3.867; 95% CI: 1.465–10.204; $p = 0.006$). Likewise, respondents with moderate or high perceived stress had 6.47-fold higher odds of severe PMS than those with low perceived stress (AOR = 6.468; 95% CI: 1.883–22.223; $p = 0.003$). Table 3 shows the results of the multiple logistic regression analysis.

Based on the results of the analyses, poor sleep quality and higher perceived stress are independently associated with severe Premenstrual Syndrome (PMS) among female adolescents residing in an Islamic boarding school. Adolescents with poor sleep quality have nearly fourfold higher odds of experiencing severe PMS, whereas those with moderate or high perceived stress had more than sixfold higher odds. In contrast, after conducting the multivariable analyses, this study has found that fast-food consumption and physical activity are not independently associated with PMS. These findings suggest that sleep quality and psychological well-being may be considered critical factors affecting PMS among adolescents attending boarding schools.

Poor sleep quality has been found to independently affect PMS. Adolescents with poor sleep quality have approximately 3.9 times higher possibility of experiencing severe PMS than those with good sleep quality. This finding is consistent with previous studies on female adolescents and young women reporting that poor sleep quality is associated with greater PMS severity.(13)(19)(23–25) Similarly, a recent systematic review by Mighani et al. 25 has shown that women experiencing PMS generally have poorer sleep quality, as indicated by prolonged sleep latency, shorter sleep duration, frequent nocturnal awakening, and reduced sleep efficiency. These findings confirm that there is a significant correlation between sleep quality and menstrual health during adolescence.

Several biological mechanisms explain how sleep quality can affect PMS, although these mechanisms are not specifically explored in this study. According to previous research, inadequate sleep may influence circadian regulation, melatonin secretion, reproductive hormone balance, serotonergic neurotransmission, inflammatory responses, and pain sensitivity, all of which have been linked to the development of premenstrual symptoms.(13)(19)(23–25) Therefore, these mechanisms should be regarded as plausible explanations based on previous evidence rather than direct findings of this study.

The association between variables observed in this study may also be affected by characteristics of the boarding school environment. Previous studies conducted in Indonesian Islamic boarding schools have suggested that structured daily activities, communal living, and intensive educational programs may contribute to reduced sleep duration and poorer sleep quality among adolescents.(14)(19)(20) Nonetheless, this study did not directly assess environmental factors such as students' daily schedules, dormitory conditions, sleep disturbances, and residential routines. Thus, to better understand the contribution of these factors to adolescents' menstrual health, future studies should incorporate objective assessments of sleep environments and boarding school characteristics.

Besides sleep quality, higher perceived stress has also been shown to independently lead to severe PMS. Adolescents with moderate or high perceived stress are about 6.5 times more likely to suffer from severe PMS than those with a low stress level. This supports the findings of previous studies that psychological stress is closely related to increased premenstrual symptoms among adolescents and young women.(2)(8)(13)(26–29) Similar associations have also been reported among Indonesian adolescents, including female students residing in Islamic boarding schools.(20)

Previous studies have revealed that academic demands, religious activities, communal living, and adaptation to residential environments may increase psychological stress among adolescents and university students.(30–33) However, although psychosocial characteristics unique to Islamic boarding schools may contribute to perceived stress, these contextual factors were not directly evaluated in the present study. Therefore, future qualitative and longitudinal studies are needed to explore

how these contextual characteristics influence stress and menstrual health among adolescents living in boarding schools.

It is important to note that while fast-food consumption demonstrates a significant association with PMS in the bivariate analysis, this association is no longer statistically significant after multivariable adjustment. This finding suggests that fast-food consumption is not independently associated with PMS in the study population. Similar findings have been reported by Quaglia et al.¹¹, who observed no significant differences in overall dietary intake between women with and without PMS after adjustment for other variables. One possible explanation is that PMS is a multifactorial condition influenced by multiple biological, psychological, behavioral, and environmental factors rather than by dietary habits alone. In addition, dietary intake was assessed using a self-reported food frequency questionnaire in the present study, which may be subject to recall bias and measurement error.

Conversely, several prior studies have reported positive associations between unhealthy dietary patterns and PMS severity.^{(11)(28)(34–39)} Previous research has suggested that diets high in saturated fat, refined carbohydrates, sodium, and added sugars may influence hormonal regulation, oxidative stress, inflammatory pathways, and micronutrient balance, thereby contributing to PMS symptoms.⁴⁰ However, these mechanisms are beyond the scope of the present study. Differences across studies may also reflect variations in dietary assessment methods, cultural dietary patterns, participant characteristics, and analytical approaches. Therefore, further prospective studies with more comprehensive dietary assessments are needed to clarify the role of diet in the occurrence of PMS among adolescents.

In this study, physical activity does not independently affect PMS severity. This finding conflicts with several prior studies, which have reported beneficial effects of regular physical activity on PMS symptoms.⁽⁷⁾⁽¹⁰⁾⁽³⁸⁾⁽³⁹⁾ However, it is in line with the finding of another study that the association between physical activity and PMS becomes attenuated after considering other behavioral and psychosocial factors.⁴¹ One possible explanation is that most respondents report moderate levels of physical activity, resulting in relatively limited variability within the study population. Consequently, this study may not be able to detect differences in PMS severity according to physical activity level. In addition, other unmeasured biological and psychosocial factors may have contributed to the observed findings.

This study carries important implications for the development of reproductive health promotion programs

for adolescents. Since poor sleep quality and higher perceived stress are independently associated with severe PMS, school-based health promotion programs may benefit from incorporating sleep hygiene education, stress management, mental health literacy, relaxation techniques, time-management skills, and accessible counseling services. Within Islamic boarding school settings, collaboration among school administrators, boarding school supervisors, health professionals, and peer educators may support early identification of adolescents experiencing severe PMS while fostering environments that promote healthy sleep habits and psychological well-being. The findings of this study provide valuable evidence that may inform the development of comprehensive reproductive health promotion programs tailored to boarding school settings, even though the effectiveness of such interventions has not been evaluated yet.

However, despite its valuable implications, this study still has several limitations. First, its cross-sectional design precludes establishing temporal correlations between lifestyle factors and PMS; instead of documenting prospective symptoms across menstrual cycles, this study assesses PMS using a validated screening instrument at a single time point. Second, although this study performs multivariable analyses, residual confounding cannot be excluded because of several unmeasured relevant biological, behavioral, and psychosocial factors. Third, this study only examines a single Islamic boarding school, which may limit the generalizability of the findings to other adolescent populations. Therefore, to confirm these findings and support the development of evidence-based reproductive health promotion strategies for adolescents, future longitudinal multicenter studies are essential.

CONCLUSION

Among female adolescents living in an Islamic boarding school in Indonesia, poor sleep quality and higher perceived stress are independently associated with severe Premenstrual Syndrome (PMS). This highlights the importance of fostering healthy sleep habits and psychological well-being as crucial elements of adolescent reproductive health. This study concurrently examines multiple modifiable lifestyle factors within the unique context of an Islamic boarding school, expanding the scant evidence on lifestyle-related factors linked to PMS in this population. The findings support the development of comprehensive school-based health promotion programs that integrate reproductive health education with sleep hygiene, stress management, and mental health support to improve adolescents' menstrual health and quality of life. Nevertheless, to clarify the temporal relationships between

these lifestyle-related factors and PMS, as well as to evaluate the effectiveness of lifestyle-based interventions, future longitudinal studies involving more diverse populations are strongly recommended.

Conflict of Interest

The authors declare no conflict of interest.

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