Majalah Ilmiah Fisioterapi Indonesia
Indonesian Scientific Journal of Physiotherapy

Original Research Articles
ISSN (Print): 2303-1921
ISSN (Online): 2722-0443
Volume 14, Number 1, Pages 60-64 (2026)
DOI: https://doi.org/10.24843/mifi.000001135

Association of Primary Dysmenorrhea with Stress and Sleep Quality Among Adolescent Girls: A Cross-Sectional Study

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Received 13 December 2025; Revised 30 December 2025; Accepted 31 December 2025; Published 3 January 2026

Abstract

Background: Primary dysmenorrhea is a highly prevalent reproductive health problem among adolescent girls and may affect not only physical well-being but also psychological stress and sleep quality. Persistent menstrual pain may trigger stress responses and sleep disturbances through neuroendocrine and behavioral mechanisms.

Objective: This study aimed to examine the association between primary dysmenorrhea severity, perceived stress, and sleep quality among adolescent girls.

Methods: An observational cross-sectional study was conducted among 222 adolescent girls residing in an Islamic boarding school in Surakarta, Indonesia. Primary dysmenorrhea severity was assessed using the Numeric Rating Scale (NRS), stress levels were measured using the Perceived Stress Scale–10 (PSS-10), and sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). Data were analyzed using Spearman's rank correlation test with a significance level of 0.05.

Results: Most participants reported severe primary dysmenorrhea (64.4%), high stress levels (54.5%), and poor sleep quality (84.2%). Primary dysmenorrhea severity showed a significant positive correlation with stress level ($r = 0.571$; $p < 0.001$), indicating a moderate-to-strong association. A significant moderate association was also observed between primary dysmenorrhea severity and sleep quality ($r = 0.440$; $p < 0.001$).

Conclusion: Primary dysmenorrhea is significantly associated with increased stress levels and poorer sleep quality among adolescent girls. These findings underscore the importance of incorporating psychological stress management and sleep-related strategies into holistic, non-pharmacological approaches for managing primary dysmenorrhea in adolescents.

Keywords
Dysmenorrhea; Psychological Stress; Sleep Quality; Adolescents; Cross-Sectional Studies

Introduction

Primary dysmenorrhea is one of the most common reproductive health problems experienced by adolescent girls and is characterized by cramping lower abdominal pain occurring before or during menstruation in the absence of identifiable pelvic pathology. Epidemiological studies have consistently reported a high global prevalence of primary dysmenorrhea among adolescents, ranging from approximately 70% to 90%, with a substantial proportion experiencing moderate to severe pain that interferes with daily activities, school attendance, and academic performance.[1] As a result, primary dysmenorrhea represents not only a physical complaint but also a multidimensional health issue with psychological, behavioral, and functional consequences.[2]

The underlying pathophysiology of primary dysmenorrhea is primarily associated with excessive prostaglandin production during menstruation, which leads to increased uterine contractility, vasoconstriction, and transient uterine ischemia. These physiological mechanisms contribute to nociceptive stimulation and pain perception.[3] However, increasing evidence suggests that the severity and subjective experience of dysmenorrhea are influenced by non-biological factors, including psychological stress and lifestyle-related behaviors, which may modulate pain sensitivity and coping capacity.[4]

Psychological stress is defined as an individual's cognitive and emotional response to perceived demands that exceed adaptive resources.[5] Adolescence is a particularly vulnerable developmental period for stress exposure due to academic pressure, social adjustment, and ongoing biological and emotional maturation. Activation of stress-related neuroendocrine pathways—particularly the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system—may alter hormonal regulation, inflammatory processes, and central pain modulation.[6] Consequently, elevated stress levels may exacerbate menstrual pain. Conversely, recurrent and severe menstrual pain may act as a chronic stressor, suggesting a bidirectional relationship between primary dysmenorrhea and psychological stress.[7]

In addition to stress, sleep quality has emerged as an important factor associated with menstrual pain. Dysmenorrhea-related discomfort may disrupt sleep initiation and maintenance, leading to reduced sleep duration, fragmented sleep, and overall poor sleep quality.[8] Sleep disturbances are known to impair endogenous pain inhibitory pathways and increase pain sensitivity through central sensitization mechanisms. Among adolescents, poor sleep quality has been associated with impaired cognitive function, emotional dysregulation, fatigue, and reduced academic performance, further amplifying the burden of dysmenorrhea.[9]

Previous observational studies have reported significant associations between primary dysmenorrhea and either psychological stress or sleep disturbances, particularly among university students and young adult populations.[10] More recent international studies published between 2020 and 2025 have emphasized the importance of psychosocial and lifestyle factors in the evaluation of menstrual health among adolescents. However, most existing studies have examined stress and sleep quality separately rather than simultaneously, limiting a comprehensive understanding of their combined relationship with dysmenorrhea.[11]

Moreover, evidence focusing specifically on younger adolescent populations remains limited, particularly in non-university settings. Adolescents living in residential educational environments, such as boarding schools or Islamic boarding schools, are exposed to unique contextual factors, including structured daily routines, academic demands, restricted personal autonomy, and communal living conditions. These factors may influence stress levels and sleep patterns differently compared with adolescents living at home. Consequently, findings from non-residential or university-based populations may not be fully generalizable to boarding school settings.

Despite the high prevalence of dysmenorrhea and its potential impact on adolescent well-being, there is a notable lack of studies examining the simultaneous association between primary dysmenorrhea, psychological stress, and sleep quality within structured residential educational environments. This contextual gap limits the development of targeted, setting-specific interventions aimed at improving menstrual health and overall quality of life among adolescent girls.

Therefore, the present study was conducted to examine the association between primary dysmenorrhea severity, perceived stress level, and sleep quality among adolescent girls living in an Islamic boarding school. Using an observational cross-sectional design, this study aimed to provide empirical evidence on the simultaneous relationships among these variables within a specific adolescent population. The findings are expected to inform the development of holistic, non-pharmacological management strategies that integrate physical, psychological, and sleep-related approaches to address primary dysmenorrhea in adolescents.

Methods

This study employed an observational analytic design with a cross-sectional approach to examine the associations between primary dysmenorrhea severity, perceived stress level, and sleep quality among adolescent girls. The cross-sectional design enabled the assessment of relationships among variables at a single point in time; however, it does not allow causal inference, and this limitation was considered in the interpretation of the findings.

The study was conducted at Assalaam Modern Islamic Boarding School in Surakarta, Central Java, Indonesia. Data collection was carried out from February to May 2024 and included preparatory activities, participant recruitment, questionnaire administration, data verification, and statistical analysis. The boarding school setting was selected because its structured daily routines, academic demands, and residential environment may uniquely influence stress levels and sleep patterns among adolescents.

The target population consisted of female adolescents aged 10–18 years who resided and attended school at the boarding school during the study period, with a total population of 497 students. The minimum required sample size was calculated using Slovin's formula with a 95% confidence level, resulting in a final sample of 222 participants. Although Slovin's formula is commonly applied in school-based research to ensure feasibility, it does not incorporate effect size estimation or statistical power considerations; therefore, the possibility of under- or overestimation of the sample size was acknowledged as a methodological limitation.

Participants were recruited using purposive sampling based on predefined eligibility criteria. This sampling approach was selected due to the specific characteristics required for inclusion—namely, active menstruation and the presence of primary dysmenorrhea—as well as logistical constraints within a residential school environment. Nevertheless, purposive sampling may introduce selection bias and limit the generalizability of the findings, and this potential bias was acknowledged in the discussion.

Eligible participants were female adolescents aged 10–18 years who were actively menstruating during the data collection period, experienced primary dysmenorrhea, were willing to participate, and were able to complete the questionnaires independently. Adolescents with diagnosed psychiatric disorders, those using analgesics, sleeping pills, sedatives, or pharmacological agents for stress management during the data collection period were excluded from the study.

The independent variable in this study was the severity of primary dysmenorrhea, while the dependent variables were perceived stress level and sleep quality. Primary dysmenorrhea severity was assessed using the Numeric Rating Scale (NRS), a validated and widely used instrument for measuring pain intensity on a scale from 0 to 10. Perceived stress level was measured using the Perceived Stress Scale–10 (PSS-10), and sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), both of which are self-administered questionnaires frequently used in adolescent populations.

Previous studies have demonstrated acceptable psychometric properties for the PSS-10 and PSQI, with reported internal consistency values exceeding the recommended threshold of 0.70. The Indonesian-language version of the PSS-10 has shown satisfactory composite reliability ranging from 0.81 to 0.93, while the Indonesian version of the PSQI has demonstrated adequate internal consistency among adolescents, with a Cronbach's alpha of approximately 0.72. These findings support the appropriateness of the instruments used in this study.

Data collection was conducted after obtaining formal permission from the boarding school authorities. Eligible participants received standardized verbal and written explanations regarding the study objectives, procedures, and voluntary nature of participation. Participants who agreed to take part completed the PSS-10 and PSQI questionnaires independently in a supervised classroom setting to minimize external disturbances, while dysmenorrhea severity was self-reported using the NRS based on pain experienced during the most recent menstrual period. All completed questionnaires were checked for completeness at the time of collection, and no missing data were identified.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version **26.0** (IBM Corp., Armonk, NY, USA). Univariate analysis was used to describe participant characteristics and the distributions of dysmenorrhea severity, stress levels, and sleep quality using frequencies and percentages. Bivariate analysis was conducted to examine the associations between primary dysmenorrhea severity and stress level, as well as between primary dysmenorrhea severity and sleep quality, using Spearman's rank correlation test. This test was selected due to the ordinal nature of the data and the non-normal distribution of the variables. Correlation strength was interpreted as weak ($r < 0.30$), moderate ($r = 0.30–0.59$), or strong ($r \geq 0.60$), and a two-tailed p-value of less than 0.05 was considered statistically significant.

Potential sources of bias included selection bias related to purposive sampling and information bias associated with self-reported questionnaire data. No imputation was performed for missing data, as all questionnaires included in the final analysis were complete. Residual confounding by factors such as nutritional status, body mass index, physical activity, and psychosocial support could not be fully controlled and was acknowledged as a limitation of the study.

Results

Participant Flow

A total of 240 adolescent girls were assessed for eligibility during the study period. After screening, 18 students were excluded. Of these, 11 did not meet the inclusion criteria, and 7 declined to participate. Consequently, data from 222 participants

were included in the final analysis. The process of participant screening, exclusion, and final inclusion in the analysis is summarized in Figure 1.

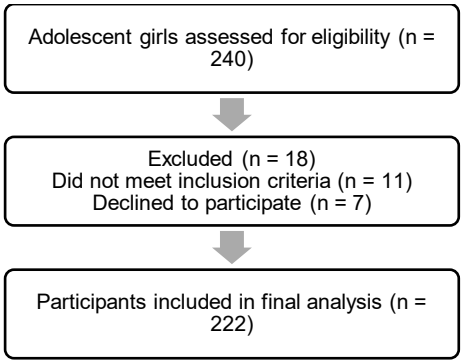

Figure 1. Flow diagram of participant selection and inclusion.

Baseline Characteristics of Participants

The baseline characteristics of the study participants are presented in Table 1. Most participants were aged 14 years (55.4%), while the remainder were aged 13 years (44.6%). The distribution of school grade was comparable between Grade VIII and Grade IX. Regarding menstrual characteristics, the majority of participants reported severe primary dysmenorrhea.

Table 1. Baseline Characteristics of Participants (n = 222)

Characteristic	n	%
Age (years)		
13	99	44.6
14	123	55.4
School grade		
Grade VIII	99	44.6
Grade IX	123	55.4
Primary dysmenorrhea severity		
Mild	34	15.3
Moderate	45	20.3
Severe	143	64.4

Distribution of Stress Levels

The distribution of perceived stress levels among participants is shown in Table 2**.** More than half of the participants reported severe stress levels.

Table 2. Distribution of Stress Levels (n = 222)

Stress level	n	%
Mild	5	2.3
Moderate	96	43.2
Severe	121	54.5

Distribution of Sleep Quality

Sleep quality assessment results are summarized in Table 3**.** Poor sleep quality was reported by the majority of participants.

Table 3. Distribution of Sleep Quality (n = 222)

Sleep quality	n	%
Good	35	15.8
Poor	187	84.2

Association Between Primary Dysmenorrhea and Stress Level

The association between primary dysmenorrhea severity and perceived stress level is presented in Table 4. A statistically significant positive correlation was identified.

Table 4. Association Between Primary Dysmenorrhea Severity and Stress Level

Variables	Spearman's r	p-value
Primary dysmenorrhea – Stress level	0.571	<0.001

Association Between Primary Dysmenorrhea and Sleep Quality

The association between primary dysmenorrhea severity and sleep quality is shown in Table 5. A statistically significant association was observed.

Table 5. Association Between Primary Dysmenorrhea Severity and Sleep Quality

Variables	Spearman's r	p-value
Primary dysmenorrhea – Sleep quality	0.440	<0.001

Summary of Main Findings

Overall, the results demonstrate that greater severity of primary dysmenorrhea was associated with higher perceived stress levels and poorer sleep quality among adolescent girls. All analyzed variables were complete, and no missing data were identified.

Discussion

This study examined the associations between primary dysmenorrhea severity, perceived stress level, and sleep quality among adolescent girls living in a boarding school environment. The findings demonstrated that greater severity of primary dysmenorrhea was significantly associated with higher stress levels and poorer sleep quality. The magnitude of these associations ranged from moderate to moderate-to-strong, indicating that menstrual pain in adolescents is closely linked to psychological and behavioral factors rather than being solely a physical phenomenon.

The observed association between primary dysmenorrhea and perceived stress aligns with current understanding of pain–stress interactions. Menstrual pain may activate stress-related neuroendocrine pathways, including the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system, resulting in increased cortisol secretion and heightened physiological arousal. These responses can amplify pain perception and reduce pain tolerance.[12] Conversely, sustained psychological stress may alter pain modulation mechanisms and inflammatory responses, thereby intensifying dysmenorrhea symptoms. The present findings support the concept of a bidirectional relationship in which pain and stress mutually reinforce one another during adolescence.[13]

The significant association between primary dysmenorrhea severity and sleep quality further highlights the multidimensional impact of menstrual pain. Adolescents experiencing severe dysmenorrhea may have difficulty initiating and maintaining sleep due to discomfort, leading to reduced sleep efficiency and overall poor sleep quality. In turn, inadequate or fragmented sleep is known to impair endogenous pain inhibitory pathways and increase pain sensitivity, potentially exacerbating dysmenorrhea symptoms.[14] This reciprocal interaction suggests that sleep disturbances may both result from and contribute to the severity of menstrual pain.[15]

When compared with previous observational studies, the present findings are consistent with reports indicating that adolescents and young adults with dysmenorrhea are more likely to experience psychological distress and sleep disturbances. Several recent international studies have emphasized that stress and sleep quality are key correlates of menstrual pain severity, even after accounting for demographic and lifestyle factors. The current study extends this body of evidence by demonstrating that these associations are also evident in younger adolescent populations residing in structured residential educational settings.[16]

A notable contribution of this study is its focus on adolescents living in a boarding school environment. Boarding schools are characterized by fixed daily schedules, academic demands, communal living, and limited personal autonomy, all of which may influence stress levels and sleep patterns.[17] These contextual factors may intensify the impact of dysmenorrhea on psychological well-being and sleep quality, potentially explaining the relatively high prevalence of severe dysmenorrhea, elevated stress levels, and poor sleep quality observed in this population.[18] Consequently, findings from non-residential or university-based samples may not be fully generalizable to boarding school settings, underscoring the importance of context-specific research.

From a clinical and physiotherapy perspective, the findings have important implications. Management of primary dysmenorrhea in adolescents should not rely exclusively on pharmacological approaches aimed at pain relief. Instead, holistic and non-pharmacological strategies should be considered, particularly those that address psychological stress and sleep disturbances. Physiotherapy-based interventions, such as exercise therapy, relaxation and breathing techniques, postural education, and guided stretching, have been shown to reduce pain intensity and improve stress regulation.[19,20] Additionally, education on sleep hygiene and stress management may help adolescents develop adaptive coping strategies that mitigate the impact of dysmenorrhea on daily functioning.

The integration of such interventions within school health programs may be especially beneficial in residential educational settings. Structured physiotherapy and wellness programs implemented at the school level could provide accessible and sustainable support for adolescents experiencing dysmenorrhea, while also promoting overall physical and psychological well-being. These approaches align with preventive health strategies and may reduce reliance on medication, particularly among younger adolescents. Several limitations of this study should be acknowledged. First, the cross-sectional design precludes causal inference, and the directionality of the observed associations cannot be definitively established. It is unclear whether stress and poor sleep contribute to more severe dysmenorrhea, whether dysmenorrhea leads to increased stress and sleep disturbances, or whether these relationships are reciprocal. Second, purposive sampling may introduce selection bias and limit the generalizability of the findings beyond the studied boarding school population. Third, all variables were assessed using self-reported instruments, which may be subject to recall bias or social desirability bias.

Furthermore, potential confounding factors such as nutritional status, body mass index, physical activity level, age at menarche, and psychosocial support were not measured and could not be controlled for in the analysis. These factors may influence both dysmenorrhea severity and psychological or sleep-related outcomes and should be considered in future research.

Despite these limitations, the study has several strengths. The relatively large sample size and the focus on an understudied adolescent population enhance the robustness and relevance of the findings. The simultaneous examination of dysmenorrhea, stress, and sleep quality provides a more comprehensive understanding of the multifaceted burden of primary dysmenorrhea among adolescents. Additionally, conducting the study within a boarding school setting offers novel insights into how environmental and contextual factors may shape menstrual health outcomes.

Future studies should employ longitudinal designs to clarify temporal and causal relationships between dysmenorrhea, stress, and sleep quality. Interventional studies, particularly randomized controlled trials, are also needed to evaluate the effectiveness of integrated, non-pharmacological interventions targeting pain, psychological stress, and sleep disturbances. Physiotherapy-based exercise and relaxation programs tailored for adolescents may represent promising strategies to improve menstrual health and overall quality of life.

Conclusion

This study demonstrates that primary dysmenorrhea is significantly associated with higher perceived stress levels and poorer sleep quality among adolescent girls living in a boarding school environment. Adolescents experiencing more severe dysmenorrhea tended to report greater psychological stress and worse sleep quality, with correlation magnitudes indicating moderate to moderate-to-strong associations. These findings confirm that the relationships observed in this study are associative rather than causal, consistent with the cross-sectional design.

The results highlight that primary dysmenorrhea should be understood as a multidimensional condition that extends beyond physical pain to encompass psychological and behavioral aspects. Stress and sleep disturbances appear to be closely linked to menstrual pain severity, suggesting that adolescents with dysmenorrhea may experience a compounded burden affecting both mental well-being and daily functioning. In residential educational settings, such as boarding schools, contextual factors including structured routines, academic pressure, and communal living may further influence these relationships.

From a clinical and practical perspective, the findings underscore the importance of adopting holistic, non-pharmacological approaches to the management of primary dysmenorrhea in adolescents. Interventions that integrate physiotherapy-based exercise programs, relaxation and breathing techniques, stress management education, and sleep hygiene counseling may help alleviate pain, reduce psychological stress, and improve sleep quality. Implementing such approaches within school health or adolescent wellness programs may provide accessible and sustainable support for young populations, particularly in residential settings.

Future research should employ longitudinal or interventional study designs to clarify causal pathways and assess the effectiveness of integrated interventions targeting pain, stress, and sleep disturbances. Understanding how these factors interact over time will be essential for developing evidence-based strategies to improve menstrual health and overall quality of life among adolescent girls.

Author Contribution

Conceptualization: Lintang Cahya Ningrum, Wahyu Tri Sudaryanto
Methodology: Lintang Cahya Ningrum, Wahyu Tri Sudaryanto
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Acknowledgments

The authors would like to thank the management and staff of Assalaam Modern Islamic Boarding School, Surakarta, for granting permission and facilitating data collection. The authors also express their appreciation to all students who participated in this study.

Conflict of Interest Statement

The authors declare no conflict of interest.

Funding Sources

This study received no external funding.

Ethics Statement

Participation in this study was voluntary, and all respondents were provided with clear information regarding the study objectives and procedures prior to data collection. Data were collected anonymously and treated confidentially. The study was conducted in accordance with ethical principles for research involving human participants.

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