

The Relationship Between Pain Intensity and Stress Level on Sleep Quality Among Junior High School Girls with Primary Dysmenorrhea: A Systematic Literature Review

Cyndi Yuliana*, Sri Novia Fauza
Universitas Indonesia
Email: cyndi.yuliana@ui.ac.id*

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ABSTRACT

Early adolescence, especially at junior high school age, is a critical period of neurobiological and hormonal development. Primary dysmenorrhea, characterized by cramping pain in the lower abdomen without pelvic pathology, is the most common gynecological complaint in this population. This condition is often underestimated despite having significant systemic impacts, including severe sleep disturbances and increased psychological stress. This systematic review aimed to comprehensively analyze the relationship between menstrual pain intensity and psychological stress levels and sleep quality in adolescent girls with primary dysmenorrhea, with a special focus on the implications for adolescent health in the school environment. This study used a Systematic Literature Review (SLR) design with the PRISMA 2020 protocol. Ten studies that met the inclusion criteria, involving a total of more than 6,000 participants from different countries, including Indonesia, South Korea, China, the United States, India, Turkey, and Brazil, were qualitatively analyzed. Data synthesis showed a strong linear relationship in which high pain intensity ($NRS \geq 7$) significantly predicted poor sleep quality ($PSQI > 5$) and impaired sleep efficiency. Adolescents with severe dysmenorrhea reported shorter sleep duration, prolonged sleep latency, and sleep fragmentation. On the other hand, psychological stress was identified as an independent variable and a crucial mediator; high stress levels, measured by DASS-21 or PSS, correlated with increased pain perception and decreased sleep quality. Longitudinal studies show that the transition to menarche at an early age exacerbates circadian rhythm disorders, including social jetlag, which are further worsened by menstrual pain.

INTRODUCTION

Adolescence is a dynamic developmental transition phase, bridging childhood and adulthood, characterized by accelerated physical growth, sexual maturation, and significant neural reorganization. For adolescent girls, menarche, or menstrual onset, is a major biological milestone that signals the maturation of the reproductive system. However, this transition is often accompanied by substantial health challenges, with primary dysmenorrhea emerging as the most commonly reported gynecological disorder. Primary dysmenorrhea is defined as painful menstruation in the absence of macroscopic pathological abnormalities of the pelvis, which usually begins within 6–12 months after menarche, when the ovulatory cycle has been established (Azizah, Saadah, Sumaningsih, & Nugroho, 2024; Kiss, Arnold, Weiss, & Baker, 2024).

The prevalence of dysmenorrhea in adolescents varies greatly globally, ranging from 60% to 93%, making it an urgent but often overlooked public health issue. In Indonesia, the incidence rate is reported to be 64.25%, with high variability between regions, such as East

Java and South Sumatra, reflecting a significant disease burden on local populations. The main clinical symptom is spasmodic cramping pain in the lower abdomen that can radiate to the back and thighs, often accompanied by symptoms such as nausea, vomiting, diarrhea, extreme fatigue, and emotional lability (Hamranani, Wisesa, & Permatasari, 2023; Liu et al., 2025; Sagita, Minata, Amalia, & Rahmadhani, 2023).

The impact of primary dysmenorrhea goes far beyond physical discomfort alone. This condition has been identified as a major cause of short-term school absenteeism and decreased academic performance among adolescent girls. Furthermore, chronic and recurrent pain experienced each month can interfere with adolescents' psychosocial functioning and overall quality of life. One of the most affected but often under-reported functional aspects is sleep quality (Azizah et al., 2024; Hamranani et al., 2023; Liu et al., 2025).

Sleep is a fundamental physiological process that is crucial during adolescence, playing an important role in physical recovery, memory consolidation, emotional regulation, and immune function. Adolescents need optimal sleep duration, approximately 8–10 hours per night, to support rapid brain development. However, pain due to dysmenorrhea often disrupts sleep architecture, causing difficulty initiating sleep, or sleep latency, frequent awakenings at night, or sleep fragmentation, and inadequate sleep duration. These sleep disorders, in turn, can lower pain thresholds, making adolescents more sensitive to pain and creating a vicious cycle that is difficult to break (Jeong, Lee, & Kim, 2023; Kiss et al., 2024; Polat & Mucuk, 2021).

In addition to pain–sleep interactions, psychological factors, particularly stress, play a central role in the pathophysiology of dysmenorrhea. Early adolescence, or junior high school age, is a period of high psychological vulnerability, during which adolescents face academic stress, changes in social roles, and hormonal fluctuations. Psychological stress is known to activate the Hypothalamic–Pituitary–Adrenal (HPA) axis, triggering the release of cortisol and catecholamines, which can increase the synthesis of prostaglandins in the uterus. Increased prostaglandins, especially PGF₂ α , lead to stronger myometrial contractions and vasoconstriction, which manifest as more severe menstrual pain. Recent studies have shown a strong positive correlation between perceived stress levels and the severity of dysmenorrhea (Azizah et al., 2024; Liu et al., 2025). Assessment of psychological stress levels in adolescents generally uses validated instruments such as the Depression Anxiety Stress Scales (DASS-21), which have been shown to have good construct validity and reliability in the Indonesian population (Hakim & Aristawati, 2023).

Although individual relationships between pain, sleep, and stress have been documented in separate studies, few systematic reviews have integrated these three variables within a single comprehensive analytical framework, especially those focusing specifically on early adolescents aged 10–15 years or junior high school students. At this age, circadian sleep patterns undergo a natural shift, with a tendency to sleep later, while coping mechanisms for stress are not yet fully mature, making this group a unique and vulnerable population (Jeong et al., 2023; Kiss et al., 2024).

This systematic review aims to evaluate and synthesize current scientific evidence regarding the tripartite relationship between dysmenorrhea pain intensity, psychological stress levels, and sleep quality in adolescent girls. In particular, this study seeks to answer questions about the prevalence and impact of sleep disorders in adolescents with primary dysmenorrhea, the mechanism underlying the relationship between pain intensity and sleep quality, and

whether stress acts as a triggering factor or consequence in the dynamics between dysmenorrhea and sleep disorders. This research provides theoretical benefits by offering a comprehensive framework for understanding the interconnections between pain, stress, and sleep in adolescent dysmenorrhea. Practically, it equips schools, health workers, and parents with evidence-based recommendations for integrated menstrual health management, stress reduction, and sleep hygiene promotion. From a policy standpoint, the findings support the development of school-based health programs and contribute to broader adolescent health and education goals.

METHOD

This research uses the Systematic Literature Review (SLR) method which is designed to identify, evaluate, and interpret all research relevant to the research question. The protocol for the preparation of this article follows the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 standard to ensure the transparency, validity, and replicability of the review process.

The literature search process was carried out comprehensively on major electronic databases including PubMed, Scopus, Google Scholar, and other international health journal directories. The keywords used were compiled based on the PICO (Population, Intervention/Exposure, Comparison, Outcome) framework using Boolean operators: ("Primary Dysmenorrhea" OR "Menstrual Pain" OR "Dysmenorrhoea") AND ("Adolescent Girls" OR "Teenagers" OR "Junior High School Students") AND ("Sleep Quality" OR "Sleep Disturbance" OR "Insomnia") AND ("Stress" OR "Psychological Stress" OR "Pain Intensity"). The search was limited to articles published in the last five-year period (2020–2025) to ensure the novelty of the data and relevance to current demographic conditions.

The studies included in this review must meet several inclusion criteria. First, the research population is adolescent girls, with the main focus on early adolescence or junior high school students (10–19 years old). Second, participants must be diagnosed or report symptoms of primary dysmenorrhea, which is menstrual pain without pelvic pathology. Third, studies must measure at least two of the three main variables, namely pain intensity, stress level, and sleep quality. Fourth, the research design is in the form of observational studies, both cross-sectional, longitudinal, case-control, and cohort that present original empirical data. Fifth, articles are written in English or Indonesian. Sixth, only full-text journal articles that have gone through a peer-review process will be included in this review. Exclusion criteria include: studies in adult women or clinical populations with secondary pathologies (such as endometriosis), review articles without primary data, editorials, and abstracts of conference proceedings that do not have complete data (Baker & Lee, 2022).

Data from eligible articles were extracted using a standard form that included information: author, year of publication, country of origin, study design, sample size, population characteristics (age), measurement instruments (e.g.: VAS/NRS for pain, PSQI for sleep, DASS/PSS for stress), and key statistical findings (p-value, odds ratio, correlation). Methodological quality assessment was carried out by examining the study design, sampling techniques, validity of the instruments, and statistical analysis use (van Iersel et al., 2024).

Ten selected article documents were analyzed in depth to compile this review. These studies came from a variety of geographical backgrounds including Indonesia, South Korea, China, India, Turkey, the United States, and Brazil.

RESULT AND DISCUSSION

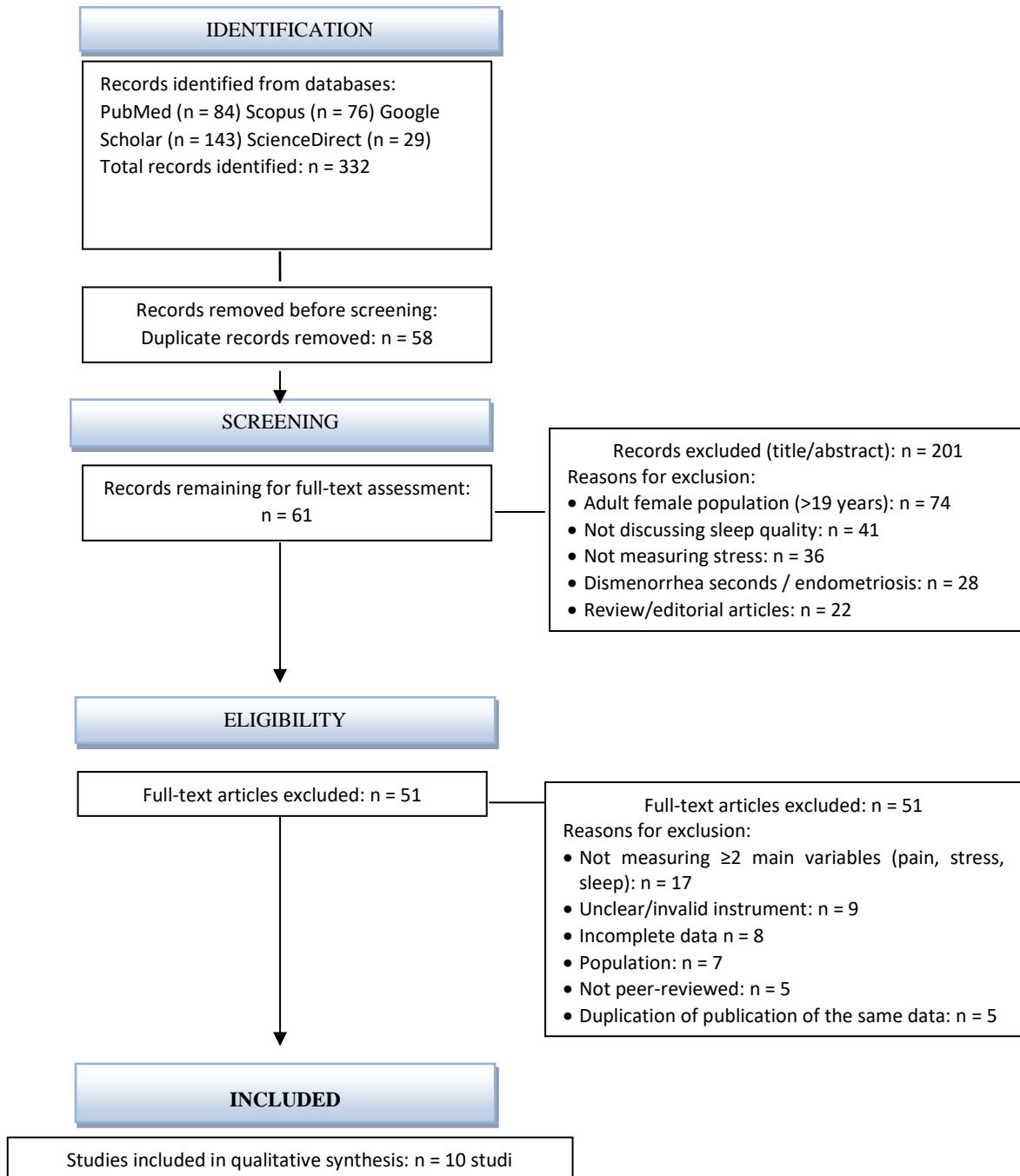


Figure 1. PRISMA Flow
Source: PRISMA 2020 flow diagram

A synthesis of data from the 10 included studies revealed consistent findings regarding the close association between pain, stress, and sleep in adolescent girls. Here are a breakdown of the findings based on the variables and their interactions (Vannuccini et al., 2023).

The studies analyzed involved a total of more than 6,000 adolescent participants. The majority of studies used a *cross-sectional* design, which allows for an assessment of prevalence and correlation between variables at a single point in time (Itani et al., 2022). One study stood out using large-scale longitudinal data from the *Adolescent Brain Cognitive Development* (ABCD) study in the US, providing insight into changes in sleep patterns as *menarche onset*. The age range of participants was generally 12-18 years, covering the junior and senior high school periods, which are crucial periods of adaptation to the menstrual cycle (Deodato et al., 2023).

The most commonly used instruments to measure variables are:

1. Pain: *The Numeric Rating Scale* (NRS) is used as the primary instrument to assess pain intensity numerically, supported by the *Visual Analog Scale* (VAS).
2. Sleep: *The Pittsburgh Sleep Quality Index* (PSQI) is used consistently to measure global sleep quality, latency, and sleep efficiency.
3. Stress: *Depression Anxiety Stress Scales-21* (DASS-21) is a valid instrument for measuring levels of stress, anxiety, and depression. The use of DASS-21 in Indonesia is considered to have good psychometric properties and is reliable for measuring this psychological construct, as validated by Hakim and Aristawati (2023).

All studies that examined this variable concluded that there was a significant negative correlation between pain intensity and sleep quality; that is, the higher the pain, the worse the quality of sleep (Armour et al., 2020).

Table 1. Summary of Studies on the Relationship of Pain, Stress, and Sleep Quality in Adolescents with Primary Dysmenorrhea

Author	Study Design	Sample	Measuring Instruments	Key Findings
Azizah et al. (2024)	<i>Cross-sectional</i>	124 junior high school students (Grades 7-8) in Ngariboyo, Indonesia	DASS-42 (Stres), NRS (Nyeri)	There was a significant relationship between stress levels and the incidence of dysmenorrhea ($p=0.017$). Most moderately stressed respondents (39.5%) experienced moderate to severe menstrual pain.
Hamranani et al. (2023)	<i>Cross-sectional</i>	109 young women in Joton Village, Klaten, Indonesia	Questionnaire, PSQI (Sleep)	A strong correlation ($r=0.519$, $p=0.000$) was found between menstrual pain and sleep quality. The majority (81.1%) of adolescents with poor sleep quality experienced severe pain.
Jeong et al. (2023)	<i>Cross-sectional</i>	519 high school students (ages 15-18) in South Korea	PSQI (Sleep), VAS (Pain), PSS (Stress), CMSS	Poor sleep quality ($PSQI > 5$) is the most important risk factor for the severity of menstrual pain symptoms ($p<0.001$). High stress is positively correlated with pain intensity and sleep disturbances.

Author	Study Design	Sample	Measuring Instruments	Key Findings
Kiss et al. (2024)	<i>Longitudinal & Cross-sectional</i> (ABCD Study)	3,037 early teens (mean age 13 years) in the United States	SDSC (Gangguan Tidur), MCTQ, Numeric Rating Scale	Short sleep duration (< 8 hours) and sleep disturbances were significantly associated with higher menstrual pain intensity ($\beta=-0.19$) and severe premenstrual symptoms.
Lee & Kim (2024)	<i>Cross-sectional</i>	519 young women (ages 15-18) in South Korea	PSS-10 (Stress), VAS (Pain), CMSS	Stress has a direct effect on menstrual symptoms and indirectly through the mediation of depression and anxiety. High levels of stress worsen the perception of pain.
Liu et al. (2025)	<i>Cross-sectional</i>	1,449 young women (ages 10-19) in Shenzhen, China	PSS-4 (Stress), Health Questionnaire	Adolescents who had "moderate" to "severe" difficulty coping with stress had a 1.66 to 1.97 times higher risk of developing primary dysmenorrhea than those who were not stressed.
Polat & Mucuk (2021)	<i>Cross-sectional</i>	250 University Students in Turkey	VAS (Pain), PSQI (Sleep)	96.8% of subjects who experienced sleep <i>division</i> during menstruation suffered from dysmenorrhea. There was a significant negative correlation between sleep duration and PSQI score ($p<0.001$), where pain worsened sleep quality.
Sagita et al. (2023)	<i>Cross-sectional</i>	60 students of SMP Negeri 4 Indralaya Utara, Indonesia	Questioner, PSQI	There was a significant association between poor sleep quality and the incidence of dysmenorrhea ($p=0,000$). Adolescents with poor sleep quality were at higher risk of dysmenorrhea (OR 0.506).
Verma & Baniya (2022)	<i>Cross-sectional</i>	492 adolescents (ages 13-19) in rural Rajasthan, India	PVAS (Pain), PHQ-9 (Depression), GAD-7 (Anxiety)	The prevalence of depression (29.25%) and anxiety (37.11%) was much higher in the dysmenorrhea group. As many as 38.99% of adolescents reported that menstrual pain directly interfered with their sleep.
Hakim & Aristawati (2023)	<i>Cross-sectional</i> (Validity Test)	629 early adult respondents (aged 20-40 years) from 34 provinces, Indonesia	DASS-21 Indonesian version (CFA test & construct reliability)	The Indonesian version of DASS-21 was proven to have good construct validity (CFI=0.914; TLI=0.901; RMSEA=0.072) and high construct reliability (CR Depression=0.88; Anxiety=0.86; Stress=0.77), supporting its validity as a valid psychological stress measuring instrument in Indonesia.

Source: researchers' compilation from ten included studies (2020–2025)

1. Strong Statistical Correlation

A study by Hamranani et al. (2023) on adolescents in Klaten found a strong correlation value ($r = 0.519$; $p < 0.001$) between pain levels and sleep quality. In this study, the majority of adolescents with poor sleep quality (81.1%) were in the severe pain category. This was confirmed by Polat & Mucuk (2021), who found a positive correlation between PSQI scores (indicating poor sleep) and dysmenorrhea severity ($\rho = 0.303$; $p < 0.001$).

2. Impact on Sleep Duration and Latency

Sagita et al. (2023) reported that adolescents with poor sleep quality had a 0.506 times greater risk or tendency (Odds Ratio / OR) to develop dysmenorrhea than those who slept well. More specifically, a study of 3,037 adolescents in the US showed that short sleep duration (<8 hours) was significantly associated with higher menstrual pain intensity ($\beta = -0.19$). Adolescents who slept less than 8 hours tended to report more intense pain and greater functional impact (Kocabey, Oden Akman, & Kasim, 2024).

3. Sleep Fragmentation

Pain causes impaired sleep continuity. Polat & Mucuk (2021) found that 96.8% of participants who reported sleep division during menstruation were those with dysmenorrhea. Difficulty starting sleep (sleep latency) is also very common, experienced by 96.3% of people with severe dysmenorrhea.

4. Cross-Cultural Consistency

These findings were consistent across countries. In Korea, Jeong et al. (2023) found that poor sleep quality (global PSQI score > 5) was the most significant risk factor for menstrual symptom severity ($p < 0.001$), even after controlling for other variables such as lifestyle and diet.

Stress has been shown to be the dominant psychological factor that worsens the physical condition of dysmenorrhea.

1. Stress as a Predictor of Pain

Azizah et al. (2024) conducted a specific study on junior high school students and found a significant relationship ($p = 0.017$) between stress levels and the incidence of dysmenorrhea. Ordinal regression analysis showed that the higher the stress level (from mild to moderate), the higher the probability of adolescents experiencing moderate to severe menstrual pain.

2. Stress Coping Mechanism

Liu et al. (2025) in an epidemiological study on 1,449 Chinese adolescents found that coping ability to stress had a significant effect. Adolescents who felt "moderate difficulty" to "very difficult" in coping with stress had a 1.66 to 1.97 times higher risk of developing primary dysmenorrhea than those who did not experience difficulty (OR=1.79, $p < 0.05$). This suggests that it is not only the presence of stress, but poor stress perception and management that exacerbates pain.

3. Broad Psychological Impact

A study in India by Verma & Baniya (2022) highlighted that the prevalence of depression (29.25%) and anxiety (37.11%) was much higher in adolescents with dysmenorrhea than in those without. Chronic stress due to recurrent pain can trigger these mental disorders, which further worsens pain perception.

4. Effects Mediation

Lee & Kim (2024) propose a mediation model in which stress not only has a direct effect, but also affects dysmenorrhea through depression and anxiety. Stress increases anxiety, which in turn increases the perception of pain and the severity of symptoms.

The results of the analysis show that these three variables do not stand alone, but interact in a complex system.

a. Vicious Cycle (Demonic Circle)

Intense menstrual pain causes sleep disturbances (insomnia, frequent waking up). Lack of sleep leads to fatigue and irritability, which increases stress levels. Increased stress, through hormonal mechanisms (cortisol and prostaglandins), again increases uterine contractility, making the pain worse. This is supported by the findings of Jeong et al. (2023) who place sleep quality as the most important risk factor that overshadows pain symptoms and premenstrual syndrome (PMS).

b. The Role of Early Menarche

Adolescents who experience menarche at a younger age tend to have a worse risk profile. Kiss et al. (2024) found that early menarche is associated with more blood flow and more intense pain, which contributes to poorer sleep patterns (later sleep and shorter duration).

c. Academic Impact

Ishikura et al. (2020), in their editorial letter, emphasized that the combination of menstrual pain and sleep disturbances has real consequences on academic performance, leading to decreased concentration and impaired memory in school.

A strong and significant relationship between dysmenorrhea pain intensity and impaired sleep quality in adolescent girls can be explained through physiological mechanisms involving inflammatory mediators. The release of prostaglandins, specifically $\text{PGF}_2\alpha$, and leukotrienes during menstruation not only triggers myometrial contractions causing uterine ischemia and cramping pain but also sensitizes pain nerve fibers, which interferes with sleep onset (Jeong et al., 2023; Azizah et al., 2024). This persistent acute pain directly prevents adolescents from initiating sleep comfortably and causes micro-arousals or brief awakenings throughout the night, drastically reducing sleep efficiency (Polat & Mucuk, 2021). In addition, hormonal fluctuations, such as a decrease in progesterone levels before menstruation, affect thermoregulation and sleep architecture, resulting in reduced Rapid Eye Movement (REM) sleep, which is essential for adolescent cognitive and mental recovery (Polat & Mucuk, 2021).

Psychological factors, particularly stress, play a central role in exacerbating the clinical manifestations of dysmenorrhea, supporting the biopsychosocial model of pain. High psychological stress in early adolescence activates the sympathetic nervous system. The use of the DASS-21 instrument is relevant because it assesses three dimensions of emotional disorders (depression, anxiety, stress) simultaneously and has validated construct reliability in the Indonesian population (Hakim & Aristawati, 2023). Increased cortisol levels under stress can suppress immune function and amplify systemic inflammatory responses, which is particularly relevant given that dysmenorrhea involves localized uterine inflammation (Jeong et al., 2023). Furthermore, psychological stress can lower the central pain threshold, resulting in hyperalgesia, where pain is perceived at higher intensity (Lee & Kim, 2024). Epidemiological studies indicate that adolescents experiencing high anxiety or depression, often triggered by

academic or social stress, report greater prevalence and severity of menstrual pain compared to peers without psychological distress (Verma & Baniya, 2022).

Within this triad, sleep quality emerges as an independent predictor crucial for adolescent reproductive health. Findings from longitudinal and cross-sectional studies show that poor sleep quality is a major risk factor that can exacerbate pain symptoms and premenstrual syndrome severity (Jeong et al., 2023; Kiss et al., 2024). Adequate, quality sleep has a natural analgesic effect and supports emotional regulation, suggesting that improving sleep quality may break the cycle linking stress and pain. However, contemporary adolescents experience “social jetlag,” a misalignment between biological circadian rhythms and school schedules, resulting in shortened sleep duration (<8 hours) and irregular waking patterns (Kiss et al., 2024). Chronic sleep deprivation is further worsened by severe menstrual pain, producing a significant sleep deficit and reducing pain tolerance thresholds (Sagita et al., 2023; Hamranani et al., 2023).

The implications of this complex interaction between pain, stress, and sleep are wide-ranging, including decreased academic performance and impaired social functioning. Sleep disturbances from menstrual pain have been directly linked to reduced concentration, memory impairments, and higher rates of school absenteeism (Ishikura et al., 2020). Therefore, clinical and educational strategies in schools should be holistic rather than partial. A comprehensive health screening approach in the School Health Unit (UKS) is recommended, including simultaneous assessments of pain intensity, stress levels, and sleep quality (Azizah et al., 2024). Non-pharmacological interventions—such as sleep hygiene education, stress management through relaxation techniques, and emotional support—should be prioritized as first-line strategies to improve the overall quality of life for adolescent girls (Ishikura et al., 2020).

CONCLUSION

Based on the results of a systematic literature review of 10 recent scientific articles, it can be concluded that there is a significant, strong, and reciprocal relationship between primary dysmenorrhea pain intensity, stress levels, and sleep quality in adolescent girls. High pain intensity consistently affects sleep quality, resulting in shorter sleep duration and disrupted sleep continuity. Furthermore, elevated psychological stress acts both as a triggering factor that exacerbates pain intensity through hormonal mechanisms and as a consequence of chronic pain and sleep deprivation. Poor sleep quality is not merely a secondary symptom but also an independent risk factor that can worsen the clinical manifestations of dysmenorrhea and contribute to emotional disorders.

Early adolescents, particularly those of junior high school age, represent a particularly vulnerable group due to the menarche transition phase and the unique psychosocial stressors they face. Therefore, schools are advised to integrate comprehensive reproductive health education programs that include stress management and the importance of adequate sleep into both curricular and extracurricular activities. Health workers should also develop adolescent dysmenorrhea management strategies that go beyond analgesic administration, incorporating cognitive-behavioral interventions to manage stress and improve sleep patterns.

In addition, researchers are encouraged to conduct longitudinal or experimental studies to evaluate the effectiveness of stress management and sleep quality interventions in reducing menstrual pain intensity in adolescents. Such studies would provide robust evidence to inform

holistic approaches to adolescent reproductive health, supporting both physical and psychosocial well-being.

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