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Research Article

THE RELATIONSHIP BETWEEN HEMOGLOBIN LEVELS AND DYSMENORRHEA PAIN INTENSITY AMONG ADOLESCENT STUDENTS AT MAN 2 YOGYAKARTA

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Abstract:

Background: Adolescent females undergo significant physical and reproductive transitions initiated by menarche. Dysmenorrhea represents the most pervasive gynecological complaint among adolescent girls, precipitating academic absenteeism and impaired quality of life. Suboptimal hemoglobin levels induce uterine myometrial hypoxia and excessive prostaglandin release, thereby exacerbating spastic dysmenorrhea pain.

Objective: To analyze the relationship between hemoglobin levels and dysmenorrhea pain intensity among tenth-grade female students at MAN 2 Yogyakarta. Methods: This quantitative observational analytic study employed a cross-sectional approach conducted in 2026. A sample of 103 female students was recruited from a population of 139 students using purposive sampling with Slovin-formula estimation. Hemoglobin levels were assessed using a validated EasyTouch Hemoglobinometer, and dysmenorrhea pain intensity was evaluated using the Numerical Rating Scale (NRS). Bivariate correlation was analyzed using Kendall's tau test (alpha = 0.05).

Results: Among respondents with normal hemoglobin levels (≥ 12.0 g/dL; 35.9%, n = 37), the majority experienced mild dysmenorrhea (59.5%, n = 22). Conversely, among students with severe anemia (< 8.0 g/dL; 23.3%, n = 24), the majority experienced moderate dysmenorrhea (62.5%, n = 15). Furthermore, 66.0% (n = 68) of respondents admitted non-adherence to weekly iron-folic acid supplementation. Kendall's tau test yielded a statistically significant correlation (tau = 0.222, p = 0.012).

Conclusion: There is a statistically significant positive relationship between hemoglobin levels and dysmenorrhea pain intensity among female students at MAN 2 Yogyakarta, demonstrating that lower hemoglobin status corresponds with heightened menstrual pain.

Keywords: Adolescents; Anemia; Dysmenorrhea; Hemoglobin level; Menstruation; Numerical Rating Scale

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1. INTRODUCTION

Adolescence represents an indispensable developmental continuum demarcated by rapid somatosensory maturation, neuroendocrine reorganization, and the biological onset of reproductive capacity (Fitria et al., 2021). For young females, puberty is clinically heralded by menarche, signaling regular cyclic changes within the hypothalamic-pituitary-ovarian (HPO) axis and endometrial lining (Perwaningtyas & Juwita, 2025). Although menstruation constitutes a normal physiological phenomenon, a substantial proportion of young women experience debilitating menstrual disorders that compromise daily academic participation, physical activities, and emotional well-being (Perwaningtyas & Juwita, 2025; Putu Artawan et al., 2022). Foremost among these gynecological disturbances is dysmenorrhea, defined as crampy, spasmodic lower abdominal pain radiating to the lumbar back and medial thighs occurring immediately prior to or during menses (Luh Neta Surastri Maharani et al., 2025; Putu Artawan et

al., 2022). Globally, the World Health Organization (WHO) estimates that dysmenorrhea affects between 50% and 90% of adolescent females worldwide, representing the leading cause of recurrent short-term academic absenteeism among high school students (Aisyaroh et al., 2022). In Indonesia, national epidemiologic surveys indicate that 64.25% of adolescent girls experience dysmenorrhea, comprising 54.89% primary dysmenorrhea and 9.36% secondary dysmenorrhea (Napu et al., 2023).

In Indonesia, statutory protections for adolescent reproductive health are legally guaranteed under Law No. 36 of 2009 regarding Health (Articles 71–73), which mandates the institutional provision of promotive, preventive, and counseling initiatives in school environments (Kementerian Kesehatan Republik Indonesia, 2018). Despite these policy mandates, dysmenorrhea remains under-addressed in secondary schools, often dismissed as an unavoidable adolescent affliction. Preliminary surveys conducted among tenth-grade students at MAN 2 Yogyakarta revealed that 9 out of 10 screened female students (90.0%) reported experiencing recurrent painful menstrual cramps, with several reporting functional distress during class hours. The intensity of dysmenorrhea exhibits pronounced individual variability, spanning mild discomfort to incapacitating prostration (Luh Neta Surastri Maharani et al., 2025).

Pathophysiologically, primary dysmenorrhea is primarily driven by the hypersecretion of endometrial prostaglandins, specifically prostaglandin F2-alpha (PGF2α) and prostaglandin E2 (PGE2), following progesterone withdrawal in ovulatory cycles (Itani et al., 2022). Elevated PGF2α triggers excessive myometrial hypercontractility and vasoconstriction of uterine arcuate arteries, generating intrauterine pressures exceeding 80–100 mmHg that surpass systemic arterial pressure. This localized vascular spasm precipitates transient uterine ischemia and cellular hypoxia, activating unmyelinated type C nociceptive nerve fibers in the pelvic plexus (Masnilawati & Thamrin, 2021; Sulistyaningdiah & Astuti, 2023). In this hypoxic cascade, circulating hemoglobin status emerges as an essential biological modifier. Hemoglobin is the iron-rich metalloprotein responsible for transporting oxygen from pulmonary alveolar beds to systemic peripheral tissues (Ardhana & Hastuti, 2018). When hemoglobin concentrations fall below normative thresholds (< 12.0 g/dL)—defining anemia—the oxygen-carrying capacity of the systemic circulation is drastically compromised (Ariana & Fajar, 2024; Jumiatun & Setyaningsih, 2023). In anemic adolescents, baseline uterine tissue oxygenation is chronically blunted; consequently, menstrual vasoconstriction induces more profound, prolonged anaerobic metabolism, lactic acid accumulation, and amplified pain transmission (Reni, 2024; Sulistyaningdiah & Astuti, 2023).

Although the ischemic-prostaglandin hypothesis provides a plausible biological rationale linking anemia to dysmenorrhea, published empirical findings remain conflicting. While several investigations demonstrate a strong positive correlation between low hemoglobin levels and severe dysmenorrhea (Masnilawati & Thamrin, 2021; Sulistyaningdiah & Astuti, 2023), other clinical evaluations suggest that dysmenorrhea severity is equally modulated by psychological stress, irregular lifestyle, physical activity, and familial predisposition (Susanti, 2024; Syamsudi et al., 2024). Furthermore, national studies indicate that adherence to government-mandated weekly iron-folic acid supplementation (Tablet Tambah Darah [TTD]) remains critically low among school-age adolescents (Diah Eko M et al., 2025; Wardani, 2024). Moreover, these lacked multivariable regression modeling to control for potential confounding variables—such as body mass index, dietary nutrient intake, stress scores, and physical activity—which limits the isolation of hemoglobin's independent clinical effect on dysmenorrhea.

Therefore, this study aimed to determine and analyze the relationship between hemoglobin levels and dysmenorrhea pain intensity among tenth-grade female students at MAN 2

Yogyakarta. The findings are intended to supply school health administrators, community health centers (Puskesmas), and public health midwives with empirical evidence to strengthen weekly iron supplementation compliance and integrate menstrual pain management into school-based health programs.

2. MATERIAL AND METHODS

2.1 Research Design

This study employed a quantitative observational analytical research design utilizing a cross-sectional approach. This design was chosen to investigate and evaluate the statistical association between the independent variable (hemoglobin levels) and the dependent variable (dysmenorrhea pain intensity) measured simultaneously at a single point in time.

2.2 Research Population and Sample

The study population comprised 139 tenth-grade female students at MAN 2 Yogyakarta. Using Slovin's formula with a 5% margin of error, 103 respondents were selected through purposive sampling. Inclusion criteria were active female students who had experienced menarche at age ≥11 years and provided informed consent. Students with secondary pelvic disorders, using oral hormonal contraceptives, or absent during data collection were excluded.

2.3 Research Setting and Time

The study was carried out at State Islamic Senior High School 2 Yogyakarta (Madrasah Aliyah Negeri [MAN] 2 Yogyakarta), located in Yogyakarta City, Special Region of Yogyakarta, Indonesia. The study was conducted in 2026.

2.4 Research Procedures

The research procedure included administrative licensing, ethical clearance, respondent screening, blood testing, and questionnaire administration. Trained enumerators collected capillary blood samples through aseptic fingertip puncture to measure hemoglobin levels. Participants then completed questionnaires on socio-demographic characteristics, weekly iron tablet consumption, and menstrual pain intensity during their most recent cycle.

2.5 Data Collection Techniques

Primary data collection integrated laboratory point-of-care screening and self-administered questionnaires. Biological data (hemoglobin concentration in g/dL) were gathered using a validated EasyTouch Hemoglobinometer following standard biosafety operating procedures. Pain intensity data were obtained using the Numerical Rating Scale (NRS).

2.6 Research Instruments

Hemoglobin concentrations were categorized per WHO into Not Anemic (≥ 12.0 g/dL), Mild (11.0–11.9 g/dL), Moderate (8.0–10.9 g/dL), and Severe Anemia (< 8.0 g/dL) (Kemenkes RI, 2018). Dysmenorrhea pain intensity was assessed using the 11-point Numerical Rating Scale (NRS, 0–10): No Pain (0), Mild (1–3), Moderate (4–6), Severe (7–9), and Very Severe (10). Adherence to weekly iron-folic acid supplementation was categorized dichotomously (Yes = routine; No = not routine).

2.7 Data Analysis

Data were analyzed using SPSS. Descriptive statistics determined absolute frequencies (f) and percentages (%) for demographic characteristics, hemoglobin categories, and dysmenorrhea severity. Bivariate hypothesis testing utilized Kendall's tau (τ) rank correlation at a significance threshold of alpha = 0.05.

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2.8 Scope and/or Limitations of the Research Used

The study's scope was delimited to tenth-grade female students at a single Islamic high school in Yogyakarta. Key methodological limitations include the cross-sectional design that predetermines correlational rather than temporal causal conclusions, the use of point-of-care capillary hemoglobinometry rather than venipuncture hematology testing, and the inability to control for unmeasured lifestyle and psychological confounders.

2.9 Ethical Considerations

This study was conducted in strict compliance with the Declaration of Helsinki. Ethical approval was formally granted by the Health Research Ethics Committee of Universitas 'Aisyiyah Yogyakarta (Komite Etik Penelitian Kesehatan [KEP-UNISA]) under Approval Certificate Number: 4981/KEP-UNISA/XII/2025. Informed consent was obtained from respondents and school guardians prior to invasive capillary sampling.

3. RESULTS AND DISCUSSION

3.1. Result

Table 1. Distribution of Respondent Characteristics (n = 103)

No	Respondent Characteristic	Classification / Category	Frequency (f)	Percentage (%)
1	Age (Years)	15 years old	49	47.6
		16 years old	52	50.5
		17 years old	2	1.9
2	Weekly Iron Supplementation (TTD)	Yes (Routinely ≥ 1x per week)	35	34.0
		No (Not routinely consumed)	68	66.0

Source: Primary research survey data, MAN 2 Yogyakarta, 2026.

As detailed in Table 1, half of the respondents were 16 years of age (50.5%, n = 52), followed by 15 years (47.6%, n = 49), and 17 years (1.9%, n = 2). Crucially, nearly two-thirds of the respondents (66.0%, n = 68) did not routinely consume weekly iron-folic acid tablets, while only 34.0% (n = 35) adhered to the recommended weekly regimen.

Table 2. Univariate Distribution of Hemoglobin Levels and Dysmenorrhea Pain Intensity (n = 103)

Variable Domain	Clinical Category / Threshold	Frequency (f)	Percentage (%)	Clinical Interpretation
Hemoglobin Level	Not Anemic (≥ 12.0 g/dL)	37	35.9	Adequate oxygenation
	Mild Anemia (11.0 – 11.9 g/dL)	9	8.7	Mild oxygen transport deficit
	Moderate Anemia (8.0 – 10.9 g/dL)	33	32.0	Substantial hypoxia risk
	Severe Anemia (< 8.0 g/dL)	24	23.3	Critical tissue hypoxia
Dysmenorrhea Pain Intensity	No Pain (NRS 0)	3	2.9	Asymptomatic menses
	Mild Pain (NRS 1 – 3)	47	45.6	Tolerable discomfort
	Moderate Pain (NRS 4 – 6)	45	43.7	Interferes with concentration
	Severe Pain (NRS 7 – 9)	8	7.8	Restricts daily activity
	Very Severe Pain (NRS 10)	0	0.0	Incapacitating prostration

Source: Primary research survey data, MAN 2 Yogyakarta, 2026.

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Univariate analysis (Table 2) showed that while 35.9% of students (n = 37) had normal hemoglobin levels, cumulative anemia was documented in 64.1% of the cohort, with 23.3% (n = 24) presenting with severe anemia (< 8.0 g/dL). Regarding menstrual pain, 45.6% (n = 47) experienced mild pain, 43.7% (n = 45) moderate pain, and 7.8% (n = 8) severe pain.

Table 3. Bivariate Cross-Tabulation of Hemoglobin Levels and Dysmenorrhea Pain Intensity (n = 103)

Hemoglobin Category	Dysmenorrhea Pain Intensity Level					Total	Statistical Test Results
	No Pain n (%)	Mild n (%)	Moderate n (%)	Severe n (%)	Very Severe n (%)		
Not Anemic (≥ 12 g/dL)	2 (1.9%)	22 (21.4%)	11 (10.7%)	2 (1.9%)	0 (0.0%)	37 (35.9%)	Kendall's tau (τ) = 0.222
Mild Anemia (11–11.9 g/dL)	0 (0.0%)	4 (3.9%)	4 (3.9%)	1 (1.0%)	0 (0.0%)	9 (8.7%)	p-value = 0.012
Moderate Anemia (8–10.9 g/dL)	0 (0.0%)	15 (14.6%)	15 (14.6%)	3 (2.9%)	0 (0.0%)	33 (32.0%)	(Significant at α < 0.05)
Severe Anemia (< 8 g/dL)	1 (1.0%)	6 (5.8%)	15 (14.6%)	2 (1.9%)	0 (0.0%)	24 (23.3%)	Reject H0
Total Respondents	**3 (2.9%)**	**47 (45.6%)**	**45 (43.7%)**	**8 (7.8%)**	**0 (0.0%)**	**103 (100.0%)**	

Source: Primary research survey data, MAN 2 Yogyakarta, 2026.

Among non-anemic students, most experienced mild dysmenorrhea (59.5%), whereas 62.5% of students with severe anemia experienced moderate dysmenorrhea. Kendall's tau showed a significant positive association between anemia severity and dysmenorrhea intensity (τ = 0.222; p = 0.012), indicating that lower hemoglobin levels were associated with greater pain intensity.

3.2 Discussion

The central finding of this investigation confirms a statistically significant relationship between hemoglobin concentrations and dysmenorrhea pain intensity among adolescent students at MAN 2 Yogyakarta (Kendall's tau = 0.222, p = 0.012). Adolescents presenting with reduced hemoglobin levels (< 12.0 g/dL) exhibited a distinct shift toward higher pain intensities (moderate to severe cramps). Specifically, 62.5% of severely anemic students experienced moderate pain, whereas 59.5% of non-anemic students reported only mild discomfort. Furthermore, the survey revealed an alarming 66.0% non-compliance rate regarding weekly iron tablet supplementation, directly paralleling the high cumulative anemia rate (64.1%) observed in the school population.

These empirical outcomes are strongly congruent with established reproductive health literature. Masnilawati & Thamrin (2021) demonstrated that adolescent hemoglobin status was significantly associated with dysmenorrhea severity (p = 0.000). Similarly, Sulistyaningdiah & Astuti (2023) observed that 59% of high school students in Lampung with low hemoglobin suffered from severe menstrual cramps, underscoring that adolescent anemia remains widespread across Indonesian secondary schools. In Tuban, Diah Eko M et

al. (2025) demonstrated that regular iron supplementation significantly elevated hemoglobin levels ($p = 0.001$) and attenuated menstrual cramping, aligning with national reviews by Wardani (2024) highlighting that compliance is the primary barrier to anemia resolution. Furthermore, international trials by Itani et al. (2022) affirm that systemic physiological status and trace mineral sufficiency directly modulate uterine hypercontractility.

The physiological mechanism linking low hemoglobin to heightened dysmenorrhea can be explained through the ischemic-prostaglandin hypothesis (Masnilawati & Thamrin, 2021; Sulistyaningdiah & Astuti, 2023). Hemoglobin serves as the sole carrier of molecular oxygen to myometrial cells. During menses, endometrial breakdown releases PGF2α, inducing physiological uterine contractions to expel the functionalis layer. In adolescents with anemia, systemic hypoxemia compromises baseline oxygen delivery to the contracting myometrium. As intramyometrial pressure rises during contractions, local microvascular perfusion is occluded, provoking acute reversible myometrial ischemia. This tissue hypoxia stimulates anaerobic glycolysis, lowering intracellular pH and triggering compensatory cyclooxygenase (COX-2) upregulation, which produces further excess PGF2α. Consequently, myometrial spasms become uncoordinated, prolonged, and severe, stimulating sensitized pelvic visceral afferent fibers and lowering somatic pain thresholds (Ardhana & Hastuti, 2018; Sulistyaningdiah & Astuti, 2023).

Although statistically significant, the correlation ($\tau = 0.222$) was relatively weak, indicating that anemia is one of several factors influencing dysmenorrhea. Some non-anemic students experienced moderate-to-severe pain, while some severely anemic students reported mild or no pain. Other contributing factors include psychological stress, lifestyle, diet, BMI, and genetic factors (Susanti, 2024; Syamsudi et al., 2024). These findings highlight the importance of strengthening school-based iron supplementation programs to support adolescent health and potentially reduce menstrual pain.

3.3 Implications

Schools and Puskesmas should strengthen the Adolescent Iron Supplementation Program through supervised weekly iron-tablet consumption, supported by nutritional counseling on iron-rich foods and vitamin C intake.

3.4 Research contribution

This study contributes empirical field data from an Islamic senior high school in Yogyakarta, documenting the quantitative relationship between point-of-care hemoglobin metrics and NRS pain scores to support evidence-based adolescent health policies.

3.5 Limitations

Several limitations must be acknowledged: (1) The cross-sectional design captures associations rather than temporal causality; (2) The absence of multivariable regression modeling controlling for confounding variables (BMI, stress, physical activity); and (3) Reliance on self-reported recall for iron tablet consumption and menstrual pain.

3.6 Suggestions

Future inquiries should conduct prospective cohort or randomized intervention studies tracking dysmenorrhea severity before and after supervised 12-week iron-folic acid supplementation, utilize automated laboratory hematology analyzers, and incorporate serum ferritin and prostaglandin biomarker assays.

4. CONCLUSION

A significant relationship was found between hemoglobin levels and dysmenorrhea intensity among female students at MAN 2 Yogyakarta ($\tau = 0.222$; $p = 0.012$), with lower hemoglobin levels associated with greater pain intensity. Non-adherence to weekly iron supplementation was high (66.0%), highlighting the need for supervised iron-tablet consumption and reproductive health education through school–Puskesmas collaboration.

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AUTHOR CONTRIBUTIONS STATEMENT

AS: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing original draft. SL: Supervision, Methodology, Validation, Writing, review and editing, Project administration.

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