



Modeling Dysmenorrhea Using PLS-SEM: The Role of Pain Frequency, Severity, and Self-Management among Female Health Students

Karwati^{1*}, Heru Santoso Wahito Nugroho²

¹ Department of Midwifery, STIKes Budi Luhur, Cimahi, West Java, Indonesia

² Center of Excellence of Community Empowerment in Health, Poltekkes Kemenkes Surabaya, Surabaya, East Java, Indonesia

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***Corresponding author**
Email: karwatidk@gmail.com

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ABSTRACT

Dysmenorrhea remains a common health issue among young women, yet limited studies have examined the behavioral structure underlying its burden, particularly among female health students. This study aimed to develop and test a structural behavioral model linking menstrual bleeding duration, pain frequency, pain severity, and primary self-management methods. A cross-sectional design was employed involving 215 female health students, with data collected through a structured questionnaire. The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the relationships among variables. The findings indicate that menstrual pain frequency significantly predicts pain severity ($p < 0.001$) and the choice of primary self-management methods ($p = 0.034$). In contrast, menstrual bleeding duration showed no significant effect on either pain severity or self-management strategies. These results highlight that pain frequency is the key determinant in shaping dysmenorrhea burden and behavioral responses, providing a novel contribution to understanding self-management patterns among health students. The study suggests that interventions should prioritize managing pain frequency to reduce dysmenorrhea impact.

Keywords: Dysmenorrhea, Pain Frequency, Pain Severity, Self-Management Method, Female Health Students.

ABSTRAK

Dismenore tetap menjadi masalah kesehatan umum di kalangan wanita muda, namun studi yang meneliti struktur perilaku yang mendasari bebannya masih terbatas, khususnya di kalangan mahasiswa kesehatan. Studi ini bertujuan untuk mengembangkan dan menguji model perilaku struktural yang menghubungkan durasi perdarahan menstruasi, frekuensi nyeri, tingkat keparahan nyeri, dan metode manajemen diri utama. Desain cross-sectional digunakan dengan melibatkan 215 mahasiswa kesehatan, dengan pengumpulan data melalui kuesioner terstruktur. Analisis dilakukan menggunakan Partial Least Squares Structural Equation Modeling (PLS-SEM) untuk mengevaluasi hubungan antar variabel. Temuan menunjukkan bahwa frekuensi nyeri menstruasi secara signifikan memprediksi tingkat keparahan nyeri ($p < 0,001$) dan pilihan metode manajemen diri utama ($p = 0,034$). Sebaliknya, durasi perdarahan menstruasi tidak menunjukkan efek signifikan pada tingkat keparahan nyeri maupun strategi manajemen diri. Hasil ini menyoroti bahwa frekuensi nyeri adalah penentu utama dalam membentuk beban dismenore dan respons perilaku, memberikan kontribusi baru untuk memahami pola manajemen diri di kalangan mahasiswa kesehatan. Studi ini menunjukkan bahwa intervensi harus memprioritaskan pengelolaan frekuensi nyeri untuk mengurangi dampak dismenore.

Kata Kunci: Dismenore, Frekuensi Nyeri, Keparahan Nyeri, Metode Manajemen Diri, Mahasiswa Kesehatan.

INTRODUCTION

Menstruation is a normal physiological process indicating reproductive maturity; however, menstrual pain (dysmenorrhea) remains one of the most common health complaints among adolescent girls and young adult women. Studies across different populations consistently report that a large proportion of young women experience dysmenorrhea, many of whom suffer recurrent

symptoms that interfere with daily activities, social participation, and learning performance. Although often considered a routine part of the menstrual cycle, dysmenorrhea represents a significant health concern due to its high prevalence and functional impact (Armour et al., 2019; Hennegan et al., 2019).

Beyond the physical sensation of pain, dysmenorrhea involves multidimensional consequences, including fatigue, reduced concentration, mood disturbances, sleep problems, and diminished quality of life (Chen et al., 2018). Among students, these effects may translate into decreased academic productivity, absenteeism, and limitations in physical or clinical activities, suggesting that menstrual pain is not merely a biological phenomenon but also a behavioral and educational issue. At the global level, dysmenorrhea is recognized as one of the leading causes of short-term school and work absenteeism among young women (Schoep et al., 2019). Despite its widespread occurrence, many individuals rely primarily on informal self-management rather than seeking professional care, often normalizing menstrual pain and managing it through rest, heat therapy, or simple behavioral adjustments (Armour et al., 2019). Regionally, cultural norms in Asian contexts further reinforce endurance and self-care practices rather than medical consultation (Hennegan et al., 2019).

At the local institutional level, preliminary data from female students at STIKes Budi Luhur Cimahi reveal an exceptionally high prevalence of dysmenorrhea, where 190 out of 215 students reported always experiencing menstrual pain and the remaining 25 reported occasional pain. This pattern indicates that dysmenorrhea is nearly universal within this population and may be socially normalized, potentially influencing how symptoms are perceived and managed. Given that these students are future healthcare providers, their experiences may shape both personal coping strategies and future clinical perspectives (Chen, Draucker, & Carpenter, 2018). Therefore, understanding the determinants of dysmenorrhea and associated behaviors in this group is particularly important for both student well-being and future health service delivery.

Existing research on dysmenorrhea has primarily focused on prevalence, biological mechanisms, and treatment effectiveness (Armour et al., 2019; Hennegan et al., 2019). While these studies provide valuable clinical insights, they often examine menstrual characteristics, pain perception, and coping behavior as separate domains. More recent menstrual-health research emphasizes the need for integrative approaches that connect symptom characteristics with behavioral responses to better understand self-management decision-making (Hennegan et al., 2020). However, empirical evidence remains limited regarding how menstrual bleeding duration may influence pain frequency, how pain frequency may shape perceived severity, and how both factors collectively determine self-management behavior within a unified structural framework.

Therefore, this study offers a novel contribution by developing and testing a structural behavioral model of dysmenorrhea that simultaneously examines the relationships between menstrual bleeding duration, pain frequency, pain severity, and the primary self-management method among female health students. By integrating physiological and behavioral dimensions within a single analytical model, this study aims to clarify key determinants of dysmenorrhea burden and provide a more comprehensive understanding of how menstrual characteristics shape both symptom experience and management behavior.

RESEARCH METHODS

This study was conducted at STIKes Budi Luhur Cimahi, Indonesia, in October 2025. The institution was selected as it represents a health-science educational environment in which female students' experiences of menstrual pain are closely related to both academic performance and future professional practice. The study employed a quantitative approach using an observational analytic design with a cross-sectional framework, allowing assessment of relationships among variables measured at a single point in time (Setia, 2016).

The target population consisted of 455 female students enrolled at STIKes Budi Luhur Cimahi. The sample size was calculated using the Slovin formula, which is appropriate for survey-based studies with known population size (Tejada & Punzalan, 2012). With a 5% margin of error, the minimum required sample was 213 respondents. To ensure adequate representation, a total of 215 students were included. Participants were recruited based on

eligibility criteria, namely female students who had experienced menstruation and provided informed consent.

The variables were defined based on the proposed behavioral model of dysmenorrhea. Menstrual bleeding duration was treated as the independent variable. Pain frequency and pain severity were specified as mediating variables, representing recurrence and perceived intensity of menstrual pain. The dependent variable was the primary self-management method used during menstruation. Pain frequency was measured categorically (rare, occasional, frequent, or constant). Pain severity was measured using a Numeric Rating Scale (NRS) ranging from 0 to 10, where 0 indicates no pain and 10 indicates the worst possible pain. For analysis, pain severity was categorized into mild (1–3), moderate (4–6), and severe (7–10). The primary self-management method was categorized based on the main strategy reported by participants, such as resting/lying down, warm compress, or other behavioral approaches. This variable configuration enabled examination of both direct and indirect relationships within a structural behavioral framework (Hair, 2021).

Data were collected using a structured self-administered questionnaire distributed via Google Forms. Online data collection was selected due to its efficiency, accessibility, and suitability for student populations (Ball, 2019; Hlatshwako et al., 2021). The questionnaire included items related to menstrual characteristics, pain frequency, pain severity, and self-management practices. All responses were recorded in categorical or ordinal formats to facilitate statistical analysis.

Data analysis was conducted in two stages. First, descriptive statistics were used to summarize the characteristics of respondents and study variables. As the data were categorical, results were presented as frequencies and percentages (Setia, 2016). Second, structural analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine relationships among variables. This approach is appropriate for exploratory and prediction-oriented research involving complex variable relationships (Hair, 2021). The analysis included evaluation of path coefficients, standard errors, t-values, p-values, and coefficients of determination (R^2) to assess the strength and significance of the hypothesized model.

This study adhered to ethical principles for research involving human participants, including voluntary participation, informed consent, confidentiality, and secure data handling. Ethical approval was obtained from the Health Research Ethics Committee of STIKes Budi Luhur Cimahi (Ethical Clearance No. 186/D/KEPK-STIKes/X/2025). Ethical compliance is essential to ensure participant protection and maintain the integrity of health research (World Medical Association, 2013).

RESULTS

Table 1. Distribution of Menstrual Characteristics, Pain, and Self-Management (n = 215).

Variable	Category	Frequency	Percentage
Bleeding duration (days)	1	12	5.6
	2	16	7.4
	3	29	13.5
	4	30	14.0
	5	52	24.2
	6	23	10.7
	7	39	18.1
	8	10	4.7
	9	4	1.9
Pain frequency	Rarely	34	15.8
	Sometimes	88	40.9
	Often	15	7.0
	Always	78	36.3
Pain severity (NRS 0–10)	0	5	2.3
	1	22	10.2
	2	22	10.2

Variable	Category	Frequency	Percentage
	3	60	27.9
	4	37	17.2
	5	32	14.9
	6	21	9.8
	7	6	2.8
	8	5	2.3
	9	4	1.9
	10	1	0.5
Primary self-management	Resting/lying down	85	39.5
	Warm compress	63	29.3
	Analgesics	25	11.6
	Posture adjustment	21	9.8
	Others	21	9.8

Table 1 presents the combined distribution of menstrual bleeding duration, pain frequency, pain severity, and primary self-management methods among respondents. Overall, most respondents experienced menstrual bleeding within the normal physiological range (4–7 days), with a peak at 5 days. Dysmenorrhea was highly prevalent, with 43.3% of respondents reporting frequent or constant pain. Pain severity was predominantly mild to moderate, with a peak at score 3. Self-management behavior was strongly concentrated in passive non-pharmacological strategies, particularly resting and warm compress, which together accounted for nearly 70% of responses.

Table 2. Structural Path Estimates in Final Model (PLS-SEM)

Path	β	Boot SE	t-value	p-value	95% CI	Effect size interpretation
Pain frequency → pain severity	0.519	0.044	11.73	< 0.001	0.433 – 0.605	Moderate-to-strong effect
Pain frequency → self-management	0.138	0.065	2.12	0.034	0.011 – 0.265	Small effect

Table 2 presents the structural path estimates from the final PLS-SEM model, including standardized coefficients (β), standard errors, t-values, p-values, and 95% confidence intervals. The results indicate that pain frequency is a statistically significant predictor of both pain severity and self-management behavior. The relationship between pain frequency and pain severity shows a moderate-to-strong effect ($\beta = 0.519$), with a narrow confidence interval indicating stable estimation. In contrast, the effect of pain frequency on self-management behavior is statistically significant but small ($\beta = 0.138$), with a wider confidence interval indicating weaker practical influence.

Table 3. Explained Variance (R^2) in Final Model

Endogenous Variable	R^2	Adjusted R^2	Interpretation
Pain severity	0.269	0.266	Moderate explanatory power
Self-management	0.019	0.015	Very weak explanatory power

Based on Table 3, pain frequency explains approximately 26.9% of the variance in pain severity, indicating moderate predictive relevance. However, it explains only 1.9% of the variance in self-management behavior, suggesting that most determinants of coping strategies lie outside the model.

The final structural model demonstrates a clear and parsimonious pattern in which pain frequency acts as the primary determinant of dysmenorrhea burden. A higher frequency of menstrual pain is associated with increased pain severity and, to a lesser extent, influences the choice of self-management strategies. However, the very low explained variance for self-management indicates that behavioral responses are likely influenced by additional external factors such as cultural norms, access to treatment, prior experiences, and health knowledge.

Menstrual bleeding duration was not retained in the final model due to its lack of significant association with other variables, indicating that physiological duration alone does not meaningfully explain variations in pain experience or coping behavior in this population.

Overall, these findings suggest that interventions should prioritize reducing the recurrence of menstrual pain, as pain frequency emerges as the most influential factor shaping both perceived severity and behavioral response.

DISCUSSION

The findings confirm that dysmenorrhea is highly prevalent among female health students, with most participants experiencing recurrent menstrual pain. This prevalence is consistent with global estimates indicating that dysmenorrhea affects a large proportion of adolescents and young adults (American College of Obstetricians and Gynecologists, 2018; WHO, 2022). The high frequency observed in this study suggests that menstrual pain should be understood not merely as a routine physiological experience but as a significant and persistent student health concern (American College of Obstetricians and Gynecologists, 2018). Behavioral and contextual factors, including academic demands and lifestyle patterns, may contribute to this elevated burden (Armour et al., 2019).

Despite the high prevalence of dysmenorrhea, menstrual bleeding duration in this population was largely within the normal physiological range, with most respondents reporting 4–7 days and a peak at five days. This pattern aligns with established clinical guidelines and epidemiological evidence indicating that typical menstrual duration reflects stable reproductive physiology (WHO, 2021; Schoep et al., 2019). Importantly, the structural analysis demonstrated that menstrual duration did not significantly influence pain frequency or severity, suggesting that normal-cycle characteristics alone are insufficient to explain dysmenorrhea burden (Armour et al., 2019).

In contrast, menstrual pain frequency emerged as the most important determinant in the model, strongly predicting pain severity and, to a lesser extent, influencing self-management behavior. This finding supports contemporary pathophysiological explanations in which repeated prostaglandin-mediated uterine activity and recurrent nociceptive stimulation contribute to increased pain perception over time (Lacovides, 2017; Barcikowska, 2020). The results also align with emerging evidence suggesting that recurrence patterns may be more critical than static menstrual characteristics in explaining dysmenorrhea outcomes (Chen, 2018; Armour, 2019).

The distribution of pain severity, which was predominantly mild to moderate, is consistent with international findings indicating that most dysmenorrhea cases fall within non-severe categories (Armour et al., 2019; Lacovides, 2015; Hu et al., 2020; Chen et al., 2018). However, even moderate pain has been shown to affect academic performance, daily functioning, and quality of life (Schoep et al., 2019). Similarly, the concentration of self-management strategies in rest and warm compress reflects commonly reported behavioral patterns among adolescents, where accessible and non-pharmacological approaches are preferred (Armour et al., 2019; Barcikowska et al., 2020; Chen et al., 2018; UNESCO, 2014; WHO, 2021). The weak association between symptom characteristics and self-management suggests that treatment decisions are influenced not only by clinical factors but also by sociocultural norms, knowledge, and prior experiences (Nutbeam & Lloyd, 2021; Armour et al., 2019).

A key contribution of this study lies in the use of a structural modeling approach to integrate menstrual characteristics, pain experience, and behavioral responses within a single framework. Unlike previous studies that examine these domains separately, this study demonstrates that pain frequency functions as the central pathway linking physiological processes to perceived severity and coping behavior. Furthermore, the findings reveal a knowledge–behavior gap among health students, indicating that even individuals with health education do not necessarily base self-management decisions solely on symptom severity (UNESCO, 2014; WHO, 2021).

This study has several limitations. First, the cross-sectional design limits causal inference between variables. Second, the measurement of self-management was restricted to the primary method, which may not fully capture the complexity of coping behaviors. Third, the model explains only a small proportion of variance in self-management, indicating that important psychosocial and contextual factors were not included. Despite these limitations, the study provides important

evidence that dysmenorrhea burden is primarily driven by pain recurrence rather than menstrual duration. In conclusion, interventions should prioritize reducing the frequency of menstrual pain episodes and improving informed self-management strategies, particularly among future health professionals.

CONCLUSION

This study confirms that dysmenorrhea is highly prevalent among female health students, with recurrent pain predominantly at mild-to-moderate levels and managed mainly through passive strategies. The structural model shows that pain frequency is the key determinant, significantly influencing pain severity and, to a lesser extent, self-management behavior, while menstrual bleeding duration has no meaningful effect.

These findings suggest that dysmenorrhea should be addressed as a recurrence-driven condition rather than solely a physiological one. Practically, interventions should focus on reducing pain recurrence, improving menstrual health literacy, and promoting appropriate self-management strategies. Strengthening menstrual health education among health students is essential to support both personal well-being and future professional practice.

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