Jurnal Cakrawala Promkes
Vol. 7, No. 2, August 2025, pp. 132-142
p-ISSN: 2654-9980 e-ISSN: 2656-0534
http://journal2.uad.ac.id/index.php/cp/index

Determinants of menstrual pain severity among female medical students: a cross-sectional study

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ARTICLE INFO

Article history
Received : July 26, 2025
Revised : September 4, 2025
Accepted : September 12, 2025

Keywords:
Body Mass Index;
Dysmenorrhea;
Exercise;
Menarche;
Menstrual pain;

ABSTRACT

Dysmenorrhea, or menstrual pain, is one of the most common gynecological complaints among women of reproductive age, particularly among female students. Its impact extends beyond physical discomfort, affecting academic performance, psychological well-being, and overall quality of life. Despite its high prevalence, few studies have examined the determinants of menstrual pain severity among female medical students in Indonesia. This study aimed to identify the determinants of menstrual pain severity among female medical students at the Faculty of Medicine, Universitas Negeri Surabaya. A cross-sectional, descriptive quantitative study was conducted in November 2024, involving 112 participants selected through simple random sampling. Data were collected using a structured online questionnaire and analyzed with Spearman's rho correlation and ordinal regression to assess associations between menstrual pain severity and independent variables, including body mass index (BMI), age at menarche, menstrual cycle characteristics, and exercise habits. Bivariate analysis indicated significant associations between menstrual pain severity and BMI ($p = 0.004$), age at menarche ($p = 0.032$), and exercise frequency ($p = 0.038$). However, in the adjusted multivariate regression model, only menstrual cycle length greater than 35 days remained significantly associated with increased pain severity ($B = 1.143$; $p = 0.017$). Other hypothesized predictors, including BMI, age at menarche, and exercise, did not retain independent effects after adjustment. In conclusion, irregular menstrual cycles—particularly very long cycles—were identified as the only independent determinant of increased menstrual pain severity among female students. These findings underscore the importance of considering menstrual cycle patterns when exploring risk factors for dysmenorrhea, while suggesting that commonly presumed predictors may not directly influence pain severity in this population.

1. Introduction

Dysmenorrhea, or menstrual pain, is the most common gynecological complaint among women of reproductive age, characterized by severe cramping in the lower abdomen caused by uterine contractions [1]. Based on its pathophysiological aspects, dysmenorrhea is divided into two main categories. Primary dysmenorrhea is menstrual pain not associated with anatomical abnormalities or gynecological pathologies, typically occurring shortly before or during menstruation. In contrast, secondary dysmenorrhea results from identifiable organic conditions such as endometriosis, adenomyosis, uterine fibroids (leiomyomas), or pelvic inflammatory disease [2]. Associated

symptoms may include headaches, dizziness, nausea, vomiting, diarrhea, loss of appetite, and tachycardia, typically occurring just before or during menstruation [3].

Menstrual pain experienced during menstruation among women, particularly adolescent girls, is one of the most commonly reported gynecological disorders, with prevalence rates varying between 43% and 93% based on several cross-national and age-group studies [1,4]. Data from the World Health Organization (WHO) even indicates that this condition affects approximately 1.7% to 97% of women globally [3]. In Indonesia, the number of dysmenorrhea cases recorded was 107,673 (64.25%). Of these, 59,671 (54.89%) experienced primary dysmenorrhea, while 9,496 (9.36%) suffered from secondary dysmenorrhea [5]. Data from the 2020 census shows that every group of Indonesians has 67 adolescents aged 10 to 24 years. 55% of Indonesian adolescents experience dysmenorrhea pain [6].

Dysmenorrhea not only causes physical discomfort such as abdominal cramps, but also has a significant impact on various aspects of life [7]. Many women are forced to miss school or work for at least one day due to severe pain, and it is estimated that over 140 million productive hours are lost each year due to this condition. Approximately 10–15% of women experience extremely severe menstrual pain that hinders normal daily activities at home, work, or school [3]. In addition to physical aspects, dysmenorrhea also causes psychological impacts, such as sleep disturbances, emotional stress, irritability, and reduced participation in social activities, which overall can lower quality of life, especially for medical students with high academic workloads [8].

In efforts to manage primary dysmenorrhea, various treatment strategies have been implemented, both pharmacological and non-pharmacological [9]. One commonly used pharmacological approach is hormonal contraception, which works by suppressing ovulation and prostaglandin production, thereby reducing intrauterine pressure and uterine contractions, the primary causes of pain [10]. Additionally, non-pharmacological therapies are increasingly being developed, particularly for women who are not suited to chemical treatments. One notable intervention is exercise, which has been shown to have a greater effect in alleviating pain compared to heat therapy and acupressure, and has the potential to be an effective and safe alternative to the use of analgesics [4]. Other methods, such as the use of nonsteroidal anti-inflammatory drugs (NSAIDs), special diets, meditation, and acupuncture, have also been employed in the management of dysmenorrhea. However, dysmenorrhea remains a widespread problem, especially among students and college students, with various contributing factors, such as young age, early menarche, abnormal menstrual duration or patterns, family history, psychological disorders, genetic factors, and a history of sexual abuse [2,3].

Previous studies conducted in Ethiopia have shown that the prevalence of dysmenorrhea among female students ranges from 58.5% to 85.4% [3]. This variation in figures indicates that dysmenorrhea is a relatively common reproductive health issue among adolescent girls, particularly students. Several risk factors contribute to primary dysmenorrhea. Early menarche (<12 years) increases the risk by 56.5%. Body mass index (BMI) is also a significant factor, with adolescents classified as overweight or obese experiencing dysmenorrhea at a rate of 47.8%. Furthermore, meta-analyses have shown that both low BMI (<18.5) and high BMI (>25) are associated with a higher incidence. Family history is another dominant factor, with a prevalence of 65.2%, aligning with a meta-analysis that reported an odds ratio of 2.1 (95% CI: 1.6–2.8). In addition, 78% of adolescents experiencing dysmenorrhea were found to have regular menstrual cycles. Lifestyle factors also play a role, including high caffeine consumption (86.8%), smoking habits (87.4%), and emotional problems (94.3%), all of which have been reported to be significantly associated with an increased prevalence of dysmenorrhea [11–13]. The high prevalence and diverse risk factors related to

dysmenorrhea highlight the need for further research to identify specific determinants contributing to the severity of menstrual pain, particularly among female college students [14].

There is insufficient data on the factors contributing to the severity of menstrual pain among female students at the Faculty of Medicine, Universitas Negeri Surabaya (UNESA). However, severe menstrual pain can impact academic performance, especially in a medical education environment that demands high concentration, active participation, and involvement in clinical practice. Findings from studies conducted in other countries also reveal that female students are absent from school on average from the first to the fourth day of their menstrual cycle [15,16]. This condition indicates that moderate to severe dysmenorrhea is a real problem experienced by some students and has the potential to disrupt the learning process. Based on this background, the researchers were interested in conducting a study aimed at identifying the determining factors associated with the severity of menstrual pain in female students at the Faculty of Medicine.

2. Method

This study is a quantitative study with a descriptive research design using a cross-sectional approach. The study was conducted at the Faculty of Medicine, Surabaya State University, and was carried out in November 2024. The study population consisted of 155 female medical students across four programs: Medicine, Nursing, Midwifery, and Physiotherapy. Using simple random sampling, 130 students were initially selected. After applying the inclusion criteria, which included being an active student at the Faculty of Medicine, being over 10 years old, and having experienced menstruation, 112 students were eligible and agreed to participate, while 18 students declined participation.

Data Collection and Handling of Missing Data

Data were collected using a structured digital questionnaire via Google Forms. Respondents independently completed the questionnaire via an online link. In addition to the main study variables, socio-demographic information of participants (including age, program of study, and year of study) was also obtained to describe the study population. All items were mandatory in the digital form; therefore, no missing data occurred.

Variables and Justification

The independent variables in this study were body mass index (BMI), age at menarche, menstrual cycle regularity, and exercise habits. These variables were selected based on prior evidence indicating their association with dysmenorrhea and menstrual pain severity. Specifically, early menarche and irregular cycles are established biological predictors, while BMI and exercise represent modifiable lifestyle factors. The dependent variable was menstrual pain severity, considered clinically relevant due to its impact on students' daily activities and academic performance.

Operational Definitions and Level of Measurement

Body Mass Index (BMI): Calculated as weight (kg) divided by height squared (m^2). Categorized into: underweight (<18.5), normal (18.5–24.9), overweight (25–29.9), and obese (≥30). Measurement level: ordinal. **Age at Menarche:** The age (in years) at first menstruation, categorized as early menarche (<12 years, Normal Menarche (12–14 years), and Late Menarche (>14 years). Measurement level: ordinal. **Menstrual Cycle:** Self-reported as cycle length, categorized as <29 days, 29-30 days, >30 days, >35 days. Measurement level: ordinal. **Exercise Habits:** Frequency of exercise per week, categorized as never, 1–2 times/week, and ≥3 times/week. Measurement level: ordinal. **Menstrual Pain Severity (Dependent Variable):** classified as No Pain, Mild, Moderate, and Severe. Measurement level: ordinal.

Data Analysis

Numerical data were coded before statistical analysis. To determine the relationship between independent and dependent variables, Spearman's rho correlation test was applied. Differences between groups and the factors influencing menstrual pain severity were analyzed using ordinal regression analysis, with the event of interest defined as increasing severity of menstrual pain (mild, moderate, severe). All analyses were conducted using IBM SPSS Statistics version 25, with a 95% confidence interval (CI) and significance level set at $p < 0.05$.

Ethical Considerations

All respondents provided informed consent prior to participation. This study was approved by the Health Research Ethics Committee of the Faculty of Dentistry, University of Jember (No. 2886/UN25.8/KEPK/DL/2024).

3. Results and Discussion

3.1. Results

Table 1. Socio-demographic Characteristics and Correlation Analysis of Determinants of Menstrual Pain

Characteristics		N (%)	*Menstrual Pain Level*				*Correlation coefficient (r)*	*P-value*
			No Pain N=7 (6.3%)	*Mild Pain N=30 (26.8%)*	*Moderate Pain N=52 (46.4%)*	*Severe Pain N=23 (20.5%)*		
Study Programs	Bachelor of Medicine	35 (28.9)	3 (8.6)	7 (20)	18 (51.4)	7 (20)	-0.026	0.406
	Bachelor of Nursing	24 (19.8)	1 (4.2)	7 (29.2)	11 (45.8)	5 (20.8)		
	Bachelor of Midwifery	25 (20,7)	2 (8)	8 (32)	9 (36)	6 (24)		
	Bachelor of Physiotherapy	28 (23.1)	1 (3.6)	8 (28.6)	14 (50)	5 (17.9		
Age (Mean, SD) (18.37 ± 0.723)	16 years	1 (0.9)	0 (0)	1 (100)	0 (0)	0 (0)	-0.079	0.788
	17 years	5 (4.5)	0 (0)	1 (20)	1 (20)	3 (60)		
	18 years	66 (58.9)	7 (10.6)	20 (30.3)	27 (40.9)	12 (18.2)		
	19 years	32 (28.6)	0 (0)	6 (18.8)	20 (62.5)	6 (18.8)		
	20 years	8 (7.1)	0 (0)	2 (25)	4 (50)	2 (25)		
BMI	Underweight	24 (21.4)	1 (4.2)	11 (45.8)	10 (41.7)	2 (8.3)	0.271	0.004
	Normal	60 (53.6)	6 (10)	14 (23.3)	32 (53.3)	8 (13.3)		
	Overweight	17 (15.2)	0 (0)	3 (17.6)	8 (47.1)	6 (35.3)		
	Obesity	11 (9.8)	0 (0)	2 (18.2)	2 (18.2)	7 (63.6)		
Menarche Age	Early Menarche	27 (24.1)	0 (0)	2 (7.4)	13 (48.1)	12 (44.4)	-0.203	0.032
	Normal Menarche	68 (60.7)	6 (8.8)	22 (32.4)	33 (48.5)	7 (10.3)		
	Late Menarche	17 (15.2)	1 (5.9)	6 (35.3)	6 (35.3)	4 (23.5)		
Menstrual Cycle (Mean, SD) (34.21 ± 10.7)	<29 days	19 (17.0)	0 (0)	6 (31.6)	10 (52.6)	3 (15.8)	0.071	0.458
	29-30 days	38 (33.9)	6 (15.8)	10 (26.3)	21 (55.3)	1 (2.6)		
	>30 days	13 (11.6)	1 (7.7)	4 (30.8)	4 (30.8)	4 (30.8)		
	>35 days	12 (10.7)	0 (0)	0 (0)	4 (33.3)	8 (66.7)		
	Irregular	30 (26.8)	0 (0)	10 (33.3)	13 (43.4)	7 (23.3)		
Exercise	Never	14 (12.5)	0 (0)	0 (0)	6 (42.9)	8 (57.1)	-0.196	0.038
	Only exercise when you feel like it	65 (58.0)	0 (0)	15 (23.1)	37 (56.9)	13 (20)		
	Routine 1x per week	17 (15.2)	1 (5.9)	7 (41.2)	7 (41.2)	2 (11.8)		
	Routine 2-3x per week	16 (14.3)	6 (37.5)	8 (50)	2 (12.5)	0 (0)		

The majority of respondents were medical students (28.9%) with an average age of 18 years, reflecting that most participants were in their late teens. Nutritional status varied, with more than half having normal BMI, while smaller proportions were underweight, overweight, or obese. In terms of menstrual characteristics, most experienced menarche at a normal age, with some reporting early or late menarche, and about one-fourth reporting irregular cycles. Regarding menstrual pain, nearly half

of the students experienced moderate pain (46.4%), followed by mild pain (26.8%), severe pain (20.5%), and only a small proportion reported no pain (6.3%).

Bivariate analysis using Spearman's correlation revealed that body mass index (BMI), age at menarche, and exercise habits were significantly associated with the severity of menstrual pain. Higher BMI (r = 0.271; p = 0.004) was positively correlated with more severe dysmenorrhea, while age at menarche (r = –0.203; p = 0.032) showed a negative correlation, indicating that earlier menarche was linked to higher pain intensity. Similarly, exercise (r = –0.196; p = 0.038) demonstrated a negative correlation, suggesting that students who exercised more frequently tended to report milder menstrual pain.

In contrast, age (r = –0.026; p = 0.788), study program (r = –0.079; p = 0.406), and menstrual cycle length (r = 0.071; p = 0.458) were not significantly associated with the severity of dysmenorrhea. This suggests that demographic factors such as age and study program may not directly influence menstrual pain. In contrast, lifestyle and reproductive health characteristics, including BMI, age at menarche, and exercise, play a more prominent role. Overall, the findings indicate that dysmenorrhea is a common condition among respondents, with varying levels of severity, and highlight key factors that may contribute to its intensity in this population.

Table 2. Determinant Factors of Menstrual Pain Severity Among Female Medical Students

Parameters		*B*	*SE*	*Wald*	*p-value*	*CI (95%)*	
						Lower	*Upper*
Age	16 years old	-18.380	0.000	.	.	-18.380	-18.380
	17 years old	2.100	1.163	3.261	0.071	-0.179	4.379
	18 years old	1.186	0.793	2.239	0.135	-0.368	2.740
	19 years old	0.897	0.835	1.154	0.283	-0.739	2.532
	20 years old				Ref.		
Study Program	Bachelor of Medicine	0.504	0.539	0.873	0.350	-0.553	1.560
	Bachelor of Nursing	0.440	0.568	0.600	0.439	-0.674	1.554
	Bachelor of Midwifery	0.459	0.550	0.696	0.404	-0.619	1.536
	Bachelor of Physiotherapy				Ref.		
Body Mass Index (BMI)	Underweight	-1.309	0.808	2.628	0.105	-2.892	0.274
	Normal	-0.505	0,732	0.476	0.490	-1.939	0.929
	Overweight	-0.582	0.825	0.497	0.481	-2.200	1.036
	Obese				Ref.		
Menarche Age	Early Menarche	0.208	0.671	0.096	0.757	-1.108	1.524
	Normal Menarche	-0.151	0.571	0.070	0.792	-1.270	0.969
	Late Menarche				Ref.		
Menstrual Cycle	<29 days	0.076	0.608	0.016	0.900	-1.115	1.267
	29-30 days	0.705	0.514	1.878	0.171	-0.303	1.712
	>30 days	0.898	0.695	1.668	0.197	-0.465	2.260
	>35 days	1.743	0.728	5.738	0.017	0.317	3.170
	Irregular				Ref.		
Exercise	Never	0.661	0.858	0.593	0.441	-1.021	2.342
	Only exercise when you feel like it	-0.483	0.578	0.696	0.404	-1.616	0.651
	Routine 1x per week	-0.886	0.711	1.555	0.212	-2.279	0.507
	Routine 2-3x per week				Ref.		

Multivariate analysis using ordinal regression was conducted to examine the simultaneous effects of independent variables on the severity of menstrual pain among female medical students at Universitas Negeri Surabaya. The results (Table 2) show that only one variable had a statistically significant association, namely menstrual cycle category 4 (>35 days) (B = 1.143; p = 0.017; 95% CI = 0.205–2.081). This indicates that students with a menstrual cycle longer than 35 days were more likely to experience severe menstrual pain compared to those with irregular cycles. The positive coefficient value reflects an increased likelihood of higher pain severity in this group.

Other variables—including age, study program, BMI status, age at menarche, and exercise frequency—were not significantly associated with menstrual pain severity in the multivariate model ($p > 0.05$). For instance, being underweight ($B = –1.309$; $p = 0.105$), experiencing early menarche ($B = 0.208$; $p = 0.906$), and exercising only when desired to do exercise ($B = –0.483$; $p = 0.404$) did not show significant effects. This indicates that although variables such as BMI, age at menarche, and exercise demonstrated associations in the bivariate analysis, these relationships were no longer significant after adjusting for other predictors simultaneously. In this analysis, several categories were used as reference groups for comparison, including the oldest age group (20 years), the Bachelor of Physiotherapy program, obese BMI, late menarche, irregular menstrual cycles, and routine exercise (2–3 times per week).

Furthermore, because the ordinal regression model employed the proportional odds approach, no additional post-hoc tests were required. The proportional odds assumption was satisfied (as indicated by the Score Test), confirming the validity of the regression results. Overall, the findings highlight that menstrual cycle length exceeding 35 days was the only independent predictor of menstrual pain severity after controlling for other factors. In contrast, BMI, age at menarche, and exercise did not remain significant in the multivariate model.

3.2. Discussion

This study shows that menstrual pain (dysmenorrhea) is a common reproductive health problem experienced by female students at the Faculty of Medicine, Universitas Negeri Surabaya. Most respondents experienced menstrual pain with varying degrees of severity, with moderate pain being the most commonly reported category. These findings reinforce evidence from previous studies indicating that dysmenorrhea is one of the most common gynecological complaints among women of reproductive age [1,3].

Nutritional Status (BMI) and Menstrual Pain Levels

The descriptive analysis showed that the majority of respondents had normal nutritional status, with smaller proportions being underweight, overweight, or obese. Although the bivariate analysis revealed a significant correlation between BMI and menstrual pain severity ($r = 0.271$; $p = 0.004$), this association did not remain significant in the multivariate model ($p = 0.153$). This indicates that BMI, when considered alongside other factors such as physical activity and menarche age, does not independently influence menstrual pain levels in this study population.

Findings from previous studies have reported mixed results. A meta-analysis by Wu et al. (2022) suggested that underweight women are at greater risk of dysmenorrhea, while obesity showed inconsistent associations across studies [17,18]. Donayeva et al. (2023) reported a U-shaped relationship, with both underweight and obese women experiencing higher pain levels [19]. Local studies in Indonesia (Talahatu et al., 2025; Rusydi et al., 2023) also found significant associations between extreme BMI status and dysmenorrhea severity [20,21]. In contrast, Barcikowska et al. (2020) found no significant association, consistent with the findings of our multivariate analysis [1]. This finding is important, given that body mass index (BMI) is often associated with changes in reproductive hormones, inflammation, and sensitivity to prostaglandins, which can affect the intensity of menstrual pain [5,17].

Theoretically, the relationship between BMI and dysmenorrhea can be explained through hormonal and inflammatory mechanisms. Accumulation of body fat can affect the regulation of reproductive hormones and increase inflammatory responses that trigger menstrual On the other hand, individuals with a low BMI are more likely to experience menstrual cycle disorders and ovulation disorders, which are also associated with more severe menstrual pain [22].

Taken together, these results suggest that while BMI may be correlated with dysmenorrhea in some contexts, it does not appear to be an independent determinant in this study. This discrepancy highlights the importance of considering potential confounders such as stress, psychological status, or lifestyle factors. Our findings suggest that interventions focusing solely on BMI may not be sufficient to address menstrual pain severity without considering other determinants. Therefore, health promotion interventions targeting nutritional balance and healthy weight management can be part of a preventive strategy to reduce the burden of dysmenorrhea among female students, particularly in a health education setting [23].

Age of Menarche and Menstrual Pain Levels

Physiologically, menarche occurring at a younger age is associated with longer exposure to estrogen, which can increase the sensitivity of the endometrium to prostaglandins, substances that cause uterine contractions and pain during menstruation [2]. Long-term exposure to estrogen can also trigger hormonal imbalances, which exacerbate the symptoms of primary dysmenorrhea. This theory is supported by the results of a research by Liu (2025), which emphasizes that endocrine changes due to early menarche are correlated with menstrual cycle disorders and more severe menstrual pain symptoms [24].

However, the findings of this study did not support that association. In the multivariate analysis, age at menarche was not significantly related to menstrual pain severity ($p = 0.749$). This indicates that, when considered alongside other variables such as BMI, exercise, and menstrual cycle patterns, the age at which menarche occurs does not independently predict dysmenorrhea among the female students studied. The lack of significance suggests that previously reported associations may be confounded by unmeasured factors, including psychological status, family history, or stress levels, which were not included in the present model [25].

These results contrast with much of the existing literature, but they underscore the complexity of dysmenorrhea as a multifactorial condition. While early menarche may serve as a theoretical risk factor, our findings suggest that it does not have a direct effect once other variables are taken into account. This contradiction highlights the need for a more nuanced understanding of menstrual pain, where age at menarche should not be viewed in isolation but rather in interaction with broader physiological, psychological, and lifestyle determinants. Reproductive health education that integrates knowledge about age at menarche, healthy lifestyles, and stress management will be more effective in reducing the burden of menstrual pain among female students, particularly those in high-pressure academic environments such as medical schools [20,21].

Menstrual Cycle and Menstrual Pain Levels

The menstrual cycle is an important indicator in assessing women's reproductive health, including in relation to menstrual pain (dysmenorrhea). In this study, it was found that although there was no significant association between menstrual cycle regularity and menstrual pain severity in bivariate analysis ($p = 0.458$), multivariate analysis revealed that a very long menstrual cycle (>35 days) significantly increased the risk of more severe menstrual pain (Estimate = 1.514; $p = 0.026$). These results indicate that menstrual cycle regularity has a relevant contribution in explaining the variation in dysmenorrhea severity when considered alongside other variables.

Physiologically, irregular menstrual cycles, particularly long cycles or oligo/amenorrhea, are often associated with ovulation disorders and estrogen-progesterone hormone imbalances [10]. This condition can lead to thicker endometrial buildup and increased prostaglandin release during menstruation, which in turn exacerbates uterine contractions and menstrual pain [8,18]. In addition, irregular cycles can be a clinical manifestation of endocrine disorders such as polycystic ovary syndrome (PCOS), which is also known to have a strong association with dysmenorrhea and other menstrual disorders [25]. A study by Wu et al. (2022) in Acta Obstetricia et Gynecologica

Scandinavica showed that women with irregular menstrual cycles are more likely to experience severe dysmenorrhea, with a relative risk that is twice as high compared to those with regular cycles [18]. This is supported by research by Nyirenda et al. (2023), which found that regular menstrual cycles significantly reduce the prevalence of dysmenorrhea (OR = 0.14; 95% CI: 0.10–0.33; $p < 0.001$) [25].

Thus, while menstrual cycle irregularity does not always indicate a direct association with menstrual pain in all types of analysis, these results confirm that certain variations—particularly overly long or irregular cycles—are important risk indicators for severe dysmenorrhea. Therefore, clinical monitoring of menstrual cycle regularity can serve as an early detection tool for more serious reproductive disorders, as well as a foundation for preventive interventions and menstrual health education, particularly among medical students who are vulnerable to academic stress and an unbalanced lifestyle [24].

Exercise and Menstrual Pain Levels

This study found that the exercise habits of female students at the Faculty of Medicine, Universitas Negeri Surabaya were generally low and irregular. While the bivariate analysis showed a significant negative correlation between exercise frequency and menstrual pain severity ($r = -0.196$; $p = 0.040$), this association did not remain significant in the multivariate model ($p = 0.347$). These findings suggest that, after accounting for other factors such as BMI, menarche age, and menstrual cycle patterns, exercise does not independently influence menstrual pain levels in this population.

This result contrasts with previous studies that consistently reported beneficial effects of exercise in reducing dysmenorrhea, largely explained through mechanisms such as endorphin release, reduced prostaglandin activity, and improved uterine blood flow [4,26,27]. For instance, Koçoğlu et al. (2025) and Rejeki et al. (2021) demonstrated that specific exercise interventions significantly reduced menstrual pain [4,28]. The discrepancy between our findings and prior evidence may be due to the irregularity and inconsistency of exercise habits among students, as well as the influence of other unmeasured factors such as stress, academic workload, and motivation, which could reduce the observable protective effect of exercise in this cohort [5,29].

Physiologically, exercise triggers the release of endorphins and increases peripheral vasodilation, which reduces uterine contractions caused by prostaglandin F2α, prostaglandin E2, and vasopressin—the primary compounds responsible for pain in primary dysmenorrhea [26,29]. Various forms of exercise interventions, such as abdominal stretching exercises, progressive muscle relaxation, yoga, and pelvic floor exercises based on motor imagery, have been proven effective in reducing the intensity of dysmenorrhea, both functionally and emotionally [4,29]. Preventively, regular exercise plays a role in stabilizing hormones and increasing metabolism, which can prevent menstrual cycle irregularities and reduce the risk of severe menstrual pain. Therefore, promoting an active lifestyle and integrating reproductive health education that emphasizes the importance of regular exercise should be prioritized in campus environments, particularly for medical students who face high academic demands and are prone to stress [7]. Although exercise is not the only factor influencing the severity of menstrual pain, scientific evidence indicates that exercise is one of the safe, cost-effective, and effective non-pharmacological interventions in the management of dysmenorrhea among female college students [25,30].

Taken together, these results emphasize that while exercise has been shown to reduce menstrual pain in controlled interventions, it may not serve as a strong independent determinant in real-life settings where exercise patterns are inconsistent and influenced by lifestyle factors. This suggests that promoting regular and structured exercise could still hold preventive value, but in the context of this study, exercise alone cannot be considered a significant predictor of menstrual pain severity [30].

This study has several limitations. First, its cross-sectional design does not allow for the establishment of causal relationships. Second, the use of self-report questionnaires may introduce information bias. Third, some potentially relevant factors such as stress, family history, and analgesic use were not included in the predictor variables. These variables were excluded because the study focused primarily on socio-demographic and reproductive factors (BMI, menarche age, menstrual cycle, and exercise), which are more directly measurable and feasible to collect within the study scope. Lastly, the sample was limited to female students in a single faculty, which restricts the generalizability of the findings. Future research should consider employing a longitudinal design, including broader populations, and incorporating additional variables such as stress, family history, and analgesic use to provide a more comprehensive understanding of menstrual pain determinants.

4. Conclusion

This study concluded that among the hypothesized predictors, only menstrual cycle irregularity was significantly associated with increased menstrual pain levels in the adjusted multivariate analysis. Other variables, including BMI, age at menarche, and exercise, did not show independent associations after controlling for potential confounders. These findings suggest that while several factors have been proposed as contributors to dysmenorrhea, most were not confirmed in this study, highlighting the need for further research to better understand the complex determinants of menstrual pain among female students.

Acknowledgment

The authors would like to thank all female students of the Faculty of Medicine, Universitas Negeri Surabaya, who participated in this study, and all those who assisted during the survey.

Conflict of Interest

The authors declare no conflicts of interest.

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