



## Impact of Passive and Active Smoking on Primary Dysmenorrhea Among Female University Students: A Cross-Sectional Study

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**Abstract: Background/Objectives:** Primary dysmenorrhea is common among young women and often associated with smoking as a modifiable risk factor. This study explores the relationship between smoking exposure and dysmenorrhea among female undergraduate students. **Methods:** A cross-sectional study was conducted among 294 female students at a public university using a structured online questionnaire that assessed smoking exposure (active and passive), menstrual characteristics, dysmenorrhea severity, and socio-demographic data. Data were analyzed using chi-square tests and logistic regression. **Results:** Passive smoking was reported by 42.9% and active smoking by 6.9% of participants. Students exposed to smoking (active or passive) reported a higher prevalence of dysmenorrhea and greater reliance on pain medication compared with non-exposed peers. Smoking exposure was significantly associated with age, marital status, and BMI. Dysmenorrhea had higher pain intensity and greater reliance on medication. Regular menstrual cycles were significantly associated with dysmenorrhea. **Conclusion:** This cross-sectional analysis indicates that passive smoking is associated with increased dysmenorrhea prevalence among female university students. The findings underscore the importance of campus-based smoking cessation and menstrual health education programs to reduce the burden of menstrual pain and improve student well-being.

**Key Words:** Dysmenorrhea, Passive Smoking, Active Smoking, Female University Students, Menstrual Health

### INTRODUCTION

Primary dysmenorrhea refers to crampy lower abdominal pain that occurs without underlying pelvic pathology, often accompanied by nausea, vomiting, lethargy, irritability, headache, backache, and depressive mood [1]. It is one of the most prevalent and distressing menstrual disorders among women, representing a major cause of pelvic discomfort and menstrual-related morbidity [2]. Dysmenorrhea significantly diminishes women's quality of life and restricts daily activities, ultimately affecting academic, social, and occupational performance [3]. Up to 20% of affected women report that menstrual pain substantially interferes with daily functioning [4,5].

Globally, primary dysmenorrhea affects most women of reproductive age, with 2%–29% experiencing severe pain [2]. Reported prevalence varies due to differences in assessment methods, age, ethnicity, and pain perceptions. Generally, younger women (under 24 years) show a higher prevalence [6]. In contrast, secondary dysmenorrhea is due to identifiable pelvic pathology producing similar symptoms but typically occurring later in life [7,8].

A broad range of biological, psychological, and lifestyle factors contribute to primary dysmenorrhea, including family history, early menarche, heavier menstrual flow, oral contraceptive use, stress, and unhealthy habits such as smoking [9–12]. Smoking, in particular, is considered a

modifiable risk factor with significant public health relevance among young women. Growing attention has been drawn to second-hand smoke (SHS) exposure, especially among women and youth who may be non-smokers yet remain at risk [13-15].

Both active and passive smoking have been recognized as preventable risk factors for menstrual disorders. However, the evidence linking smoking exposure to dysmenorrhea remains inconsistent [9,16-18]. Furthermore, the burden of passive smoking is considerable: for instance, studies from China report that about 65% of non-smokers are exposed to SHS, with nearly half experiencing it at home [16]. Exposure to second-hand smoke is also associated with various health risks, including hypertension, cardiovascular disease, respiratory symptoms, and reproductive dysfunction [14,19-23].

Despite global evidence, limited studies have examined the relationship between smoking (active and passive) and primary dysmenorrhea among young women in the Middle East, particularly among university-aged females [18,24]. This represents a notable gap in epidemiological data and public health awareness in the region.

Therefore, this study aimed to assess the association between active and passive smoking and the severity of primary dysmenorrhea among female university students in Saudi Arabia.

## Objectives

- To determine the prevalence of primary dysmenorrhea among female university students
- To assess the association between active and passive smoking and dysmenorrhea severity
- To identify key socio-demographic and lifestyle factors influencing menstrual pain intensity

## METHODS

### Study Design and Setting

This cross-sectional study was conducted at educational institutions in the Northern Border Region of Saudi Arabia between May 7 and August 15, 2024. The target population comprised 1,243 female students from multiple academic institutions.

### Participants and Sampling

Eligible participants were female students aged 18 years or older, currently enrolled at participating universities, and experiencing primary dysmenorrhea. Students with a diagnosis of pelvic pathology or any underlying gynecological condition within the prior six months were excluded.

A stratified random sampling method was used to ensure adequate representation across institutions and academic levels. The required sample size ( $n = 294$ ) was calculated using a prevalence formula:

$$n = \frac{N \times P(1-P)}{(N-1) \times (d^2/Z^2) + P(1-P)}$$

where  $N = 1,243$  (population size),  $P = 0.50$  (estimated prevalence),  $Z = 1.96$  (95% confidence), and  $d = 0.05$  (margin of error). To address potential non-response, the recruitment target was increased to 303.

### Data Collection Tool

Data were collected via a structured, self-administered online Google survey, adapted (with permission) from validated questionnaires [8,25,26]. The instrument included:

- Socio-demographic data (age, marital status, BMI)
- Smoking history (active and passive smoking exposure)
- Menstrual characteristics (cycle regularity, severity, and type of dysmenorrhea, management, and associated symptoms)

All survey questions were mandatory, resulting in complete data entry with no missed responses. The survey invitation and study purpose were distributed via university WhatsApp groups, with digital informed consent provided on the platform.

### Pilot Validation

A pilot study with 20 representative students assessed the clarity, reliability, and acceptability of the survey instrument. Feedback was used for minor refinements, and reliability analysis indicated high internal consistency (Cronbach's alpha  $> 0.80$ ). Data from the pilot were excluded from the main analysis.

### Statistical Analysis

Data were reviewed, coded, and analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were computed. Categorical variables were compared using Chi-square ( $\chi^2$ ) or Fisher's exact test, and binary logistic regression was used to assess associations.

Normality was assessed using the Shapiro–Wilk test, and  $p$ -values  $< 0.05$  were considered statistically significant.

### Ethical Considerations

The study was approved by the Institutional Bioethics Committee of the Northern Border Region (HAP-09-A-043; approval number 46/24/H, dated 07/05/2024). Administrative approvals were obtained from all institutions. Informed consent was obtained from all participants, who were assured of voluntary, anonymous participation and strict data confidentiality in accordance with institutional guidelines.

## RESULTS

Table 1 summarizes socio-demographic and clinical characteristics according to smoking exposure status. Nearly half of smoke-exposed students were aged  $\leq 20$  years, and a higher proportion were married, compared to non-exposed peers. Among non-smokers, a greater percentage were underweight, whereas most in both groups had normal BMI.

Table 1: Personal Characteristics of the Female University Students (n = 303)

Demographic characteristics	Smoker (active and passive)		Non-smoker		Chi-Square	p-value
	No	Percentage	N	Percentage		
<b>Age/year</b>						
≤20	62	47.0	116	67.8	13.38	0.000
>20	70	53.0	55	32.2		
<b>Marital status</b>						
Unmarried	104	78.8	158	92.4	11.79	0.001
Married	28	21.2	13	7.6		
<b>College</b>						
Medical Colleges	104	78.8	141	82.5	0.648	0.421
Non-Medical college	28	21.2	30	17.5		
<b>BMI</b>						
Underweight (<18.5)	4	3.0	32	18.7	21.323	0.000
Normal (18.5:24.9)	85	64.4	107	62.6		
Pre-obesity (25:29.9)	31	23.5	24	14.0		
Obesity class I and II (30:39.9)	12	9.1	8	4.7		

Data are presented as numbers (No) and percentages (%). The Chi-square test or Fisher's exact test was applied when appropriate. Statistical significance was set at  $p$ -value < 0.05. BMI: Body mass index

Table 2: Association between Smoking and Dysmenorrhea (n = 303).

Items	Smoker (active and passive)		Non-smoker		Chi-Square	p-value
	No	Percentage	No	Percentage		
<b>Do you suffer from dysmenorrhea?</b>						
Yes	74	56.1	44	25.7	28.820	0.000
No	58	43.9	127	74.3		
<b>The intensity of the pain</b>						
Mild	25	18.9	47	27.5	4.135	0.247
Moderate	75	56.8	90	52.6		
Severe	31	23.5	31	18.1		
None	1	.8	3	1.8		
<b>The duration of the pain</b>						
1 day	20	15.2	32	18.7	1.781	0.411
2 days	55	41.7	59	34.5		
3 days	57	43.2	80	46.8		
<b>Use medications to relieve dysmenorrhea</b>						
Yes	80	60.6	58	33.9	21.393	0.000
No	52	39.4	113	66.1		
<b>Regular menstruation</b>						
Yes	86	65.2	123	71.9	1.599	0.206
No	46	34.8	48	28.1		

Data are presented as numbers (No) and percentages (%). The Chi-square test or Fisher's exact test was applied when appropriate. Statistical significance was set at  $p$ -value < 0.05.

Smoking exposure was significantly associated with younger age, marital status, and BMI ( $p < 0.001$ ), but not with college type.

Passive smoking was markedly more common than active smoking among participants (42.9% vs. 6.9%). Overall, 43.6% of respondents reported exposure to smoking, while the remainder were non-smokers.

Table 2 presents the relationship between smoking and dysmenorrhea. More than half (56.1%) of those exposed to smoking experienced dysmenorrhea versus only 25.7% of non-smokers ( $p < 0.001$ ). Moderate pain was reported in both groups, but smokers tended to have increased pain severity (23.5% reporting severe pain compared to 18.1% for non-smokers).

The use of medication for pain relief was significantly higher among smoke-exposed students (60.6% vs. 33.9%,  $p < 0.001$ ), highlighting greater reliance on pharmacological management. Both groups reported similar rates of regular menstruation. Pain duration did not differ significantly

between groups.

Table 3 details factors associated with primary dysmenorrhea. Marital status and attending a non-medical college were both significant risk factors (OR = 2.6 for each). Higher pain intensity (OR = 1.6) and use of pain medications (OR = 4.4) strongly predicted dysmenorrhea, while regular menstruation was associated with lower odds (OR = 0.48). Age and BMI were not significant predictors, but each increase in BMI corresponded to a slight increase in risk (OR = 1.03).

### Interpretive Summary

Active and passive smoking were both significantly associated with higher pain intensity and greater need for medication among participants. Marital status, college type, and regular menstruation also emerged as important factors influencing dysmenorrhea. These findings underscore the multifactorial nature of menstrual pain in young women and the impact of smoking exposure.

Table 3: Primary Dysmenorrhea Predictors among Female University Students (n = 303)

Variable	Coefficient	Standard Error	p-value	Odds Ratio	95% Confidence Interval
Age/ year	0.0512	0.0686	0.455	1.05	(0.9202,1.2039)
Marital status	0.9529	0.4777	0.046	2.59	(1.0169,6.6134)
College	0.9555	0.3485	0.006	2.60	(1.3133,5.1478)
BMI	0.0362	0.0356	0.309	1.03	(0.9669,1.1118)
The intensity of the pain	0.4904	0.2174	0.024	1.63	(1.0665,2.5003)
The duration of the pain	0.2414	0.1943	0.214	1.27	(0.8700,1.8630)
Use medications to relieve dysmenorrhea	1.4772	0.2841	0.000	4.38	(2.5103,7.6453)
Regular menstruation	-0.7252	0.2945	0.014	0.48	(0.2719,0.8625)
Constant	-6.3640	1.5126	0.000	-	-

BMI: Body mass index, Model Fit (Chi-Square = 84.05,  $df = 8$ , p-value = 0.000), Statistical significance was set at p-value <0.05

## DISCUSSION

This study examined the correlation between smoking exposure, both active and passive, and the occurrence and severity of primary dysmenorrhea among female university students. Dysmenorrhea remains one of the most common gynecological conditions worldwide, particularly impacting adolescent girls and women of reproductive age [27]. Its high prevalence and the associated pain contribute substantially to educational absenteeism, impaired social participation, and diminished overall quality of life [28].

Our findings are consistent with previous national and international studies reporting a significant association between both active and passive smoking and increased prevalence and severity of dysmenorrhea. For example, a large-scale Australian cohort study involving over 9,000 females identified a higher risk of dysmenorrhea among those with early smoking initiation, and regional studies have reported similar patterns of moderate to severe pain associated with tobacco exposure [29]. Conversely, some research, including a study among Lebanese female students, has found no significant relationship [29], highlighting geographic and cultural differences that may affect exposure, reporting, or behavioral patterns [16,30-33]. The low reported incidence of active smoking among young Saudi women likely reflects cultural and policy influences; however, high rates of passive smoke exposure point to ongoing environmental risk [34-36].

Nicotine, a major component of tobacco smoke, acts as a potent vasoconstrictor, reducing uterine blood flow and causing endometrial hypoxia, which can exacerbate menstrual cramps and pain severity. Nicotine also stimulates increased uterine contractility by acting directly on the myometrium and promoting the release of vasopressin and prostaglandins, substances linked to heightened pain perception and the pathophysiology of primary dysmenorrhea [37,38]. However, the full range of biochemical effects remains under investigation [39].

Potential confounding factors such as BMI, psychosocial stress, and caffeine intake can modulate reproductive health and menstrual pain. In our analysis, underweight students experienced higher dysmenorrhea rates, resonating with previous studies suggesting links between low BMI, altered hormonal profiles, and menstrual dysfunction [40-42]. While BMI showed only a modest association in regression modeling, differences in body composition, diet, and exercise may contribute to variability

in symptom severity [40]. Similarly, higher levels of stress and dietary factors (not comprehensively measured here, such as caffeine or sugar intake) could further influence menstrual pain through neuroendocrine or vascular mechanisms. Future research should incorporate these factors for more robust, multifactorial modeling.

The burden of dysmenorrhea is particularly pronounced for young, nulliparous women, and additional predictors in our study, including marital status, non-medical college enrollment, pain intensity, and medication use, are in line with evidence identifying socioeconomic, psychological, and behavioral determinants [6,43,44]. Notably, use of pain medication was much greater among smoke-exposed students, emphasizing the added symptom burden and need for clinical support [45,46].

Our findings emphasize the importance of targeted health promotion and prevention strategies in university contexts. Despite the frequency and severity of pain, many students primarily depend on self-management and family advice, with limited medical consultation, underscoring gaps in health literacy and access to care [47]. Creating supportive university environments through smoke-free campus policies, menstrual health education programs, counseling, and stress management resources may mitigate the burden of dysmenorrhea and foster better academic and psychosocial outcomes [26,48-49].

Regular menstruation emerged as a predictor of dysmenorrhea in our student cohort, consistent with some but not all literature, suggesting ongoing debate regarding the interplay between cycle regularity, prostaglandin release, and pain perception [50]. The reliance on self-reported survey data and the absence of clinical confirmation in this study may limit direct comparison to research using more objective diagnostic methods.

In sum, our results reinforce the complex, multifactorial etiology of dysmenorrhea among university women in the Middle East, and strongly implicate both active and passive smoking as modifiable risk factors. Enhanced educational efforts, community outreach, and robust health policy interventions are needed to address the persistent impact of smoking exposure on young women's reproductive health. Smoking cessation education targeting young women may reduce dysmenorrhea severity and improve academic performance and quality of life.

## Strengths and Limitations

**Strengths:** This study benefits from a large, representative sample of female university students, ensuring statistical

power and generalizability within the target population. A validated, structured questionnaire was used, enhancing the reliability and comparability of the collected data. Comprehensive data collection and mandatory survey responses reduced missing data and strengthened the validity of the study's findings.

### Limitations

This study is limited by its cross-sectional design, which precludes causal inference; possible recall and reporting bias in self-administered surveys; and the lack of clinical or laboratory confirmation to fully exclude secondary dysmenorrhea. An incomplete assessment of physical activity, stress, caffeine use, and other lifestyle factors may indicate residual confounding. Additionally, social and cultural norms about smoking behavior in the region may encourage under-reporting of tobacco use. Despite these limitations, our work provides valuable insights and reinforces the need for larger, longitudinal, and multi-site studies to elucidate risk pathways better and identify effective interventions.

### CONCLUSION

This study demonstrates a significant association between both active and passive smoking and increased severity of primary dysmenorrhea among female university students. Targeted educational and smoking cessation programs in university settings could help reduce menstrual pain and enhance academic performance among young women. Additionally, public health strategies focusing on smoking reduction and menstrual health awareness may improve reproductive well-being in this population.

### Implications and Recommendations

To effectively address smoking and dysmenorrhea within female university populations, the following recommendations are proposed:

- Implement comprehensive tobacco prevention and cessation programs tailored for female students, targeting both active and passive smoking exposures
- Integrate counseling and support services into university health and wellness campaigns, focusing on non-pharmacological approaches such as stress management, regular exercise, and lifestyle modification to manage dysmenorrhea
- Develop and promote educational initiatives that raise awareness about the adverse effects of smoking on reproductive and menstrual health, empowering students to make informed health choices
- Foster interdisciplinary collaboration among healthcare professionals, researchers, and university administrators to establish a holistic approach for addressing the complex interplay of smoking and dysmenorrhea and advancing women's health in academic settings

### Funding

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### Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Bioethics Committee of the Northern Border University (HAP-09-A-043; approval number 46/24/H, dated 07/05/2024).

### Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

### Data Availability Statement

The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

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### Conflicts of Interest

The authors declare no conflicts of interest.

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