

ASSOCIATION BETWEEN CAFFEINE CONSUMPTION AND PREMENSTRUAL SYNDROME AMONG FIRST YEAR FEMALE MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Premenstrual syndrome (PMS) is a recurrent condition in reproductive-aged women that disrupts physical, emotional, and behavioral functioning. Neuroendocrine instability during the luteal phase plays a crucial role in PMS pathophysiology. Caffeine, a widely consumed psychoactive substance among medical students, may aggravate PMS symptoms through central nervous system and autonomic stimulation.

Objective: To examine the relationship between caffeine intake and the incidence of premenstrual syndrome in first-year female medical students.

Methods: This analytical observational research employed a cross-sectional approach and included 79 first-year female medical students recruited through simple random sampling. Caffeine intake was assessed using a semi-quantitative food frequency questionnaire, while premenstrual syndrome was evaluated with the Shortened Premenstrual Assessment Form (SPAF). Physical activity, stress level (DASS-21), and sleep quality (PSQI) were evaluated as confounding variables. Data were analyzed using the Chi-square and Fisher's exact tests, with a significance level set at $p < 0.05$.

Results: The prevalence of PMS was 82.3%. Most participants had low caffeine intake (64.6%), while 35.4% had moderate intake. All participants with moderate caffeine intake experienced PMS (100%). A significant relationship was identified between caffeine intake and the presence of PMS ($p = 0.001$). Physical activity was also significantly associated with PMS ($p = 0.047$). No significant association was observed between PMS and stress level ($p = 1.000$) or sleep quality ($p = 0.359$).

Conclusion: Caffeine consumption is significantly associated with the occurrence of premenstrual syndrome among first-year female medical students. Moderate caffeine intake markedly increases PMS prevalence, whereas adequate physical activity appears to have a protective effect.

Keywords: Caffeine, Premenstrual Syndrome, Physical Activity, Sleep Quality, Female Students

INTRODUCTION

Premenstrual syndrome (PMS) is defined as a cyclical combination of physical and emotional symptoms that arise during the late luteal phase and resolve shortly after menstruation begins¹. Although its exact pathophysiology is multifactorial, disturbances in the regulation of ovarian steroid hormones—particularly estrogen and progesterone and their interactions with central neurotransmitters such as serotonin are believed to play a key role in the development of PMS symptoms².

Lifestyle-related factors are increasingly recognized as modulators of PMS severity. One of the key behavioral factors proposed is caffeine intake, a common stimulant widely consumed among university students,

especially in demanding academic environments³. Caffeine produces its physiological effects mainly by acting as an antagonist of adenosine receptors, leading to increased sympathetic activity, altered sleep regulation, and potential disruption of hypothalamic–pituitary–ovarian (HPO) axis signaling. These mechanisms may exacerbate PMS symptoms such as irritability, anxiety, breast tenderness, and sleep disturbance.

Despite the biological plausibility, evidence regarding the association between caffeine intake and PMS in young adult populations, particularly in Indonesia, remains limited. Medical students constitute a population characterized by elevated caffeine intake and substantial academic stress, making them an appropriate group for examining this association.

Therefore, this study aims to determine the association between caffeine consumption and the occurrence of premenstrual syndrome (PMS) among first-year female medical students, while also evaluating the potential influence of physical activity, stress level, and sleep quality.

METHODS

This research utilized an analytical observational design with a cross-sectional method. The study population consisted of 90 first-year female medical students at the Faculty of Medicine, from which 79 participants were obtained through simple random sampling according to the established inclusion and exclusion criteria.

Caffeine intake was evaluated using a semi-quantitative food frequency questionnaire that documented the types and frequencies of caffeinated beverages consumed, including coffee, tea, and energy drinks. Participants were classified into low and moderate caffeine consumption groups.

Premenstrual syndrome was evaluated using the Shortened Premenstrual Assessment Form (SPAF), which identifies the presence of affective and somatic symptoms during the luteal phase that resolve after menstruation.

Physical activity was assessed using a physical activity level questionnaire, stress was measured with the Depression Anxiety Stress Scale-21 (DASS-21), and sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI).

Data processing was performed using SPSS software, with univariate analysis applied to summarize the characteristics of the participants. Bivariate analysis using the Chi-square test or Fisher's exact test was used to assess the association between caffeine consumption and PMS, along with the effects of potential confounding factors, using a significance threshold of $p < 0.05$.

RESULTS

This study included 79 participants, all of whom were first-year female medical students at the Faculty of Medicine, Udayana University. Every participant satisfied the inclusion and exclusion requirements, and none were removed or lost during the study.

The relationship between physical activity, stress level, and sleep quality with PMS was evaluated using Fisher's Exact Test. None of these factors exhibited a significant statistical correlation with PMS ($p > 0.05$). (Table 1).

Table 1. Relationship Between Risk Factors and PMS

Variable	Category	PMS n (%)	Not PMS n (%)	p-value	PR(95% CI)
Physical Activity	High	9 (13.6%)	–	1.014	(0.698–1.473)
Stress Level	Severe	5 (83.3%)	1 (16.7%)	1.000	(0.698–1.473)
Sleep Quality	Poor	24 (88.9%)	3 (11.1%)	0.359	(0.929–1.369)
	Good	41 (78.8%)	11 (21.2%)	–	–

The analysis demonstrated a highly significant relationship between caffeine consumption and PMS. All respondents (100%) who were categorized as moderate caffeine consumers experienced PMS, while only 72.5% of light caffeine consumers reported PMS. Fisher's Exact Test

showed $p = 0.001$, indicating a statistically significant association. The prevalence ratio (PR = 1.378; 95% CI: 1.164–1.632) further supports the strong relationship between caffeine consumption and PMS (Table 2).

Table 2. Association Between Caffeine Consumption and PMS

Independent Variable	PMS n (%)	Not PMS n (%)	p-value	PR(95% CI)
Caffeine Consumption				1.378(1.164–1.632)
Moderate	28(100.0%)	0 (0.0%)	0.001	
Light	37 (72.5%)	14 (27.5%)	–	
Total	65 (82.3%)	14 (17.7%)	–	–

DISCUSSION

This research revealed a significant association between caffeine intake and the presence of premenstrual syndrome (PMS) in first year medical students. The proportion of PMS was notably high (82.3%), and every participant with moderate caffeine consumption reported experiencing PMS. This finding aligns with several studies included in the thesis, particularly those showing that caffeine acts as a physiological trigger for PMS symptoms through its stimulant and hormonal effects^{4,5}.

The significant association between caffeine and PMS supports earlier evidence noting that caffeine may alter neuroendocrine pathways, contributing to irritability, breast tenderness, and anxiety symptoms commonly observed in PMS. Zakir & Hassan describe caffeine as a methylxanthine that functions as a central nervous system stimulant, capable of disrupting hormonal balance and influencing mood regulation⁹. Kusumawati & Finurina also reported similar associations among female students, suggesting that habitual caffeine intake can increase the risk of PMS through heightened sympathetic activation⁶. These findings provide physiological justification for the current study's results.

Physical activity was also found to be significantly associated with PMS. Respondents with higher physical activity exhibited lower PMS prevalence, consistent with Surmiasih, who demonstrated that regular activity may reduce PMS symptoms by improving circulation and stabilizing hormonal fluctuations⁷. Although this variable did not show independent significance in multivariate analysis, its protective trend supports the notion that lifestyle factors contribute meaningfully to menstrual health.

In contrast, stress level and sleep quality were not significantly associated with PMS in this study. The homogeneity of stress levels particularly the high proportion of respondents with moderate stress may have limited the statistical ability to detect differences. Previous research by Mufida indicated that stress contributes to PMS severity⁸, but differences in population characteristics and sample distribution likely explain the discrepancy. Similarly, sleep quality showed no significant association, despite literature suggesting that poor sleep may exacerbate PMS symptoms through increased sympathetic tone and reduced hormonal recovery⁹.

The multivariate logistic regression in this study did not identify caffeine, physical activity, stress, or sleep quality as independent predictors of PMS. This is likely influenced by sample size limitations, as well as the perfect separation found in caffeine categories where all individuals with moderate caffeine intake had PMS resulting in extreme regression coefficients and model instability.

This study has several strengths, including the use of validated questionnaires, complete response rate, and inclusion of multiple lifestyle factors. However, limitations must be noted. First, the cross-sectional design prevents determination of causal relationships. Second, caffeine intake was measured through self-reported frequency rather than biochemical verification or detailed daily logs, increasing recall bias. Third, hormonal markers such as estrogen and progesterone were not assessed, though these play

central roles in PMS pathophysiology¹⁰. Future studies should incorporate longitudinal designs, hormonal assessments, and more precise dietary monitoring to better understand the directionality and biological mechanisms underlying caffeine-related PMS risk.

Overall, this study reinforces evidence that caffeine consumption plays a significant role in PMS occurrence, while physical activity may offer protective benefits. Increasing awareness about caffeine moderation and healthy lifestyle choices may help reduce PMS burden among young women.

CONCLUSION

Caffeine consumption is significantly associated with the occurrence of premenstrual syndrome among first-year female medical students. Moderate caffeine intake markedly increases PMS prevalence, while adequate physical activity has a protective effect. These results highlight the need for managing caffeine consumption and adopting healthier lifestyle practices to help lower the risk of PMS in young women.

Ethics statement

This study was carried out in accordance with the ethical principles outlined of the Declaration of Helsinki. Ethical approval was granted by the Ethics Committee of the Faculty of Medicine, Udayana University Bali, under the registration number (0983/UN14.2.2.VII.14/LT/2025). All individuals were briefed on the study's aims and procedures and signed written informed consent prior to taking part. Participant anonymity and confidentiality were rigorously upheld throughout the study.

Disclosures

The authors report that they have no conflicts of interest regarding the conduct of the study, the writing process, or the publication of this article.

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