



RELATIONSHIP BETWEEN CAFFEINE CONSUMPTION AND PERCEIVED STRESS IN MEDICAL STUDENTS

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ABSTRACT

Background: Medical students often experience high levels of stress due to demanding academic schedules. Caffeine consumption, widely used to combat fatigue and enhance alertness, may influence perceived stress and sleep quality. However, the relationship between caffeine intake and stress in Indian medical students remains underexplored.

Objective: To examine the association between daily caffeine consumption and perceived stress, measured using the Perceived Stress Scale (PSS-10), among undergraduate medical students.

Methods: A cross-sectional study was conducted among 100 medical students using an online questionnaire. Data on demographics, lifestyle habits, caffeine intake, and sleep duration were collected. Caffeine consumption was quantified in milligrams per day and categorized as low (<100 mg/day), moderate (100–300 mg/day), or high (>300 mg/day). Stress levels were assessed using the PSS-10. Statistical analyses included descriptive statistics, one-way ANOVA, and Kruskal–Wallis tests to evaluate differences in stress across caffeine categories.

Results: The majority of participants reported moderate caffeine intake (51%) and 6–7 hours of sleep per night. The overall mean PSS-10 score was 16.5 ± 3.5 , indicating moderate stress. Higher caffeine consumption was significantly associated with elevated perceived stress (ANOVA $F = 13.52$, $p < 0.001$; Kruskal–Wallis $H = 20.76$, $p < 0.001$). Caffeine intake increased progressively across academic years, with senior students exhibiting slightly higher stress scores.

Conclusion: Higher caffeine consumption among medical students is associated with increased perceived stress, potentially compounded by insufficient sleep. These findings highlight the need for stress management strategies, education on safe caffeine use, and promotion of healthy coping mechanisms in medical training programs.

Keywords: Caffeine consumption; Perceived stress; PSS-10; Medical students; Sleep quality; Academic stress

1. INTRODUCTION

Caffeine, a naturally occurring methylxanthine, is the most widely consumed psychoactive substance globally [1]. It is found primarily in coffee, tea, energy drinks, and aerated beverages, and acts as a central nervous system stimulant by antagonizing adenosine receptors [2]. Among university

populations, particularly medical students, caffeine consumption is highly prevalent as a means to combat fatigue, enhance alertness, and sustain long study hours. However, the academic demands and irregular schedules characteristic of medical education are also associated with increased psychological stress. This dual exposure to both heightened stress and frequent caffeine intake raises important questions regarding their interrelationship. Perceived stress refers to an individual's appraisal of life events as unpredictable, uncontrollable, or overwhelming. The Perceived Stress Scale (PSS-10) [3], is among the most validated instruments for assessing subjective stress levels. Studies in various contexts have consistently shown that medical students experience higher stress compared to their non-medical peers, often attributed to academic pressure, fear of failure, competition, and clinical responsibilities [4]. Chronic stress may adversely affect mental health, learning efficiency, and physical well-being, emphasizing the importance of identifying modifiable behavioral factors that influence stress levels [5]. Caffeine has been reported to exert both beneficial and adverse psychological effects [6]. In low to moderate doses, it can improve alertness, attention, and reaction time. However, excessive intake may lead to anxiety, irritability, sleep disturbance, and elevated stress perception. The mechanisms linking caffeine to stress involve both physiological and behavioral pathways: caffeine stimulates the hypothalamic-pituitary-adrenal (HPA) axis, increasing cortisol and catecholamine release, which may amplify stress responses. Conversely, habitual users may develop tolerance to these effects, leading to complex bidirectional interactions [7].

Several studies across different populations have reported mixed findings regarding the relationship between caffeine consumption and stress. For instance, one study found a positive association between higher caffeine intake and elevated perceived stress, coping difficulties, and burnout among university athletic department staff [8]. In contrast, another study reported that caffeine consumption was linked to increased positive affect throughout the day but was not associated with changes in negative affect, suggesting that caffeine's impact on stress and negative emotions may be minimal when other lifestyle factors are controlled [9]. Despite these insights, there is a lack of quantitative data examining this relationship among Indian medical students using validated stress scales, such as the Perceived Stress Scale (PSS-10), alongside standardized assessments of caffeine intake. Given the high academic demands and lifestyle pressures in medical education, exploring the association between caffeine consumption and perceived stress in this population is particularly relevant [10]. Hence, the present study aims to examine the relationship between daily caffeine consumption and perceived stress (PSS-10 scores) among medical students. By quantifying caffeine intake in milligrams per day and analyzing its association with perceived stress through both correlation and regression models, this study seeks to provide empirical insight into whether caffeine contributes independently to stress perception or merely coexists as a coping behavior. Understanding this relationship could inform student wellness programs, encourage moderation in caffeine use, and promote evidence-based interventions for stress management in medical training environments.

2. METHODOLOGY

A cross-sectional study was conducted among 100 undergraduate medical students using a structured Google Form-based questionnaire. The survey was circulated across multiple medical colleges in Tamil Nadu. Participation was voluntary and anonymous, and no personally identifiable information was collected; therefore, formal ethical approval was not required in accordance with institutional guidelines.

2.1 Data Collection

The questionnaire collected the following information:

- Demographics: Age, sex, academic year
- Lifestyle characteristics: Average sleep duration, smoking and alcohol habits
- Beverage consumption: Types and quantities of caffeine-containing beverages (e.g., coffee, tea, energy drinks, soft drinks)

Caffeine intake was estimated in milligrams per day using standard reference values for each beverage. Based on daily intake, participants were categorized into:

- Low consumption: <100 mg/day
- Moderate consumption: 100–300 mg/day
- High consumption: >300 mg/day

Perceived stress levels were assessed using the Perceived Stress Scale (PSS-10), a validated 10-item scale with total scores ranging from 0 to 40. Higher scores indicate higher levels of perceived stress.

2.2 Inclusion Criteria

- Undergraduate medical students of any year.
- Students who consented to participate in the study.
- Students who completed the questionnaire fully.

2.3 Exclusion Criteria

- Participants reporting chronic illness.
- Participants with psychiatric conditions under treatment.
- Participants with incomplete responses for caffeine intake items.
- Participants with incomplete responses for PSS-10 items.

2.4 Statistical Analysis

Data were analyzed using SPSS v26. Descriptive statistics summarized participant characteristics. One-way ANOVA and Kruskal–Wallis tests evaluated differences in mean PSS-10 scores across caffeine consumption categories. Post-hoc analyses identified pairwise differences. Statistical significance was set at $p < 0.05$.

3. RESULTS

3.1 Demographic Characteristics

A total of 100 medical students participated in the study, comprising 50 females and 50 males (Table 1). The majority of participants (66%) belonged to the 20–22 years age group, followed by 22% aged below 20 years and 12% above 22 years.

Variable	Category	Count
Sex	Female	50
	Male	50
Age Group	<20 years	22
	20–22 years	66
	>22 years	12

Table 1. Sex and Age Group Distribution of Participants

3.2 Lifestyle and Caffeine Consumption Patterns

Most students (85%) reported not smoking, and 83% stated they did not consume alcohol, while 15% and 17% were occasional smokers and drinkers, respectively (Table 2). Regarding caffeine intake, 51% of participants were categorized as moderate caffeine consumers, 33% as low intake, and 16% as high intake. Average sleep duration was between 6–7 hours for the majority of students (Table 3).

Variable	Category	Count
Smoking	No	85
	Occasional	15
Alcohol	No	83
	Occasional	17

Table 2. Lifestyle Habits of Participants

Variable	Category	Count
Sleep Hours	4	1
	5	19
	6	34
	7	38
	8	8
Caffeine Category	Low	33
	Moderate	51
	High	16

Table 3. Sleep Hours and Caffeine Category Distribution

3.3 Perceived Stress and Caffeine Intake

The mean Perceived Stress Scale (PSS-10) scores and caffeine consumption levels across academic years are summarized in Table 4. The overall mean PSS-10 score among all students was 16.5 ± 3.5 , indicating moderate stress levels. Caffeine intake increased progressively from the first to the final year, corresponding to a slight increase in perceived stress.

Year	Mean PSS10 Score	Mean Caffeine (mg/day)	Mean Sleep (hours)
Year 1	16.25	152.20	6.45
Year 2	16.35	137.15	6.50
Year 3	17.15	191.85	6.20
Year 4	16.40	211.10	6.25
Final Year	16.40	181.55	6.25

Table 4. Mean Stress Scores, Caffeine Intake, and Sleep Hours by Academic Year

3.4 Statistical Analysis

A one-way ANOVA was conducted to examine differences in perceived stress (PSS-10 scores) among the three caffeine consumption categories (low, moderate, high). The results showed a significant difference in stress levels between groups ($F = 13.52$, $p = 0.00001$). A non-parametric Kruskal–Wallis test also confirmed the finding ($H = 20.76$, $p = 0.00003$), supporting that perceived stress varied significantly with caffeine intake level (Table 5).

Test	Statistic	p-value
One-way ANOVA	13.5156	0.00001
Kruskal–Wallis	20.7644	0.00003

Table 5. ANOVA Results for PSS-10 Scores Across Caffeine Categories

Overall, the findings demonstrate that higher caffeine consumption was associated with increased perceived stress among medical students. Moderate caffeine consumers formed the largest group, and those reporting higher intake tended to experience greater stress scores. Despite moderate levels of perceived stress, sleep duration, and caffeine consumption patterns indicate potential behavioral coping mechanisms among students.

4. DISCUSSION

This study investigated the relationship between caffeine consumption, sleep duration, and perceived stress among undergraduate medical students. The majority of participants reported moderate caffeine intake (51%), an average sleep duration of 6–7 hours, and moderate stress levels, with a mean PSS-10 score of 16.5 ± 3.5 . These findings are consistent with previous studies showing that caffeine use is highly prevalent among medical students and is often perceived as a tool to cope with academic

demands [11-13]. Higher caffeine consumption in our cohort was significantly associated with increased perceived stress. This aligns with Šabić (2019), who observed that elevated stress in college students correlated with unhealthy lifestyle behaviors, including higher caffeine intake [14]. Similarly, Yi et al. (2022) reported that greater consumption of caffeinated beverages was linked to poorer sleep quality, which may indirectly elevate stress levels. These findings suggest a bidirectional relationship in which stressed students may consume more caffeine, which in turn can worsen sleep and stress outcomes [15]. Sleep duration in our study was below the recommended 7–8 hours, consistent with previous research. Nasir et al. (2022) reported that caffeine intake negatively impacted sleep quality among medical students [16], while Khan et al. (2024) found that frequent energy drink consumption disrupted sleep in Saudi medical students [17]. Our findings also resonate with Qasem et al. (2024), who observed that energy drink consumption was common among Jordanian medical students and was associated with lifestyle factors linked to stress [18]. Collectively, these studies support the notion that caffeine use, although often intended to counteract fatigue, may perpetuate a cycle of poor sleep and elevated stress.

Interestingly, caffeine intake increased progressively across academic years in our cohort, peaking in Year 4, with slightly higher stress scores among senior students. This pattern is consistent with findings from Gangwal et al., [13] and Rehman et al., [11] which indicated that senior medical students tend to consume more caffeine due to increased academic workload and clinical responsibilities. Kassaw et al. (2024) also reported that problematic coffee use among medical and health science students was linked to academic stress, further supporting our observation of a relationship between caffeine intake and stress [19]. Overall, our results reinforce the evidence that caffeine consumption, sleep quality, and perceived stress are closely interrelated among medical students [20, 15, 16, 13, 19, 20]. While moderate caffeine intake is widespread and socially accepted, excessive consumption may have negative consequences, including impaired sleep and increased stress levels. These findings highlight the importance of promoting healthier coping strategies, such as stress management interventions, sleep hygiene education, and awareness regarding safe caffeine consumption

5. LIMITATIONS

This study's cross-sectional design limits causal inference. Self-reported data on caffeine intake and stress may be subject to recall and social desirability bias. The sample size was modest and limited to a single institution, which may affect generalizability. Future longitudinal studies with larger, diverse samples are warranted to better understand causal pathways and the impact of interventions.

6. FUTURE DIRECTIONS

Future research should aim to address these limitations. Longitudinal studies would be useful to explore the temporal relationship between caffeine use, stress, and sleep, helping to clarify causality. Incorporating objective measures, such as actigraphy for sleep or biochemical markers of caffeine intake, may reduce bias from self-reporting. Further studies could also examine the differential impact of various caffeine sources, particularly energy drinks versus coffee or tea, given the emerging concerns about energy drink use. Expanding research across multiple institutions and cultural contexts would improve generalizability. Finally, interventional studies on stress management programs, sleep hygiene education, and awareness campaigns on safe caffeine consumption could provide practical insights for improving student well-being.

7. CONCLUSION

This study demonstrates a significant association between caffeine intake and perceived stress among undergraduate medical students. Moderate caffeine consumption was most common, but higher intake correlated with elevated stress levels and insufficient sleep, suggesting a potential cycle in which caffeine is used to counteract fatigue yet contributes to stress and sleep disruption. The progressive increase in caffeine use across academic years underscores the impact of escalating academic demands. These findings emphasize the importance of implementing stress management

interventions, promoting sleep hygiene, and encouraging moderated caffeine consumption to support the well-being and academic performance of medical students. Future longitudinal and interventional studies are warranted to establish causality and develop targeted strategies for healthier coping behaviors.

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