

ORIGINAL ARTICLE

Comparison of Caffeine and Nicotine on Sleep Quality of Male Medical Students of Quaid-e-Azam Medical College, Bahawalpur

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ABSTRACT

Background: Caffeine and nicotine are two commonly used substances among medical student to combat fatigue and improve alertness. However both substances have been associated with reduced sleep duration and increased sleep latency. Comparative studies evaluating their effects on sleep quality among medical students are scarce.

Objective: To assess the prevalence of caffeine and nicotine use among male medical students of Quaid-e-Azam and to evaluate their comparative effects on sleep quality of the students.

Method: This cross-sectional study was conducted in the Department of Pharmacology, QAMC. A total of 200 male MBBS students aged 18–25 years were recruited. Participants were classified into caffeine users (n = 110), nicotine users (n = 50), and non-consumers (n = 40). Sleep quality was assessed using the Pittsburgh sleep quality index (PSQI). Data were analyzed by one-way ANOVA followed by Tukey's HSD post hoc test using SPSS version 25. A p-value < 0.05 was considered statistically significant.

Results: Overall, 120 students (60%) reported poor sleep quality (PSQI > 5). Poor sleep was most frequent among nicotine users (74%), followed by caffeine users (62.7%), and non-consumers (35%). Nicotine users had the shortest mean sleep duration (5.4 ± 1.2 hours) and longest sleep latency (34 ± 11 minutes) compared to caffeine users (5.9 ± 1.4 hours; 28 ± 9 minutes) and non-consumers (6.8 ± 1.1 hours; 18 ± 6 minutes). Intergroup comparisons showed nicotine had significantly greater effects statistically on both sleep duration and latency as compared to caffeine (p < 0.001).

Conclusion: Both caffeine and nicotine negatively affect sleep quality among male medical students, with nicotine leading a more pronounced effect by reducing sleep duration and increasing sleep latency.

Keywords: Caffeine, Nicotine, Male medical students

INTRODUCTION: Sleep is a physiological phenomenon for maintaining optimal mental, psychological, and physical health. Memory consolidation, normal tissue repair, and neurochemical restoration are the processes that occur during sleep [1]. Sleep deprivation is linked with impaired concentration, reduced learning ability, irritability, and ultimately long-term health consequences such as physical and psychiatric ailments [2]. Medical students habitually exhibit of poor sleep patterns due to strict class hours, exam pressure, and unhealthy lifestyle patterns that include consumption of stimulants [3]. Among the most common psychoactive substances that influence sleep are caffeine and nicotine. Both substances are widely consumed throughout the world, and their impact on sleep quality is a subject of continuous scientific interest for medical professionals [4]. Caffeine, a widely consumed CNS stimulant, primarily found in coffee, tea, chocolate, carbonated and energy drinks. Pharmacological mechanism involves inhibition of phosphodiesterase (PDE) enzymes non-specifically and antagonizing adenosine receptors that ultimately block sleep and enhancing the alertness [5]. Moderate consumption of caffeine is associated with improved attention, reduced fatigue, and heightened performance.

However, excessive or late-night consumption can lead to insomnia, disrupted sleep, late sleep onset, and overall reduced sleep duration [6]. Nicotine, on the other hand, is the primary psychoactive component in tobacco. Pharmacological action of nicotine involves activation of neuro nicotinic (N_N) receptors [7]. It has dual stimulant and relaxant properties. Initially, it enhances alertness and concentration, but chronic use leads to dependence and withdrawal that include sleep disturbances. It reduces rapid eye movement (REM) sleep, late sleep onset, and frequent awakening that ultimately results in poor sleep quality [8]. Medical students use caffeine and nicotine routinely to combat stress and extend wakefulness in routine that enhances in exam seasons. But chronic excessive use of these on stimulants may paradoxically decline their academic performance by impairing sleep quality. Poor sleep not only lessens learning but also leads to low mood and impulsive behavior that leads insidious effect on their lives [9,10]. Globally, studies have compared the effects of caffeine and nicotine on sleep quality. However, direct comparative studies among medical students in Pakistan is limited. Considering the high prevalence of both caffeine and nicotine consumption among youth of Pakistan, it is crucial to investigate their impact within this vulnerable population. This study aims to bridge the knowledge gap by directly comparing the effects of caffeine and nicotine consumption on the sleep quality of medical students at Quaid-e-Azam Medical College, Bahawalpur.

METHOD: This cross-sectional study was conducted in Pharmacology department of Quaid-e-Azam Medical College (QAMC), Bahawalpur after getting ethical approval from Institutional review board (IRB) of Medical education department of QAMC, Bahawalpur (letter # 336/DME/QAMC dated 26-05-25). Due to strong cultural association of Nicotine use (Cigarettes, vapes and nicotine pouches) in males, only male students were the part of this study [11]. Sample size was calculated using 95% confidence interval, expected prevalence of poor sleep among stimulant users of 50%, and 7% margin of error that inclined by the relevant studies, 200 male MBBS students who showed willingness through informed consent were the part of study [12,13]. study groups were formed on the basis of self-reported stimulant use i.e. caffeine users, nicotine users, and non-consumers. Inclusion criteria Enrolled male students of QAMC aged between 18–25 years. Self-report was considered reliable for classifying students into caffeine users, nicotine users, and non-users. Regular caffeine users were defined as students consuming at least one caffeinated product (tea, coffee, soft drink, or energy drink) daily for at least 3 months. Likewise, Regular nicotine users were defined as students consuming at least one nicotine-containing product daily (cigarettes, vape/e-cigarette, or nicotine pouches) for at least 3 months. Non-consumers were defined as students who reported no regular use of caffeine-containing products (tea, coffee, soft drinks, or energy drinks) and no use of nicotine-containing products (cigarettes, vapes/e-cigarettes, or smokeless tobacco) during the preceding 3 months. Exclusion criteria included Students with diagnosed psychiatric disorders (e.g., depression, anxiety), students on sleep-inducing medications or other psychoactive drugs or those with chronic medical conditions such as epilepsy, asthma, etc. After informed consent, students were briefed about study objectives. Sleep quality was assessed through Pittsburgh sleep quality index (PSQI) [14]. Questionnaires were distributed and completed during free academic hours while maintaining the confidentiality. Data was analyzed using SPSS version 25. Normality of continuous variables was assessed using the Shapiro–Wilk test, while homogeneity of variances was evaluated using Levene's test before applying one-way ANOVA. As assumptions were met, one-way ANOVA followed by Tukey's HSD post-hoc test was used for intergroup comparisons. $p < 0.05$ was considered significant.

RESULTS: Based on their self-reported stimulant use, participants were classified into Caffeine user, Nicotine user and non-consumers. Among 200 participants regular stimulant use was common, with 110 students (55%) reporting caffeine consumption, 50 (25%) reporting nicotine use, and 40 (20%) reporting no stimulant use. The mean age of the cohort was 21.4 ± 1.8 years. Overall, 120 students (60%) met criteria for poor sleep (PSQI > 5). By exposure group, poor sleep was identified in 37(74%) of 50 nicotine users, 69 (62.7%) of 110 caffeine users, and 14 (35%) of 40 non-consumers.

Daytime dysfunction was most common in students using nicotine. 33 students (66%) of nicotine user reported reduced concentration and daytime sleepiness. 59 (54%) of 110 caffeine user and 11 of 40 non-consumer reported day time sleepiness and reduced concentration. Assumptions of normality and homogeneity of

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variance were assessed prior to conducting one-way ANOVA. The Shapiro–Wilk test indicated that sleep duration and sleep latency were normally distributed across all groups ($p > 0.05$). Levene’s test confirmed homogeneity of variances for sleep duration and sleep latency ($p > 0.05$), indicating that the assumptions required for ANOVA were satisfied.

Comparative analyses of mean sleep duration and mean sleep latency are described in the Table Sleep duration showed a significant difference between groups ($F(2,197) = 23.4$, $p < 0.001$, $\eta^2 = 0.17$), indicating a large effect size. Similarly, sleep latency also demonstrated a significant group effect ($F(2,197) = 29.6$, $p < 0.001$, $\eta^2 = 0.21$), suggesting a large effect size and a meaningful difference in sleep patterns across groups. Graphical representation of means of sleep duration and sleep latency in bar chart is illustrated in Figure 01

Table 1. Group-wise sleep duration and latency with p-values (one-way ANOVA)

Variable		Caffeine (n=110)	Nicotine (n=50)	Non-Consumers (n=40)	p-value
Mean Sleep Duration (hours)		5.9 ± 1.4	5.4 ± 1.2	6.8 ± 1.1	< 0.001
Mean Sleep Latency (minutes)		28 ± 9	34 ± 11	18 ± 6	< 0.001

Note: p-values from one-way ANOVA comparing the three groups.

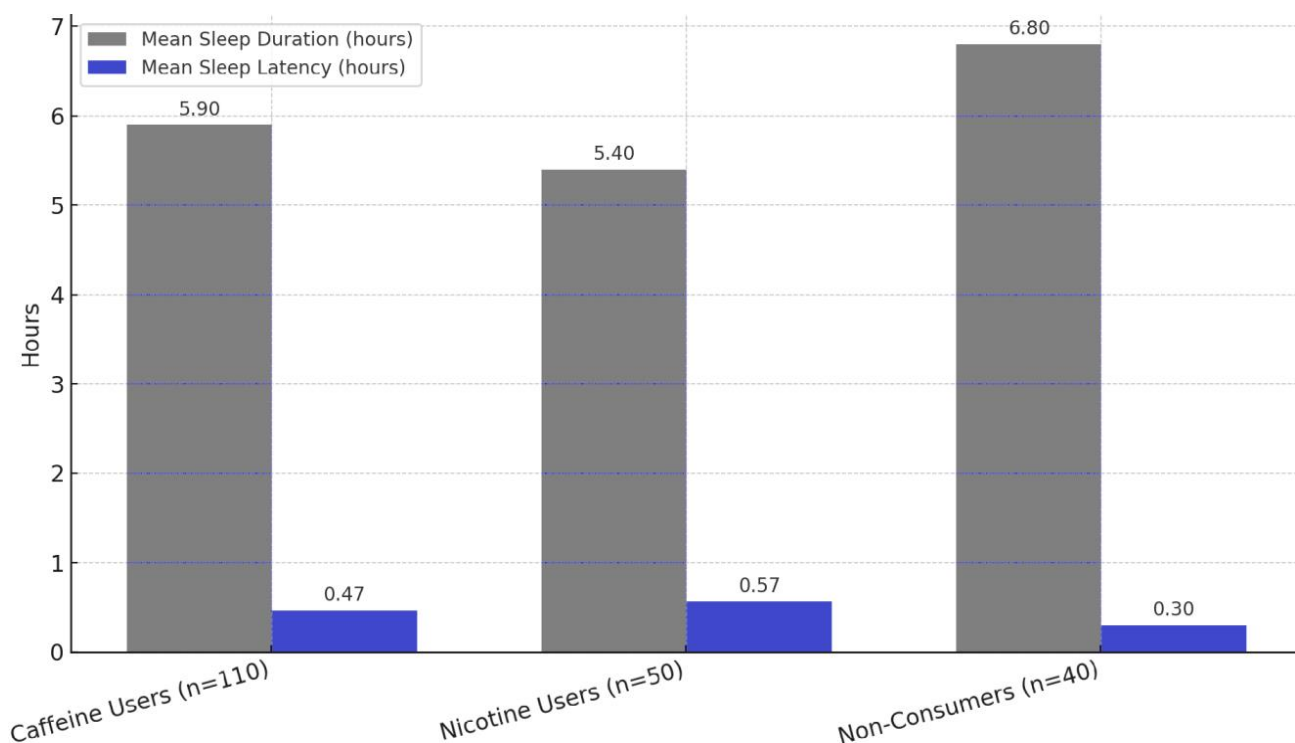


Figure 1: Graphical representation of means of sleep duration and sleep latency

Table 2 presents the results of Tukey’s HSD post-hoc analysis following one-way ANOVA. Pairwise comparisons showed statistically significant differences in both sleep duration and sleep latency across all three groups (nicotine users, caffeine users, and non-consumers). These results confirm that each group demonstrated distinct sleep characteristics.

Table 2 Tukey’s HSD post-hoc comparisons for sleep duration and sleep latency

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Intergroup comparison of sleep duration				Confidence interval(CI) Lower – Upper	p-value
Comparison			Mean Difference		
Caffeine vs Nicotine			0.50	0.20 – 0.80	<0.001
Caffeine consumer	vs	Non-	-0.90	-1.20 – -0.60	<0.001
Nicotine consumer	vs	Non-	-1.40	-1.70 – -1.10	<0.001
Caffeine vs Nicotine			-6.0	-8.0 – -4.0	<0.001
Caffeine consumer	vs	Non-	10.0	8.0 – 12.0	<0.001
Nicotine consumer	vs	Non-	16.0	14.0 – 18.0	<0.001

** Note: Mean differences are calculated as (first group – second group). Negative values indicate lower values in the first group, while positive values indicate higher values in the first group.*

DISCUSSION: Sleep is an essential need of a person. A healthy adult requires 7-8 hours good quality sleep. During sleep body undergoes normal wear and tear that keeps body in an optimal state [15]. Medical students face a lot of stressors in their activities that lead them to use psychostimulant substances i.e. Caffeine and nicotine [16].

This study compares relations of caffeine and nicotine on sleep quality of male medical students. It was found that male medical students that are not habitual users of caffeine and nicotine have good quality sleep, not only in sleep latency but also in duration. Similar findings were observed in a nationwide survey of France that ended that non user of nicotine has better sleep latency and healthier sleep hours [17]. Likewise, a cross sectional study conducted in Turkey also concluded medical students who are non-dependent on caffeine has better sleep patterns [18]. Similarly a study conducted in King Faisal University, KSA, also reported that students who utilized either 02-03 cups of coffee or 05 or more cups of tea experienced statistically significant increase in sleep latency period, inconsistent sleep and decreased sleeping hours [19]. These findings are consistent with the present study, where higher caffeine use was associated with sleep debt. While comparing our results of nicotine on sleep, we found a research project by Valentina in university students of Chile, recognized that nicotine users had poor quality of life with delayed sleep latency and increase daytime sleepiness [20]. Her findings strengthen our results that nicotine disturbs sleep pattern. Meanwhile literature review of Nihaal found association that nicotine disturbs sleep latency and duration due to night time cravings. He also found snoring and obstructive sleep apnea are more frequent in habitual nicotine users as compared to non-users. His findings also align with our findings that nicotine worsens sleep quality [21].

While comparing effects of caffeine and nicotine, pattern of disrupted sleep was more in nicotine user than caffeine not only by increasing the sleep latency but also by decreasing the duration. These results are supported by the research project of Christine E. Spadol who found a link that evening caffeine doesn't affect sleep whereas evening nicotine intake causes troubled sleep [22]. Meanwhile meta-analysis by Debora Meneo reported that nicotine leads to greater sleep dissatisfaction as compared to caffeine, a finding that is parallel to our results [23].

In summary this study demonstrates that both caffeine and nicotine are negatively related to sleep quality with nicotine exerting a more obvious disruptive impact. Future studies should be carried out with involving neurochemical basis to better understand how these substances influence sleep.

Limitation of this study was that thorough characteristics of caffeine and nicotine exposure, including dose, timing, frequency, and type of product used, were not explored. Furthermore, potential confounding factors i.e. academic year, examination period, stress levels, screen time, physical activity, BMI, and symptoms of

depression and anxiety were not assessed. Future studies should consider these variables to provide a more comprehensive understanding of the association between caffeine and nicotine use on study outcomes.

CONCLUSION: Caffeine and nicotine both increase sleep latency and decrease sleep duration among male medical students of Quaid-e-Azam Medical College, Bahawalpur, with nicotine was associated with poorer sleep quality as compared to caffeine.

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