

# Assessing the correlation between caffeine consumption and its effect on the academic performance of medical students of Shifa College of Medicine, Islamabad, Pakistan: A Cross-Sectional Study

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## Author's Contribution

<sup>1,2,3</sup> Conception of study

<sup>1,2,3</sup> Experimentation/Study conduction

<sup>1,2,3</sup> Analysis/Interpretation/Discussion

<sup>1,2,3</sup> Manuscript Writing

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## Abstract

**Objective:** To assess the correlation between caffeine consumption and its effect on the academic performance of medical students of Shifa College of Medicine, Islamabad, Pakistan.

**Materials and Methods:** A descriptive cross-sectional study was conducted at Shifa College of Medicine and its affiliated hospital for about three months from 10<sup>th</sup> June 2019 to 15<sup>th</sup> August 2019. Second-year medical students actively took part in it. We used convenient sampling; a total of 101 students eagerly participated in it. We used a detailed self-administered questionnaire in which simplified questions with four to five options were given. Participants marked their responses to the provided options. A correlation was noticed between their Locomotive System and Gastrointestinal System modular exam scores with the questionnaire response. Data were analyzed by SPSS version 23.

**Results:** Out of 101 participants, 51.5% were males, and 48.5% were females. About 77.2% of participants were consuming caffeine in any form, while 22.8% never consumed caffeine. Those who consumed moderate (200-400 mg) caffeine in any way performed better in the Locomotive System Module with a mean score of 71.88%. Simultaneously, those who consumed a lot more than 400 mg of caffeine scored better in the Gastrointestinal Tract Module with a mean score of 76.50%.

**Conclusion:** By conducting this study, we identified that caffeine consumption is surprisingly high in medical students. The correlation between caffeine consumption and its effect on medical students' performance is not significant.

**Keywords:** Academic performance, Caffeine consumption, Medical students.

## Introduction

Coffee was discovered in 850AD by a herdsman, Khaldi, in Abyssinia, situated in Upper Egypt.<sup>1</sup> Over time, coffee ingredients were found in different areas of the world: coffee beans (*Coffea arabica*) found in Arabia, the tea leaf (*Thea Sinensis*) detected in China, and the Kola nut (*Theo-Bromo cocoa*) located in Mexico.<sup>1</sup> Caffeine is present in a wide range of products, namely coffee, tea, soft drinks, hot chocolate, confectionery such as chocolate, and many over-the-counter medications, including cold remedies and analogies.<sup>2</sup> Caffeine is one of the central nervous system stimulants preferred by children and adults today.<sup>3,4</sup> It is naturally or additively found in foods and beverages. Multiple potential health adverse effects have been commonly observed in adolescents and adults who relish caffeinated drinks at the expense of their health. Caffeine intake between 100-400 mg has been associated with severe adverse effects on the central nervous system (CNS) such as confusion, anxiety, tremors, hyper-excitation, extreme agitation, to name a few.<sup>5,6</sup>

Many people worldwide rely on caffeine, especially during the morning, to stay alert and increase attentiveness. Many college students have justified their caffeine consumption by stating that it helps them cope with tedious and demanding academic situations,<sup>7,8</sup> with 49% of Puerto Rican students claiming caffeinated products to be a handful in managing stressful study schedules.<sup>9</sup>

Students reportedly claimed that they had consumed caffeine to increase alertness, perform demanding tasks better, boost attention span and long-term memory, and rapid locomotive movements.<sup>10,11</sup>

Some of the researched evidence even sheds light on other adverse effects commonly seen in children and young persons who regularly consume caffeinated products.<sup>12-15</sup> Consequences like sleep disturbance, high mean blood pressure, diminished absorption of minerals, bone health, and increased dependence on alcohol.<sup>5,12-14</sup>

Recent studies present credible evidence that caffeine usage is becoming common in students of Rawalpindi and Islamabad. It has been widely witnessed that consuming caffeine in any form has been more trending among youth, especially amongst students. When discussing students, the researchers initiated their idea to base their research on medical students as they are more burdened than the students of other fields. The study aimed to judge medical students' knowledge regarding potential adverse effects of

caffeinated products; it was also conducted to see caffeine consumption and its relationship with medical students' academic performance. A previous study like this has been conducted in Bahrain, where the anxiogenic effect of caffeine on its students was judged.<sup>20</sup> Such a study has never been conducted on Pakistani medical students, correlating their modular exam scores with the amount of caffeine intake.

## Materials and Methods

The current study has been accomplished in Islamabad, federally administered as part of the Islamabad Capital Territory. It also happens to be the capital city of the Islamic Republic of Pakistan, encompassing 906.5 square kilometers of area.

A cross-sectional study was carried out on second-year medical students in a renowned medical college: Shifa College of Medicine (SCM), Islamabad. Questionnaires were designed and handed over to the participants to fill in after thorough informed consent. Participants were addressed to opt out of the study if they felt uncomfortable at any point in the study. Participants were told not to mention their names; instead, roll numbers were assigned anonymously to preserve their identity. A validated Caffeine Food Frequency Questionnaire (C-FFQ) was used to collect the data.<sup>21</sup> It included details about age, gender, amount of caffeine consumption daily, type of caffeine consumed (black coffee, milk/cream added to coffee, milk/dark chocolate, soft drink, energy drink), the purpose of using caffeine, side effects of caffeinated products, whether they have experienced side effects of caffeine-if yes, which one(s), and what outcomes they expect to see by consuming caffeinated products. The modular exam scores were recorded from the Course Director of Gastrointestinal tract (GIT) module and Locomotor System (LMS) module, divided into two sub-modules with LMS A and LMS B, dividing Upper Limb and Lower Limb into two separate sub-modules. Each modular exam consisted of seventy multiple-choice questions to assess students. Data had been recorded, and then it was analyzed by SPSS version 23. Mean  $\pm$  SD was used for quantitative data. P-value  $\leq 0.05$  was considered significant.

Inclusion criteria:

- Participants should be full-time registered students in SCM.
- Must meet age criteria- range 18 to 24 years old.
- Participants must be from the second year.

Exclusion criteria: Any participant who does not fit the inclusion criterion.

We used a convenient sampling technique. The participants were informed about the true nature of the study beforehand to reduce detection and awareness bias. The second-year medical students had not studied pharmacology and forensics yet, so they were not familiar with caffeine consumption and overdose signs and symptoms. In return, this minimized awareness bias.

All participants voluntarily entered the study and were coerced in no way to participate in this descriptive research. Their identity remained strictly anonymous, and their information remained confidential in a password-protected computer only accessible to the research group members. They were given the option to opt out of the research at any time, and upon request, their data would be erased from the computer. Data was solely accessible to the principal investigator and other study team members. Data was kept anonymous and analyzed.

## Results

After collecting and analyzing the survey, the researchers concluded that, out of 101 participants, 52 (51.5%) were males, and 49 (48.5%) were females. About 78 (77.2%) participants consumed caffeine in any form, while 23 (22.8%) were non-consumers.

The average score of participants who had never consumed caffeine for three modules combined was 67.17% (Table 1). In contrast, the average score of

students who finished a lot more than 400 mg of caffeine was 61.95% for three modules (Table 1). 23 (22.8%) always preferred caffeine during an exam; 33 (32.7%) were consuming it often; 26 (25.7%) rarely drank it, while 19 (18.8%) never consumed caffeine before, during, or after the exam. The participants who were consuming caffeine solely for exam preparations were 18 (17.8%); 30 (29.7%) participants were utilizing it for reducing fatigue; 7 (6.9%) were using it as sleeping aid; 3 (3.0%) were consuming it to combat stress; 21 (20.8%) utilized it for mood elevation; 22 (21.8%) were non-consumers. Participants who were drinking caffeine for coping with academic load or stress were 36 (35.6%), while the remaining 65 participants (64.4%) were not habitual of consuming caffeine. Around 66 (65.3%) participants knew that caffeine harms their health when compared to 35 (34.7%) participants who were not aware of this fact. Out of 101 participants, 43 (42.6%) people consumed caffeine once per week; 24 (23.8%) preferred it twice; 8 (7.9%) consumed it thrice or more times, while 26 (25.7%) never drank caffeine in a week. Moreover, 29 (28.7%) participants accepted that they were addicted to caffeine, while 72 (71.3%) believed that they were not addicted to caffeine in any form.

The p-value showed that the results were not significant, and we accept the null hypothesis. The Pearson correlation concluded that there was no statistically significant correlation between students' academic performance and the amount of caffeine consumption (Table 2).

**Table 1: Module scores and caffeine consumption amount**

Module	Caffeine consumption	N	Mean	S. D	P-Value
LMS A Scores	Not At all	23	71.3974	13.62211	0.925
	A little 20-200 mg	54	70.2474	13.35946	
	Moderate 200-400 mg	22	71.8827	13.88399	
	A lot more than 400 mg	2	66.6100	8.83883	
	Total	101	70.7935	13.32416	
LMS B Scores	Not At all	23	53.9022	6.26735	0.153
	A little 20-200 mg	54	53.0528	7.07508	
	Moderate 200-400 mg	22	54.1977	6.92072	
	A lot more than 400 mg	2	42.7500	2.47487	
	Total	101	53.2916	6.91453	
GIT Scores	Not At all	23	76.22	10.379	0.947
	A little 20-200 mg	54	75.00	10.674	
	Moderate 200-400 mg	22	74.45	11.156	
	A lot more than 400 mg	2	76.50	4.950	
	Total	101	75.19	10.530	

**Legend:** LMS = Locomotor System Module; GIT = Gastrointestinal System Module; N = Total Number; S. D = Standard Deviation; Significant P ≤ 0.05

**Table 2: Pearson Correlation (2 Tailed) of Caffeine consumption with Module Scores**

		<i>LMS A scores</i>	<i>LMS B scores</i>	<i>GIT scores</i>
<b>Caffeine Consumption</b>	<b>Pearson Correlation Sig. (2 Tailed)</b>	<b>-0.078</b>	<b>-0.128</b>	<b>-0.031</b>

Legend: LMS = Locomotor System Module; GIT = Gastrointestinal System Module

## Discussion

Medical students' lives begin with multiple tests: entrance exam, internal exam preparation, research work, and clinical examinations; throughout the entire medical course, the students have to experience extreme stress and sleepless nights.<sup>1</sup> Medical students need to work hard beyond their mental capacity and physical stress to show progress in their exams.<sup>1</sup> It is a possible reason why medical students consume caffeinated beverages to combat academic stress; this is one of the coping strategies.<sup>1</sup> There are many caffeine consumption products in medical students at SCM, as observed in our research. Results of a similar study conducted at DUHS, Karachi, Pakistan concluded that their students utilized caffeine to boost academic performance (71.5%), cope with academic stress or load, increase IQ (22%), boost self-confidence (71%), and improve study hours (45%).<sup>15</sup> Similar figures and percentages have been calculated in students at SCM. However, no significant association had been found between caffeine consumption and academic performance in medical students at SCM. Apart from borderline tachycardia in 3 students, no such side effects were witnessed in our study population. Caffeine consumption is just not practiced in this field, but other students in business or engineering fields also prefer consuming it. Caffeine itself has been the most widely used psychoactive drug worldwide. Students have been consuming caffeine in the form of tea, chocolates, coffee, soft drinks, and energy drinks.

It is a common perception that by drinking caffeine, an individual can increase concentration levels and remain proactive throughout the day.<sup>2</sup> The majority of fit adults can consume 400 milligrams (mg) of caffeine or less per day as it appears safe.<sup>2</sup> Do not forget that the real caffeine quantity in drinks differs vastly, especially among energy drinks.<sup>2</sup> University of Puerto Rico Medical Sciences Campus conducted a study on first and second-year students. It represented that more than two-thirds of students consumed caffeinated products to remain awake during the exam and diminish workload and academic stress. Caffeine binds and blocks adenosine receptors, preventing

attachment of adenosine molecule to its original receptor in the brain; this is followed by an indirect influx of numerous neurotransmitters like norepinephrine, acetylcholine, serotonin, dopamine, glutamate, and gamma-aminobutyric acid (GABA)- all these alter cognitive function.<sup>22</sup> However, through statistical analysis, researchers concluded that none of these factors significantly increased academic pressure or load.<sup>9</sup> Similar results have been observed during our cross-sectional research as well.

Our study has observed the detail that one-fifth of the total participants, 20 (19.8%), consumed energy drinks. Medical students must know the drastic health effects energy drinks impose on humans; they may then educate and counsel the remaining population about it, mostly young individuals. The United States Food and Drug Administration has alerted the public that two types of caffeine: powder and liquid form, can have hazardous levels leading to toxicity. One teaspoon of powdered caffeine is equivalent to about twenty-eight cups of coffee. Such lofty caffeine levels can manifest severe problems regarding health and possibly lead to death.<sup>2</sup> Ergo it is imperative to educate about the different side effects of caffeine consumption to the population.

The sole reason for the rise in the number of caffeinated beverages consumption is due to the products' successful media and social marketing. The young generation is an easily targeted audience; it attracts them like metal to a magnet; they easily fall for these trends. Youngsters can conveniently fall prey in the hands of flaunting social media, advertisements, and other sources like these. Hence, it is claimed that most people (youth) do not use caffeine for productive reasons. Most of the time, immense peer pressure contributes to the cause, especially when everyone else is trying it, and it becomes easily accessible to them at all times.<sup>16</sup>

Aga Khan Medical University researched energy drinks consumption practices among medical students of a Private sector University of Karachi. Surprisingly, television had been marked as the vital source of providing information 153(66%), followed by a discussion between friends 113(48%).<sup>17</sup>

The sole purpose of conducting this research was to spread awareness among students, especially among medical students. Caffeine itself follows quite dangerous side effects, injuring both physical and mental health. It had been considered one of the favorite drugs which are legal. Still, most of its consumers do not realize the problems it creates, nor do they know the considerate amount to intake this standard, not an addictive drug. As discussed earlier, caffeine is present in multiple drinks and food; people should be aware of caffeine present in tea, coffee, cocoa, or an energy drink. Caffeine is found in several plants: tea, coffee beans, guarana berries, and cocoanuts (although the quantity is relatively small, around 0.2-0.4 percent), acts as a toxin to defend against herbivores. It is alarming to know that the tea plant's leaves possess the most amount of caffeine, an estimation of 5 percent in contrast to 1 percent for coffee beans.<sup>18</sup>

A plethora of side effects of caffeinated products consists of long as well as short term adverse effects. Short-term effects include muscle contraction, which can be consistently twitching along with tachycardia. An increased heart rate causes multiple issues, often resulting in the slowing of blood flow to the stomach and constriction of blood vessels on the skin. The liver releases more sugar into the bloodstream. Lastly, breathing tubes open ups as well.<sup>18</sup> No such side effects were experienced in our study population.

Athletes started consuming a moderate amount of caffeine beverages, which improved endurance while performing aerobic exercises, like cycling or sprinting. It aids in combating restlessness and fatigue. However, caffeine works as a diuretic as well. It could achieve dehydration status earlier in active athletes.<sup>18</sup>

The chronic use of caffeinated products may pose health risks. It can be considered abuse- caffeinism: a syndrome exhibiting multiple side effects, such as sleeplessness, ringing in the ears, anxiety, irregular heartbeat, stomach upset, and many more.<sup>13</sup> Such severe side effects were not experienced by our study population. We specifically addressed this in the questionnaire.

A cross-sectional study had been conducted at three colleges in Jeddah, Saudi Arabia, regarding energy drinks consumption amongst medical students and interns. The study concluded that the significant reason for consuming energy drinks was rejoicing leisure time with friends (57.5%), gaining energy for studying (56.4%) and staying up for a long duration (50.5%).<sup>19</sup> In contrast, the majority of SCM students

consumed energy drinks to reduce fatigue (29.7%), elevate mood (20.8%), and exam preparation (17.8%).

This research has a few limitations to it. SCM medical students of the second year per se are assumed to have ample information regarding health and nutrition since they have a complete module on "Nutrition and Metabolism" in the course program. So, there is a plausibility of awareness bias here. This data was explicitly gathered from only one batch of students, ergo limited to just one private medical university. So, it does not showcase the entire medical students of Pakistan. Furthermore, these results are confined to the medical field and may not profoundly establish links with students of other specialties. However, this research addresses the common misconceptions of medical students about consuming caffeinated products.

Future research should identify the amounts of caffeine present in a caffeinated product they are consuming per serving, the amounts of caffeine they consume depending on a plethora of situations, and the side effects: physical and mental, associated with caffeine consumption. For future studies, non-medical students from different areas can also be recruited and then included in this kind of research. This way, we can assess how much caffeine they consume and the level of expertise they possess on caffeine's adverse effects. Thorough differences in knowledge between medical and non-medical groups may be studied through it. Drinking caffeine might be a choice to work hard in an unstoppable manner, but it should not become a habit of any student, especially the ones who have to serve humanity in the later years of their life. To get rid of this habit, medical students should work practically, just like 64.4% of participants avoided caffeine. The study has covered topics, including short and long-term effects, deliberately to spread awareness among students whose intake of caffeine is rising with each passing day. Hence, whether being affected by caffeine, it's more important to focus on sleep patterns; students should consume a healthy and balanced diet. Further side effects of caffeine consumption on medical students, other than the one mentioned in the above paragraph can be studied in follow-up studies.

## Conclusion

By analyzing the correlation between caffeine consumption amongst medical students, the research concludes that there is a dire need to raise awareness about caffeine consumption in medical students; they

have been exposed to an ever-increasing workload in a demanding field. Although there is a high consumption rate of caffeinated products in medical students to increase academic performance, no significant association was established between the two.

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