

## Assessment of Trends of Consumption of Caffeine Containing Products and their Effects on Medical Undergraduate Students

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### ABSTRACT

**Objectives:** To assess trend of consumption and withdrawal effects from caffeine containing products among medical undergraduate students of Karachi.

**Study design and setting:** Cross-sectional study conducted via web-based questionnaire, from January 2020 to June 2021.

**Methodology:** Undergraduate medical, MBBS students aged 18-24 years, studying in 6 different medical universities of Karachi were included in the study. An online survey was conducted. An online questionnaire was designed which consisted of 28 self-made questions that focused on collecting basic sociodemographic information, coffee consumption habits, and any adverse event associated with caffeine intake. The questionnaire was posted online and undergraduate medical students were invited to participate in the study.

**Results:** One hundred and fifty seven students participated in the study. Out of 157 students 94% admitted to consuming some form of caffeine containing product (CCP), with 42.3% (n = 66) of the total believing that they were addicted to caffeine. A significant number also believed that CCPs helped students deal with their problems. Withdrawal symptoms include migraines, sleep disturbances, and loss of focus, leading to an inability to perform daily tasks. A positive correlation was also found between the daily intake of any CCP and incidence of withdrawal symptoms (p=0.01).

**Conclusion:** Many students in medical universities of Karachi are moving towards caffeine dependence, due to daily consumption over a prolonged period of time. Promoting responsible consumption habits and spreading awareness over potential adverse effects of CCPs, especially amongst a younger audience could improve the health and lifestyles of students in the long-term.

**Keywords:** Addiction, Caffeine, Substance Abuse, Withdrawal

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### INTRODUCTION:

Caffeine is a widely consumed substance and is ingested in various forms by all age groups.<sup>1</sup> Tea is one forms of caffeine consumed especially in Pakistan, India, China and Britain. It has multiple effects on health, some being controversial such as reduced BMD (bone mineral density). Daily caffeine intake has shown to have some correlation with increased body mass index.<sup>1,2</sup> It has been seen that the blood chemistry has altered concentrations of AST, ALT, and plasma creatinine in those drinking caffeine.<sup>3</sup> A growing number of clinical studies express that caffeine users develop addiction to the substance and are incapable of reducing their intake despite knowledge of repeated health problems associated with continued use. The World Health Organization (WHO) along with health care professionals identifies caffeine dependence as a disorder.<sup>4</sup> Consequently, with work and productivity there also seems to be an effect on academic performance. Many students use caffeine as a stimulant to increase productivity and work however data would suggest the end result to be the opposite. A previous research study found that excess energy drink drinking is connected to lower academic scores such as grade point averages (GPAs).<sup>5</sup>

The consumption of energy drinks, despite the variation in the reason for choosing these drinks, is quite common among college students. A primary aim of ingesting caffeine is to have more energy and stay awake.<sup>6</sup> Existing literatures prove that caffeine consumption is driven by a number of factors such as taste, withdrawal symptoms such as headaches, keeping alert for longer periods of time, ceasing fatigue, and social factors.<sup>7</sup> Despite this fact, it has been shown that frequent consumption of caffeine has been unsuccessful in enhancing mental alertness and mental performance.<sup>8</sup> A study showed that “alexithymia, a personality trait characterized by negative moods and deficient emotion regulation”, was linked to heavy caffeine intake.<sup>9</sup> The use of coffee has shown poor sleep quality and increased commission errors to combat sleep disturbances can therefore be detrimental in situations requiring inhibitory control. Thus, linking to reduced work productivity and general wellbeing.<sup>10</sup> Given all these reasons and more, it is no surprise that caffeine abuse is progressively being included in the list of potentially harmful substances for the youth in terms of health.<sup>11</sup> However, despite the many risks of excessive and prolonged caffeine intake, many people –especially adolescents and young adults – continue to consume large quantities of caffeine containing products. Therefore, the main objective of our cross-sectional study was to examine the trend of caffeine consumption in Pakistani adolescents and young adult students, and to evaluate its relationship with withdrawal symptoms, thus assessing its addictive ability in this sub-population.

#### **METHODOLOGY:**

The study was conducted after Institutional Board Review approval was obtained from Jinnah Sindh Medical University JSMU/IRB/2020/-303. A cross-sectional study was conducted via web-based questionnaire, from January 2020 to June 2021. Undergraduate medical, MBBS students aged 18-24 years, studying in 6 different medical universities of Karachi were included in the study. Students from all the five years were included in the study. Any student who did not complete the survey was excluded from the study. An online survey was conducted. The questionnaire was posted online and undergraduate medical students were invited to participate in the study. A Sample size was 157, was calculated based upon a similar study done previously.<sup>12</sup> It was calculated using the sample size calculator available at: <http://www.raosoft.com/samplesize.html> considering the confidence interval of 95%. students were selected by using convenience sampling for this cross-sectional study. An online questionnaire was designed which consisted of 28 self-made questions that focused on collecting basic sociodemographic information (age, gender, and education level), coffee consumption habits, and any adverse event associated with caffeine intake. The validity of questionnaire was assessed by carrying out a small pilot test within one university including a small sample size of 50 students. The

reliability was assessed by sending the questionnaire to 5 experts on the subject and having research experience of 10 years.

The participants were made aware of their rights in a disclaimer section before the survey, and they were explicitly informed that no monetary compensation would be provided in exchange for participation. The anonymity of all participants remained preserved.

The IBM Statistical Package for the Social Sciences (IBM SPSS version 26; IBM Corp Inc, Armonk, NY) was used to analyse the data. Categorical data was presented in terms of frequencies and percentages, whereas continuous variables were expressed as mean  $\pm$  standard deviation. Pearson chi-square test of independence was used for comparing continuous and categorical variables wherever applicable. A p-value of  $<0.05$  was considered significant.

#### **RESULTS:**

A total of 157 students participated in the study. Out of 157 participants, 123 (78.3%) were females and 34 (21.7 %) males. The mean age of the study population was  $20.7 \pm 1.7$  years. There were 148 participants (94.3%) who admitted that they have taken caffeine, at some point in their life, in the form of coffee, tea, caffeine tablets, or energy drinks. Fifty two participants (33.5%) began consuming tea /coffee in their early childhood (between 2 to 10 years of age).

Different caffeine containing drinks were preferred by everyone. Many preferred more than one drink. Tea was the preferred drink for 134 (85.4%) participants, coffee was preferred by 121 (77.1%) participants, and energy drinks were consumed by 47 (36.3%) participants, whereas 27 (16.6%) participants consumed caffeine in the form of tablets.

Table 1 summarizes the habits caffeine consumption among university students.

Withdrawal symptoms were experienced by 66 study participants (42.3%). They feel moderate to severe withdrawal symptoms, leaving them unable to perform daily tasks without caffeine consumption. Withdrawal symptoms include migraines, sleep disturbances, and loss of focus. Pearson's chi-squared test showed a positive correlation between daily intake and withdrawal symptoms ( $p=0.01$ ). Figure 1 shows the common withdrawal symptoms reported. The age at which respondents reportedly first tried CCPs was neither significantly associated with the one adverse effect upon excessive consumption ( $p = 0.431$ ), nor was it linked to withdrawal symptoms ( $p = 0.710$ ). Similarly, the initial reasons for consuming CCPs were not significantly linked to adverse effects ( $p = 0.387$ ) or withdrawal symptoms ( $p = 0.444$ ). However, those who reportedly increased caffeine intake when preparing for or taking exams, were found to have a significant relationship with adverse reactions ( $p = 0.041$ )

Figure 1 shows common reported adverse effects among

Table 1: Caffeine consumption trends among the MBBS students studying in medical universities in Karachi

Consumption Habits	Gender		P - value	Age			P - value
	Males (n, %)	Females (n, %)		<19 years (n, %)	20-23 years (n, %)	>23 years (n, %)	
<b>When did you start taking caffeine? If you do not consume regularly when was the first time you tried it?</b>							
2-10 years old	14,41.2	38,31.1	<b>0.533</b>	8,29.6	41,33.1	3,60.0	<b>0.325</b>
11-15 years old	13,38.2	57,46.7		12,44.4	58,46.8	0,0	
16+ years	7,20.6	27,22.1		7,25.9	25,20.2	2,40.0	
<b>What's your preferred time of the day to consume caffeine?</b>							
Morning	7,21.2	34,28.1	<b>0.187</b>	7,25.9	32,26.2	2,40	<b>0.875</b>
Evening	6,18.2	9,7.4		4,14.8	11,9.0	0,0	
Night	3,9.1	4,3.3		2,7.4	5,4.1	0,0	
Anytime throughout the day	14,42.4	56,46.3		10,37	57,46.7	3,60	
Never	3,9.1	18,14.9		4,14.8	17,13.9	0,0	
<b>Which of the following below drove you towards caffeine consumption?</b>							
Peer pressure	6,22.2	12,12.0	<b>0.264</b>	2,9.1	14,14	2,40	<b>0.068</b>
Studies	7,25.9	32,32		7,31.8	31,31	1,20	
Curious about effects	4,14.8	7,7		1,4.5	8,8	2,40	
Curious about taste	10,37.0	49,49		12,54.5	47,47.0	0,0	
<b>How many cups of caffeine/bottles of energy drinks do you consume in a day?</b>							
0	11,32.4	37,30.3	<b>0.548</b>	10,37	37,29.8	1,20.0	<b>0.737</b>
1	6,17.6	33,27.0		8,29.6	30,24.2	1,20.0	
2	10,29.4	33,27.0		6,22.2	36,29.0	1,20.0	
3	3,8.8	13,10.7		3,11.1	12,9.7	1,20.0	
More than 3	4,11.8	6,4.9		0,0	9,7.3	1,20.0	
<b>Do you feel caffeine helps you deal with your problems?</b>							
Yes	18,54.5	49,41.9	<b>0.196</b>	9,36.0	57,47.5	1,20	<b>0.304</b>
No	15,45.5	68,58.1		16,64.0	63,52.5	4,80	
<b>Does your caffeine intake start/increase during exam time only?</b>							
Yes	10,29.4	56,45.9	<b>0.161</b>	11,40.7	54,43.5	1,20	<b>0.783</b>
No, I consume it all the time	16,47.1	38,31.1		9,33.3	42,33.9	3,60	
I don't take it regardless	8,23.5	28,23.0		7,25.9	28,22.6	1,20	
<b>If someone told you, you were addicted, would you deny or accept?</b>							
Accept	16,57.1	50,52.6	<b>0.674</b>	6,31.6	59,59	1,25	<b>0.045</b>
Deny	12,42.9	45,47.4		13,68.4	41,41	3,75	

Figure 1: Common withdrawal symptoms reported among the caffeine consuming MBBS students studying in medical universities in Karachi

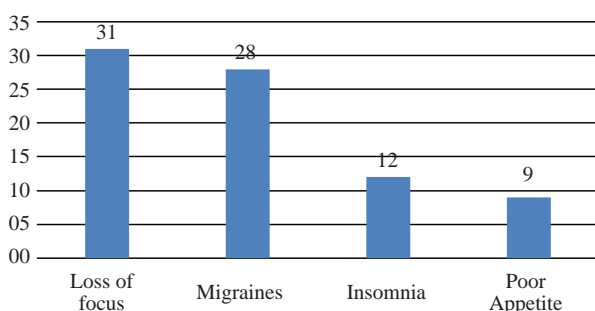
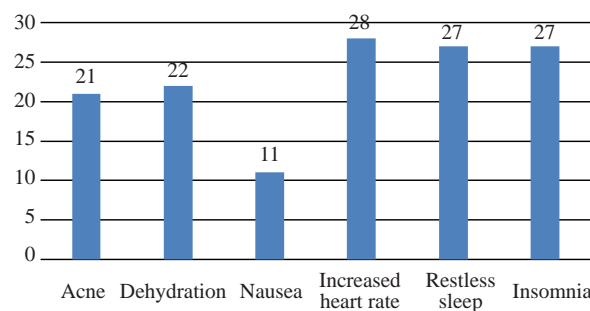


Figure 2: Common adverse effects reported among the caffeine consuming MBBS students studying in medical universities in Karachi



the participants who consumed caffeine. Furthermore, a large fraction of students claimed to have faced some sort of withdrawal symptom upon cessation of the CCP they consumed (n = 61 / 139, 43.9%), though there was no significant relation when stratified by gender (p = 0.350). Additionally, a large fraction of respondents reported that their caffeine intake increased at the onset of exams (n = 66 / 156, 42.3%), though no significant relationship could be found with gender (p = 0.161) or current age (p = 0.783). Interestingly, if told that they were addicted to a CCP, a slightly higher fraction of people admitted that they would be willing to accept this information (n = 66 / 132, 54%). When this was further analysed, no significant relation was found with gender (p = 0.674), however, the current age showed a significant relationship (p = 0.045)

### DISCUSSION:

Our study on caffeine withdrawal is subject to heavy gender biased as the study population is based in medical universities which are known to have an 80-85% female population across Pakistan.<sup>13</sup> Caffeine consumption escalates in the student population during exams. The problem commences when withdrawal headaches are considered as a trigger to take even more caffeine. The headaches are the beginning of more harmful side effects like sleeplessness, insomnia, and lack of mental alertness.

Studies report that the caffeine intake in young adults was 357 ±400 mg/ day and a median intake of 259 mg/ day.<sup>12</sup> Our research shows that college students start taking caffeine at a very early age, and it keeps increasing in amount as they grow. Majority of student population in Pakistan take caffeine in tea, usually starting as young as three years old at teatime with the family.<sup>13</sup> As children consume more caffeine at younger ages (2-16 years), it is potentially detrimental to their growth and development due to caffeine's known consequence of disturbed sleep patterns.<sup>14</sup> There is sufficient evidence in the literature to suggest that children are consuming caffeine and it is a problem.<sup>15</sup>

Multiple studies have shown that caffeine-withdrawal syndrome is clinically significant. Caffeine Use Disorder was added to DSM-5 and requires further research as a diagnosis.<sup>16</sup> This study solidifies that caffeine is a real addiction, and caffeine dependence need to be addressed. There is evidence that a steady caffeine reduction and cessation program may be executed using a manual-only approach.<sup>17</sup>

There is sufficient literature to prove how caffeine disrupts sleep cycles and neurological function.<sup>18</sup> It has been shown to disrupt sleep quality typically, patterns, and durations.<sup>19</sup> A study, in particular, describes that high doses of caffeine extended stage 1 sleep in young adults.<sup>20</sup> Despite the growing trend of adverse effects to caffeine, no 'safe limit' has been determined for said stimulant particularly in South Asia, though there have been proposed values.<sup>21</sup> Health Canada

has proposed a limit of 2.5mg/kg/day, however additional data is required.<sup>22</sup> It is widely known that college students often resort to substance abuse in times of severe pressure due to academic and other responsibilities that come with adulthood particularly during and after the COVID19 pandemic.<sup>23</sup> However, there is little to no information available to the public regarding caffeine dependence or its adverse effects.<sup>24</sup> Lack of this knowledge leads to further consumption of caffeine.

There are few limitations to this study. One of the limitation is that a limited number of university students responded, and study is limited to only Karachi. Few male students participated in the study which raises the question of gender bias. Quantitative assertion of caffeine cannot be done as this survey is based on the word of the participants. Majority of students enrolled in the universities of Karachi are female especially medical and dental colleges, heavy gender bias is present in the study.

Further research on the harmful effects of caffeine as an addictive substance is required to be conducted so the harmful effects of caffeine could be highlighted. Study regarding the awareness of harmful effects, dependence and addiction to caffeine containing products among different populations can help highlight the knowledge regarding the issue among the targeted populations.

### CONCLUSION:

Many students in medical universities of Karachi are moving towards caffeine dependence, due to daily consumption over a prolonged period of time. Promoting responsible consumption habits and spreading awareness over potential adverse effects of CCPs, especially amongst a younger audience could improve the health and lifestyles of students in the long-term.

#### Authors Contribution:

**Fatima Fakhir Musharraf:** Conception, drafting, analysis, approval  
**Asad Ali Siddiqui:** Drafting, analysis, approval  
**Muhammad Mustafa Ali:** Drafting, analysis, approval  
**Shazia Fakhir Durrani:** Reviewing, drafting, analysis, approval  
**Fatima Abid:** Revision, analysis, approval  
**Aijaz Qureshi:** Revision, approval

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