

## ORIGINAL ARTICLE

## DOES CAFFEINE INTAKE INFLUENCE MENTAL HEALTH OF MEDICAL STUDENTS?

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## ABSTRACT

Caffeine (1,3,7-trimethylxanthine) consumption among students is known to increase alertness and energy, as well as to alleviate stress. There has been an increase of caffeine consumption amongst young adults. Currently, there are no studies regarding caffeine consumption and its influence on mental health among Malaysians. We aimed to determine the relationship of caffeine consumption with depression, anxiety and stress among medical students. A cross sectional study was conducted among medical students in the Faculty of Medicine, Universiti Kebangsaan Malaysia. Data were collected via an online survey using two questionnaires, namely the semi-quantitative Food Frequency Questionnaires on Caffeine Intake and Depression, Anxiety and Stress Scale (DASS-21). A total of 262 medical students completed the survey. The prevalence of depression, anxiety and stress was 9.2%, 16.8% and 1.1%, respectively. Majority of students (98.5%) consumed caffeine from coffee, tea, soft drinks, energy drinks and chocolate drinks/food. The median daily caffeine consumption among consumers was 67.98 (25<sup>th</sup>, 75<sup>th</sup> percentile: 24.83, 139.71) mg/day. There was a significant association between race and anxiety ( $p=0.038$ ) in which the Malay students had the highest prevalence (21.1%), followed by Indian (16.1%), other races (15.4%) and Chinese students (3.8%). Caffeine consumption did not influence mental health of medical students in this study. Anxiety is the most prominent mental health problem among them. We recommend a programme tailored to medical students in recognising symptoms of mental health problems so that early intervention can be carried out.

**Keywords:** Caffeine, 1,3,7-trimethylxanthine, mental health, medical students

## INTRODUCTION

Caffeine (1, 3, 7-trimethylxanthine), a central nervous system (CNS) stimulant of the methylxanthine class and a natural alkaloid, is the most widely consumed psychoactive substance around the world. The most popular caffeine-containing beverage is coffee, which contains more caffeine than most other beverages, and is consumed more widely and frequently. The major source of caffeine consumption are beverages like tea, carbonated soft drinks and energy drinks, while chocolate and other cocoa-containing foods contribute fewer amounts of caffeine to the diet. Caffeine is a psychoactive drug that, according to research, can cause or enhance anxiety and other stress-related signs and symptoms in several ways. It is classified as a nootropic as well because it sensitizes neurons and provides mental stimulation. Caffeine's main mechanism concerns antagonizing adenosine receptors. Adenosine causes sedation and relaxation when it acts upon its receptors, located in the brain while caffeine prevents this action and causes alertness and wakefulness. Medical students are known to lead a stressful life that requires an extended period of wakefulness and a high level of concentration to cope with their

academic workload. Therefore, medical students are one of the most susceptible and more prone to consume caffeine than others among college students<sup>1</sup>.

According to the Malaysian Ministry of Health statistics, there was an increase in mental health problems among Malaysian students from one in ten in the year 2011 to one in five in the year 2016<sup>2</sup>. There are a number of local studies that look at mental health problems amongst Malaysian undergraduates. A study done in Malaysia showed that the prevalence of psychological stress among medical students was high while psychological stress was also significantly associated with depression<sup>3</sup>. Anxiety is another one of the most common psychiatric problems faced by medical students. One study shows that the global prevalence rate of anxiety among medical students was 33.8% and it is most prevalent among medical students from the Middle East and Asia<sup>4</sup>. Based on a study among Malaysian undergraduates, it was found that the prevalence rate of perceived stress was at 37.7%. In the study, it was also found that perceived stress among first year and female students were higher than others<sup>5</sup>. A study in

Kelantan, Malaysia found that the prevalence of depression among medical students was 22.0%<sup>6</sup>.

There are a number of known factors that contribute to the rise in mental health problems especially amongst undergraduates. The main contributors for mental health problems are academic pressure, financial burden, increased accessibility of higher education, increased female-to-male ratio, increased use of technology and dramatic change in lifestyle of students<sup>7</sup>. A study in Kota Bharu, Kelantan found that there was a high prevalence of stress among secondary school students, the major stressors were related to academic and contributing factors of stress were related to school training, students and parents<sup>8</sup>.

The increasingly worrying number of medical students affected by mental health problems is a call for concern. Therefore, there is a need to look into all possible factors that may play a role in worsening this issue. Thus, this study aims to evaluate the relationship of caffeine intake with depression, anxiety, and stress among medical students in Universiti Kebangsaan Malaysia.

## METHODS

This is a cross-sectional study conducted among medical students in the Faculty of Medicine, Universiti Kebangsaan Malaysia. The sampling unit is individual medical student who was above the age of 18 at the time of the study. Those who were clinically diagnosed with a psychiatric disorder such as major depressive disorder, panic disorder, generalised anxiety disorder and/or bipolar disorder were excluded from this study. Data were collected by convenience sampling method via an online survey. Questionnaires comprising of sociodemographic information, Food Frequency Questionnaires (FFQ), Depression, Anxiety and Stress Scale (DASS 21) were distributed to all medical students from year 1 until year 5.

The sample size was calculated to be 256 students within a population of 1000 medical students. The confidence interval was 95% with a 4.5% margin of error. Consent was obtained from the respondents before starting the survey. A total of 262 medical students had completed the survey. A pilot study was conducted before-hand to identify the caffeinated food and drinks regularly consumed by the medical students. The pilot study was done among 30 medical students who were not involved in the main study and their 24-hour dietary intake was recorded for 3 days (2 working days and 1 weekend day). A set of FFQs was constructed based on the findings from the 24-hour dietary intake. Subsequently, the respondents were required to

answer the newly developed FFQs and the results were correlated with the 24-hour dietary intake. Foods that were not commonly taken by the respondents were taken out from the FFQs. The edited version of the FFQs was then distributed to the respondents for the main study. The total amount of caffeine intake per day for different beverages and food were calculated based on the Malaysian Food Composition Database (MyFCD), followed by multiplication with the intake frequency. Thus, an average of caffeine intake per day for each respondent was obtained.

The population of medical students were also given a Depression-Anxiety-Stress Scale (DASS 21) questionnaire. DASS 21 questionnaire was used to screen for the presence of depression, anxiety and/or stress symptoms. Data were collected for all three parts of the questionnaire. For anxiety, any value above 7 was grouped as "Having anxiety symptoms" and values less than or equal to 7 were grouped as "Not having anxiety symptoms". For stress, any value above 14 was grouped as "Having stress" whereas values less than or equal to 14 were grouped as "Not having stress". For depression, any value above 9 was grouped as "Having depression" while values less than or equal to 9 were grouped as "Not having depression". Age, gender, race, previous high school status and year of study were also collected as descriptive data for this study. Data were analysed using SPSS software (Statistical Package for Service Solutions version 22.0). Categorical variables were presented in frequencies and percentages. Continuous variables were presented as mean and standard deviation or median and interquartile range according to normality of distribution. Mean differences between two exposure groups were analysed using independent t-test or Mann-Whitney U test. Differences in proportions between two exposure groups were analysed using chi-squared test or chi-squared test with continuity correction. A p value less than 0.05 was considered statistically significant.

## RESULTS

The total number of respondents who completed the study was 262 medical students with 63.4% Malay, 19.8% Chinese, 11.8% Indian and 5.0% Others. Table 1 shows the distribution of the respondents based on their race, gender, year of study (pre-clinical or clinical) and previous high school status (non-boarding or boarding school). Our respondents were predominantly female students at 73.3% of the total respondents. Clinical students made up 60.7% of the respondents and 62.6% were not from boarding schools previously.

**Table 1: Sociodemographic characteristics of the respondents (N = 262)**

Sociodemographic variable		Frequency (f)	Percentage (%)
Gender	Male	70	26.7
	Female	192	73.3
Race	Malay	166	63.4
	Chinese	52	19.8
	Indian	31	11.8
	Others	13	5.0
Year of study	Pre-clinical	103	39.3
	Clinical	159	60.7
Previous high school	Non-boarding school	164	62.6
	Boarding school	98	37.4

The prevalence of depression among medical students was 9.2% (24 out of 262) (Table 2). The results trend shows that the Malay respondents had a higher prevalence of depression (10.8%) as compared to the non-Malay respondents (6.2%). Female respondents had a higher prevalence of depression (9.9%) than male respondents (7.1%), while medical students in clinical years had a

higher prevalence of having depression (11.3%) compared to preclinical year students (5.8%). Medical students who attended non-boarding school previously were at a higher prevalence of having depression (11.0%) as compared to students who attended boarding school (6.1%). However, all the associations were not significant in this study.

**Table 2: Prevalence of depression and its associated factors (N = 262)**

Characteristics		Depressed (n=24) f (%)	Not depressed (n=238) f (%)	p-value
Race	Malay	18 (10.8)	148 (89.2)	0.222
	Non-Malay	6 (6.2)	90 (93.8)	
Gender	Male	5 (7.1)	65 (92.9)	0.494
	Female	19 (9.9)	173 (90.1)	
Year of study	Clinical	18 (11.3)	141 (88.7)	0.132
	Pre-clinical	6 (5.8)	97 (94.2)	
Previous high school	Boarding school	6 (6.1)	92 (93.9)	0.188
	Non-boarding school	18 (11.0)	146 ( 89.0)	

Table 3 shows that the prevalence of anxiety among medical students was 16.8% (44 out of 262). Malay respondents had a significantly higher prevalence of anxiety which was 21.1% as compared to the non-Malays (9.4%) (p = 0.039). The trend shows that the female respondents had a higher prevalence of anxiety (18.8%) than the male respondents (11.4%). Medical students in pre-clinical years had a higher prevalence of anxiety (17.5%) as compared to clinical year students (16.4%), while medical students who attended boarding school previously were at a higher prevalence of anxiety (20.4%) as compared to students who attended non-boarding school (14.6%). However, these associations were not significant.

The prevalence of stress among medical students was 1.1% (3 out of 262) (Table 4). The trend shows that the Malay respondents had a higher prevalence of stress (1.2%) compared to the non-Malays (1.0%). The male respondents had a higher prevalence of stress (1.4%) than the female respondents (1.0%). Medical students in clinical years had a higher prevalence of stress (1.3%) as compared to pre-clinical year students (1.0%). Medical students who attended non-boarding school previously were at a higher prevalence of stress (1.8%) as compared to students who attended boarding school (0%). However, there was no significant relationship between all sociodemographic variables and stress.

Table 3: Prevalence of anxiety and its associated factors (N = 262)

Characteristics	Anxiety (n=44) f (%)	Non-anxiety (n=218) f (%)	p-value
<b>Race</b>			0.039*
Malay	35 (21.1)	131 (78.9)	
Non-Malay	9 (9.4)	87 (90.6)	
<b>Gender</b>			0.161
Male	8 (11.4)	62 (88.6)	
Female	36 (18.8)	156 (81.2)	
<b>Year of study</b>			0.812
Clinical	26 (16.4)	133 (83.6)	
Pre-clinical	18 (17.5)	85 (82.5)	
<b>Previous high school</b>			0.226
Boarding school	20 (20.4)	78 (79.6)	
Non-boarding school	24 (14.6)	140 (85.4)	

\*Significant value at  $p < 0.05$ .

Table 4: Prevalence of stress and its associated factors (N = 262)

Characteristics	Stressed (n=3) f (%)	Not stressed (n=259) f (%)	p-value <sup>a</sup>
<b>Race</b>			1.000
Malay	2 (1.2)	164 (98.8)	
Non-Malay	1 (1.0)	95 (99.0)	
<b>Gender</b>			0.795
Male	1 (1.4)	69 (98.6)	
Female	2 (1.0)	190 (99.0)	
<b>Year of study</b>			0.831
Clinical	2 (1.3)	157 (98.7)	
Pre-clinical	1 (1.0)	102 (99.0)	
<b>Previous high school</b>			0.178
Boarding school	0 (0)	98 (100.0)	
Non-boarding school	3 (1.8)	161 (98.2)	

<sup>a</sup> Chi-square with continuity correction

The prevalence of caffeine intake among the medical students was 98.5% (258 out of 262) and the median concentration of caffeine intake among the consumers was 67.98 (25th,75th percentile: 24.83, 139.71) mg/day. Table 5 shows that male respondents consumed more caffeine per day, 90.00 mg/day, as compared to female respondents, 65.82 mg/day. However, there was no significant difference between the two genders ( $p = 0.126$ ). Respondents who were depressed based on the DASS-21 score consumed more caffeine per day at a median of 87.66 mg/day as compared to those who

were not depressed at 66.07 mg/day. However, the difference of caffeine consumption between those who were depressed and not depressed was not significant ( $p = 0.150$ ). The respondents who were having anxiety consumed slightly more at 70.02 mg/day than those who did not have anxiety who consumed 67.42 mg/day. However, the difference was not significant ( $p = 0.972$ ). Respondents who were not stressed based on the DASS-21 score consumed caffeine per day at 68.19 mg/day than those who were stressed (11.13 mg/day). However, the difference was not significant ( $p = 0.146$ ).

Table 5: Depression, anxiety, stress and their association with caffeine intake (N = 262)

Variables	Caffeine intake (mg/day)	p-value <sup>b</sup>
	Median (25 <sup>th</sup> percentile, 75 <sup>th</sup> percentile)	
<b>Gender</b>		0.126
Male (n = 69)	90.00 (34.62, 146.21)	
Female (n = 189)	65.82 (19.30, 137.39)	
<b>Depression status</b>		0.150
Depressed (n = 24)	87.66 (36.75, 227.38)	
Not depressed (n = 234)	66.07 (21.56, 137.08)	
<b>Anxiety status</b>		0.972
Anxiety (n = 44)	70.02 (26.96, 124.67)	
Non-anxiety (n = 218)	67.42 (22.36, 143.51)	
<b>Stress status</b>		0.146
Stressed (n = 3)	11.13 (3.9, 11.13 <sup>c</sup> )	
Not stressed (n = 255)	68.19 (25.70, 143.24)	

<sup>b</sup>Mann-Whitney U test; <sup>c</sup> 50<sup>th</sup> percentile

## DISCUSSION

The lack of literature on the association between caffeine and mental health issues was the main motivation behind this study. We quantified caffeine consumption by using a validated Food Frequency Questionnaires consisting of 18 different foods and beverages that contain caffeine. We then tried to correlate the total caffeine consumption per day to the prevalence of mental health issues which was screened using the DASS-21. Among the 262 medical students who responded, it was found that the prevalence of depression, anxiety and stress was at 9.2%, 16.8% and 1.1% respectively. We also found that most of the respondents, 98.5% specifically, consumed caffeine regularly.

The prevalence of mental health issues was significantly lower when compared to previous studies done in another public university in Malaysia<sup>9</sup> and a private university in Malaysia<sup>10</sup>, both of which showed a high prevalence of depression, anxiety and stress. The study by Shamsuddin et al.<sup>9</sup> showed a prevalence of depression, anxiety and stress at 37.3%, 63.0% and 23.7% respectively. The subsequent study by Fuad et al.<sup>10</sup> observed a prevalence in depression, anxiety and stress at 60%, 76% and 47% respectively. The results are tremendously different compared to the current study in our centre. However, even if the prevalence is significantly different, it is evident that there is a general trend among medical students to have higher prevalence of anxiety. We feel that though this shows the prevalence of mental health issues among medical students, it is

still not very accurate as this is a cross sectional study, and the questionnaires were distributed during the examination week for the students. This could have had an impact on the prevalence of the individual mental health issues that we tested for. Meanwhile, although there was no significant association between depression and the students' demography, there is a trend showing that the Malay students, female, studied in clinical years, and from non-boarding school background had a higher prevalence of depression.

From this study, although the DASS questionnaire is not a diagnostic instrument, the prevalence of depression, anxiety and stress symptoms of moderate severity or above highlights the need for attention from health care professionals and the university administrative personnel. Early detection is consequential in reducing the possible morbidities from psychiatric disorders. Morbidities such as suicide, increased risk of substance abuse and increased risk of cardiovascular problems may prove to be fatal.

Majority of students (98.5%) consumed caffeine from coffee, tea, soft drinks, energy drinks and chocolate drinks/food. The median daily caffeine consumption for consumers was 67.98 mg/day. In another study done in a Malaysian private medical school, it was found that most (43%) of the participants consumed less than 100mg/day of caffeine<sup>11</sup>. Both are lower than a different study that was done whereby the average caffeine consumption was at 306.98mg/day<sup>12</sup>. This large difference may be attributed to the different



questionnaires used to measure caffeine consumption.

Despite multiple literatures in the past that associate caffeine intake to the occurrences of mental health issues, this study had no significant association between caffeine and depression, anxiety and stress. A recent study done in a private tertiary centre in Malaysia found that consumers of caffeinated energy drinks are likely to get psychological distress<sup>13</sup>. However, a few other studies showed that caffeine consumption was significantly associated with decreased risk of depression<sup>14</sup>, and that caffeine consumption acts as an independent protective factor for depression<sup>15</sup>. The fact that our data had no statistical significance can be attributed to a lot of different factors, one of which is the major limitation of our study; the limited number of respondents.

A study reported that caffeine consumption was associated with increased anxiety symptoms in young adult males<sup>16</sup>. Another review reported there is a substantial literature documenting the anxiogenic effects of caffeine in both experimental and realistic situations<sup>17</sup>. The lack of correlation of this study with the findings from previous literature can be attributed to the vast coping mechanisms that the respondents have. The low incidence of depression, anxiety and stress may be due to the Personal and Professional Development (PPD) module that the medical students have been exposed as part of the curriculum. A local study carried out on the efficacy of such modules revealed that intervention programmes improved students' reflective skills which could consequently lead to better coping mechanisms to mental health issues among the students<sup>18</sup>.

#### LIMITATION OF STUDY

There are some limitations in this study. Firstly, we had difficulties in gathering information regarding caffeine concentration in food and beverages due to lack of relevant literature on the subject matter. We suggest referring the American Food and Drug Administration database and company information for caffeine concentration of common foods and drinks. It was also noted that in order for us to have established results, this study needs a larger sample size and a higher response rate among the respondents so that we can capture sufficient data required in this study. The findings of this study would be useful in recognising the effect of caffeine that can be seen among medical students in local universities. Local literature on the subject matter is not available specifically regarding the effect of caffeine on mental health among medical students. The data that was presented in this study can be used to make specific, targeted intervention on the

students who are in need of it. It is also evident that more research has to be done locally on caffeine as we need data which can be correlated with our population.

#### CONCLUSION

There is no significant association between caffeine consumption and mental health in this study. Previous literature reported that caffeine plays a significant role in influencing mental health. Our study also brought into light the prevalence of mental health issues among medical students. Targeted intervention such as counselling, relevant psychotherapies and pharmacological treatment should be carried out to tackle these issues early on. More research has to be done locally on the effect of caffeine so that accurate recommendations on caffeine intake can be given to the local consumers.

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