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A Cross Sectional Study on Caffeine Consumption and Caffeine Expectancy Among Undergraduate Medical Students

Sowmiya Rajeswaran*, Muhammad Zulkhairie Bin Zulkifli, Nurul Atasya Binti Budi Irawan, Norarina Binti Mohd Seh, Lee Ser Yin

Faculty of Medicine, Melaka Manipal Medical College, Manipal Academy of Higher Education (MAHE), Melaka, Malaysia

Abstract

Caffeine is the most commonly consumed psychoactive substance in the world and not only found in coffee, but also present in other products that includes tea, energy drinks, caffeine containing medicine and soft drink. The aim of conducting the research is to study caffeine expectancy with gender, ethnicity, type of caffeinated products and frequency based on dependence/ withdrawal, work enhancement, appetite suppression, mood enhancement, physical performance, negative physical effect and also on sleep disturbance. A cross sectional study was conducted from October to December 2019 in our college. Purposive sampling was used to enroll students for this study and they were asked to respond to the validated questionnaires on a Liker scale. A questionnaire related to the caffeine expectancy was used in this study. Each of the question represents a domain that we can elicit based on the expectancy towards caffeine consumption which are dependence/withdrawal, physical enhancement, mood enhancement, appetite suppression, negative effect, sleep disturbance and work enhancement. The analysis included frequency, percentages, mean, standard deviation, unpaired T-test and ANOVA. A total of 127 participated in this study; we find that 70.9% of medical student consumed caffeine in the form of tea, 68.5% in the form of coffee and 43.3% in form of soft drinks or energy drinks. Most of the medical student aware and expect the positive effect towards caffeine consumption but less awareness on its negative side effect such as appetite suppression and dependence/withdrawal. But for the sleep disturbance, most of them are fully aware about this effect and that's is the most reason they consume caffeine in the night so that they can study effectively. Based on gender, there is no different on the expectancy towards caffeine consumption between female and male. But according to ethnicity, there is different on how they expect towards caffeine consumption; where Chinese has the least expectancy on work enhancement after consume caffeine while Malay and Indian has the least expectancy on negative effect after caffeine consumption. Most of the medical students that consume the caffeinated products believed that by consuming caffeine will increase the productivity. Students believes that caffeine can make them more alert, more energetic, and even improves their concentration, attention and motivation towards work. Future research should explore the association between caffeine dose with the caffeine expectancy. Study on psychometric assessment such as stress and anxiety can be conducted along with caffeine expectancy.

Keywords

Caffeine, Cross-sectional, Medical Students

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* Corresponding author
E-mail address: sowmiya.rajeswaran@gmail.com (S. Rajeswaran), zulkhairie_zulkifli@yahoo.com (M. Z. B. Zulkifli)

1. Introduction

Caffeine is the most commonly consumed psychoactive substance in the world. [1] Caffeine is not only found in coffee, but also present in other products that includes tea, energy drinks, caffeine containing medications (Excedrin, No-Doz) and also in soft drinks. [2] On a daily basis, about 80% of the world's population consumes some form of caffeine. [3] The most widely consumed beverages in the world is coffee. In 2017/2018, around 161.74 million 60 kilogram bags of coffee were consumed worldwide, which is a slight increase from 158 million bags in the previous year. [4] Most of medical student, about 94% of them consume caffeine in any form such as tea and coffee. [5]

There are many beneficial effects of caffeine consumption, and one of it to be an effective performance enhancer to remain active throughout exercise by delaying fatigue and increasing time to exhaustion with the intake of energy drinks. [6] Besides, caffeine was found to have positive relationship between habitual caffeine consumption and performance on verbal memory, visuospatial reasoning and reaction time tasks and the effects became stronger with increasing age. [7] Other than that, caffeine often used to increases alertness and improves performance on tasks that required sustain level of attention. [8] Furthermore, caffeine also can be effectively used to enhance lipolysis, fat oxidation and glycogen breakdown and has been shown to be a potent supplement to increase metabolic rate and stimulate weight loss. [9] A study among medical practitioner prove that by increasing the consumption of coffee by more than one cup per day over a 4 years period, it will reduce the risk from developing diabetes mellitus type II by 1%. This study linked the high intake of coffee over a period of 4 weeks with increased fasting insulin concentration, thus it helps in reducing the risk of diabetes type II. [10] Caffeine as a cognitive enhancer is shown by its indirect action towards arousal, mood and concentration. Low dose caffeine will improve hedonic tone and reduce anxiety while at high dose, it can cause tense arousal such as anxiety, jitteriness and nervousness. [11]

On the other hand, abstinence towards caffeine in those who consume regularly with face symptoms of caffeine withdrawal such as detrimental effects and even more severe effects, that including greater sleepiness, lower mental alertness, and poorer performance on simple reaction time, choice reaction time and recognition memory tasks. [12] Upon reviewing on basic science and clinical data on caffeine abuse, dependence, and withdrawal previous researchers concluded that caffeine withdrawal but not caffeine abuse or dependence should be included as a diagnosis in DSM-IV and ICD-10. [13] It is revealed in a critical review of caffeine withdrawal avoidance of withdrawal symptoms plays a central role in habitual caffeine consumption. [14] Increased amounts of caffeine may lead to dependency due to increased tolerance and hence there would be a need for greater amounts to gain the same stimulatory benefits. [15] There are concerns that excessive intake of caffeine increase the risks of dehydration, anxiety, headache and sleep disturbances. [16]. Also, in the practice of consuming caffeine via energy drink, users had reported higher odds of having poor quality of sleep. [17] In addition, most caffeine in the least fluid ounces is found in energy drink, which is potentially high threat to the population of people with heart problem. [18] In a study that was conducted in Korean adolescents revealed caffeine intake was positively associated with the severity of depression and the severity of insomnia. [19] In another study conducted on Brazilian adults of 18- 75 years old, showed an age-related increase in caffeine-induced insomnia and poorer mental health indicators among people with caffeine-induced insomnia. [20]

In a study of caffeine habits among medical students in Riyadh, Saudi Arabia, it was found that a very high percentage of caffeine consumers are among medical students and about (57.9%) said that they consume more caffeine while studying for exam to overcome stress during exams period. [21] Besides, in another study conducted among third year medical students in South Africa revealed social consumption up to (70%) and preference for the taste up to (72.4%) as other reasons for caffeine consumption and coffee to the most commonly consumed caffeinated product. [22] Another study that was conducted among undergraduate students of various medical and dental colleges in India revealed caffeine has been demonstrated for increment of sharpness as well as alertness level of the individual. At the same time it revealed that unfavorable impacts on uncontrolled admission of caffeine for which there is a need to keep a check on the admission of caffeine. [23] In a research study titled psychological and situational predictors of caffeine consumption in daily life revealed while experimental research has shown generally positive effects of caffeine on a variety of mood outcomes, the degree to which caffeine is used in order to achieve such effects may depend on users' anticipation of these effects following consumption. Expectancies of improved performance with caffeine were positively related to average daily caffeine consumption and symptoms of caffeinism [24].

In a study of caffeine consumption motive demonstrated the different role of the underlying motives for gender, age, and the type of caffeinated products. In that study showed that higher scores on some motives for caffeine consumption in female participants who has higher daily caffeine consumption. In relation to age the study revealed younger

age group had higher mean scores on alertness, whereas the older age group had higher mean scores on habit and symptom management. As for the type of caffeinated products taste appeared to be equally and highly important to be considered an important finding with regard to the popularity and maintenance of caffeine consumption. [25] In a study that was conducted on US adults showed ethnicity and age were the variables most strongly associated with intake of caffeine. [26]

To our knowledge, no research that assesses the expectancies of the psychological and physical effects of caffeine among medical students has been conducted in our setting. With this in mind we state our research question in a way that we are interested to view the response from medical students which in a way represents the multi ethnicity of Malaysia. The objectives of conducting the research is to study the caffeine expectancy with gender, ethnicity, type of caffeinated products, and the frequency based on dependence / withdrawal, work enhancement, appetite suppression, mood enhancement, physical performance, negative physical effects and also on sleep disturbance. The research hypothesis for the research are caffeine expectancy is different between male and female undergraduate medical students in MMMC for dependence, mental activation, appetite suppression, enhancement of mood, and physical performance enhancement. Another hypothesis that we state for our project is that coffee has different caffeine expectancy than other caffeinated drinks among the undergraduate medical students in MMMC.

2. Methodology

2.1. Study Design and Study Time

A cross sectional study was conducted from October 2019 to December 2019 in our college, Melaka Manipal Medical College, Melaka, Malaysia.

2.2. Study Setting and Study Population

Our college has two campuses; one based in Muar, Johor and the other is based in Malacca. The Muar campus offers Bachelor of Medicine and Surgery (MBBS) Semester 6 and 7, while the Malacca campus offer (MBBS) semester 8, 9, and 10, Bachelor of Dental Surgery (BDS), Foundation in Science (FIS). The study was aimed to determine caffeine consumption and caffeine expectancy among undergraduate medical students.

2.3. Sampling Size

Based on previous research that had been conducted on the medical students at Karachi, Pakistan, they found that the majority 94% of the medical students consumed caffeine meanwhile [5], 6% of the students did not consumed caffeine in any form, from which an estimated proportion of 0.94 was taken. Based on the application software "Epi Info "version 7.0 with our population size 750, expected frequency 94% and precision error of 4.0%, so with a confidence level of 95% we conclude that our sample size is 115.

Upon calculating the sample size (n) using formula application software "Epi Info '' version 7.0, we then chose to allow non-response of 30% and calculation is as below:-

$$n\ final = n\ calculated / 1 - non\ response\%$$

$$= 115 / 1 - 0.3\ (30\%)$$

$$= 164$$

2.4. Sampling Method

Purposive sampling was used as the sampling method while conducting the study, which is a non-probability sampling method. The inclusion criteria were the medical students who voluntarily agreed to participate in the study and the questionnaires must be completed to be considered valid for the research after they filled up the consent form. Meanwhile, for the exclusion criteria, included those who did not fill up the consent form, not available when the questionnaires were distributed, incomplete questionnaires and irrelevant responses. We distributed our questionnaires to medical students of semester 6 and 7 from Muar Campus only.

2.5. Data Collection

The questionnaire consisted of two parts. The first part contained of the informed consent (awareness and knowledge of the participants 'right), demographic data (age, gender, semester, nationality and ethnicity) and the information regarding coffee consumption among undergraduate medical students. The second part included 47 questions regarding caffeine expectancy from undergraduate medical student. The questionnaire was taken from the psychological assessment journal.

From the previous study of Caffeine Expectancy Questionnaire (CAffEQ): Construction, Psychometric Properties, and Associations With Caffeine Use, Caffeine Dependence, and Other Related Variables, the researcher assessed the reliability of the CaffEQ factor structure and the test-retest reliability was completed by a web based survey. [2]

There are several domain made up of the questionnaire, for instance; withdrawal/ Dependence (12 items, e.g. I feel miserable when I do not have my usual caffeine), Energy/ Work Enhancement (8 items, e.g. caffeine makes me feel more alert.), Appetite suppression (5 items, caffeine suppress

feeling of hunger), Social/ mood enhancement (6 items, e.g. caffeine makes me friendlier), physical performance enhancement (3 items, e.g. Workout are better after having caffeine.), Anxiety/negative physical effects (9 items, e.g. caffeine makes me feel nervous), sleep disturbance (4 items, e.g. using caffeine late in the day disrupt my sleep.). There are four positive domains such as Energy/work enhancement, Appetite suppression, Social/ mood enhancement, physical performance enhancement; and three negative domains such as withdrawal/ dependence, anxiety/ negative physical effects, sleep disturbances. To assess the potential latent factor structure of the 47-item CaffEQ, participants completed a survey consisting of the 47-item CaffEQ as well as measures of demographics, caffeine exposure and caffeine dependence symptoms, anxiety and sleep. Individuals who regularly used multiple caffeine-containing vehicles were instructed to base response on "caffeine in general". Individuals who do not consume caffeine or rarely consume caffeine were instructed to base their responses on how they would expect to be affected by caffeine. The students were asked to respond to the questionnaire on a six-point likert scale- very unlikely (1), unlikely (2), a little unlikely (3), a little likely (4), likely (5) and very likely (6). The total scoring range for withdrawal/dependence subscale (12 to 72) (higher score indicates more dependence), for energy/ work enhancement subscale (8 to 48) (higher score indicates more work enhancement), for appetite suppression subscale (5 to 30) (higher score indicates more appetite suppression), for social/ mood enhancement (6 to 36) (higher score indicates more mood enhancement), for physical performance enhancement subscale (3 to 18) (higher score indicates more physical performance enhancement), for anxiety/ negative physical effects subscale (9 to 54) (higher score indicates experience of negative effects), and lastly for sleep disturbances subscale (4 to 24) (higher score indicates sleep disturbance), depending on the extent to which they agreed on the concerned participants' right.

2.6. Data Processing and Data Analysis

Data was fed into Microsoft Excel and compiled. Epi Info version 7.0 was used to statistically analyse the data. For the quantitative data (Caffeine expectancy; Withdrawal/Dependence, Energy/Work enhancement, Appetite suppression, Social/Mood enhancement, Physical performance enhancement, Anxiety/Negative physical effects, Sleep disturbance) the mean and standard deviation and range were calculated, whereas for the qualitative data (gender, ethnicity, nationality, semester, type of caffeinated products consumed, daily or non-daily intake), the frequency of those data were counted and the percentage were calculated. We set the level of significant at 5% which is 0.05. Statistical test that was used for the hypothesis testing was determined based on the independent and dependent variable and the details are tabulated as below.

Table 1. Statistical Test used.

Independent variable	Dependent variable	Statistical test
Gender (Male, Female)	Caffeine expectancy:	Unpaired T-test
Ethnicity (Malay, Chinese, Indian, Others)	1. Withdrawal/Dependence	ANOVA
Coffee consumption (yes/no)	2. Energy/Work enhancement	Unpaired T-test
Coffee consumption (daily/non-daily)	3. Appetite suppression	Unpaired T-test
	4. Social/Mood enhancement	
	5. Physical performance enhancement	
Soft drink consumption (yes/no)	6. Anxiety/Negative physical effects	Unpaired T-test
	7. Sleep disturbance	
	8. Total caffeine expectancy score	
Soft drink consumption (daily/non-daily)		Unpaired T-test
Tea consumption (yes/no)		Unpaired T-test
Tea consumption (daily/non-daily)		Unpaired T-test
Caffeine-containing medications (yes/no)		Unpaired T-test

2.7. Ethical Consideration

Participants of our study were obtained by voluntary participation. Informed consents were distributed to participants and they were asked to sign the consent forms if they voluntarily participating in our study. Furthermore, confidentiality of all data obtained from the participants were maintained. Besides, the research was conducted ethically by obtaining approval from the Research Ethics Committee, Faculty of Medicine of Melaka Manipal Medical College, Malaysia.

3. Results

Table 2. Demographic profile of undergraduate medical students (n=127).

Variables	n (%)
Age	
≤21	40 (31.5%)
22-23	79 (62.2%)
>23	8 (6.3%)
Mean (SD)	22.0 (1.1)
Gender	
Female	83 (65.4%)
Male	44 (34.7%)

Variables	n (%)
Ethnicity	
Chinese	34 (26.8%)
Indian	36 (28.4%)
Malay	32 (25.2%)
Others	25 (19.7%)
Nationality	
International	16 (12.6%)
Malaysian	111 (87.4%)
Semester	
6	67 (52.8%)
7	60 (47.2%)

Table 3. Caffeine Consumptions of Undergraduate Medical Students (n=127).

Variables	n (%)
Coffee	
Yes	87 (68.5%)
No	40 (31.5%)
Soft drinks/Energy drinks	
Yes	55 (43.3%)
No	72 (56.7%)
Tea	
Yes	90 (70.9%)
No	37 (29.1%)
Caffeine-containing medications	
Yes	2 (1.6%)
No	125 (98.4%)

Table 3 illustrates the caffeine consumption among undergraduate medical students. The comparison was made between type of caffeine consumed and percentage of each type of the products. Majority of students consumed tea with 70.9%, followed by coffee with 68.5%. As for soft drink there were 43.3% students and the lowest number of students preferred caffeine-containing medications with 1.6% of them.

Table 4. Caffeine Expectancy among Undergraduate Medical Students (n= 127).

Variables	Mean (SD)	Min-Max
Dependence (12-72)	29.0 (13.7)	12-72
Work Enhancement (8-48)	30.2 (9.4)	8-48
Appetite Suppression (5-30)	12.5 (5.4)	5-30
Mood Enhancement (6-36)	19.3 (7.4)	6-36
Physical Enhancement (3-18)	8.6 (4.1)	3-18
Negative Effects (9-54)	21.5 (8.8)	9-45
Sleep Disturbance (4-24)	13.6 (6.1)	4-24
Total Score (47-282)	134.7	

Based on table 4, it shows the caffeine expectancy among undergraduate medical students. Most of the medical students have the positive expectancy while consuming caffeine. For the work enhancement, mood enhancement and physical enhancement, most of the students score more than half of the total score for each variable. It shows that most of the undergraduate medical student aware about positive side effect towards caffeine consumption. While on the other hand, most of the undergraduate medical students score not more than half of the total score for the negative side effects such as dependence, appetite suppression. It shows that they does not aware about the bad effects of caffeine. But for the sleep disturbance, most of them do aware about this because students tend to drinks caffeinated drink such as coffee or tea to make them feel awake in the night to study.

Table 5. The Association between Gender and Caffeine Expectancy among Undergraduate Medical Students (n= 127).

Variables	Male (N=44) Mean (SD)	Female (N=83) Mean (SD)	Mean Difference (95% CI)	P Value
Dependence	29.5 (11.8)	28.7 (14.7)	0.8 (-4.3 to 5.9)	0.746
Work Enhancement	28.9 (7.3)	30.9 (10.3)	-2.0 (-5.5 to 1.4)	0.248
Appetite Suppression	11.8 (4.9)	12.9 (5.6)	-1.1 (-3.1 to 0.9)	0.282
Mood Enhancement	18.8 (6.5)	19.5 (7.8)	-0.7 (-3.4 to 2.0)	0.607
Physical Enhancement	8.9 (3.9)	8.4 (4.1)	0.6 (-0.9 to 2.1)	0.462
Negative Effects	22.9 (7.8)	20.8 (9.3)	2.0 (-1.2 to 5.3)	0.218
Sleep Disturbance	13.3 (6.0)	13.8 (6.2)	-0.4 (-2.7 to 1.8)	0.698

In table 5, for dependence domain, male mean score is 29.5 and female mean score 28.7. It has the highest mean score among all the other domains for male which means there is highest caffeine expectancy in dependence. In work enhancement, male mean score is 28.9 whereas female mean score is 30.9. For females, it has the highest mean score among all the other domains. In appetite suppression, the male mean score is 11.8 whereas female mean score is 12.9. In mood enhancement, male mean score is 18.8 whereas female mean score is 19.5. In physical enhancement, the male mean score is 8.9 whereas female mean score is 8.4. Both male and female mean score has the lowest score compared to other domains, which means the undergraduate medical students had the least caffeine expectancy towards physical enhancement. In negative effects, male mean score is 22.9 whereas female mean score is 20.8. In sleep disturbance, male mean score is 13.3 whereas female mean score is 13.8.

Table 6. The Association between Ethnicity and Caffeine Expectancy among Undergraduate Medical Students (n= 127).

Variables	Malay (n=32)	Chinese (n= 34)	Indian (n=36)	Others (n=25)	$F(Df_1, Df_2)$	P Value
Dependence	28.2	27.5	31.3	28.8	0.49 (3,123)	0.690
Work Enhancement	31.2	26.1	31.6	32.4	3.10 (3,123)	0.029
Appetite Suppression	13.3	11.7	11.9	13.6	0.90 (3,123)	0.443
Mood Enhancement	20.0	17.1	20.8	19.1	1.67 (3,123)	0.175

Variables	Malay (n=32)	Chinese (n= 34)	Indian (n=36)	Others (n=25)	$F(Df_1, Df_2)$	P Value
Physical Enhancement	8.1	8.1	9.6	8.2	1.11 (3,123)	0.356
Negative Effects	19.9	23.4	19.2	24.5	2.75 (3,123)	0.046
Sleep Disturbance	13.8	12.3	13.9	15.0	1.01 (3,123)	0.405

Based on the table 6, it shows the results of the association between ethnicity and caffeine expectancy among undergraduate medical students. The work enhancement has the significant mean difference for the caffeine expectancy among ethnicity, which the p-value is 0.029, <0.05, hence it is significant. Chinese scored the lowest mean value compare to Malay, India and others. The negative effects has the significant mean difference with a p-value of 0.046, <0.05. Thus, the result is significant. Based on the result, shows that Chinese and others has the highest mean value of negative effects compare to others ethnicity. It shows that the dependence mean score is the highest in Indian compare to others ethnicity. The p-value in dependence is 0.0690, which is >0.05. Meanwhile, there is no significant association difference in dependence in between ethnicity and caffeine expectancy. Meanwhile, in the appetite suppression, mood enhancement, physical enhancement and sleep disturbance shows no significant value.

Table 7. The association between coffee consumption and caffeine expectancy among Undergraduate Medical Students (n= 127).

Variables	Yes (n=87) Mean (SD)	NO (n=40) Mean (SD)	Mean difference (95% CI)	P value
Dependence	31.1 (13.6)	24.4 (12.9)	-6.8 (-11.9 to -1.7)	0.009
Work enhancement	31.6 (9.1)	27.1 (9.3)	-4.6 (-8.0 to -1.1)	0.010
Appetite Suppression	15.5 (6.4)	12.5 (5.4)	-3.0 (-10.6 to 4.6)	0.434
Mood enhancement	20.2 (7.5)	17.3 (6.9)	-2.9 (-5.7 to -0.2)	0.037
Physical Enhancement	9.1 (4.2)	7.3 (3.5)	-1.8 (-3.3 to -0.3)	0.019
Negative effects	19.5 (2.1)	21.6 (8.9)	2.1 (-10.4 to 14.6)	0.744
Sleep Disturbance	14.0 (5.7)	12.9 (6.8)	-1.1 (-3.4 to 1.1)	0.330

Table 7 shows the association between coffee consumption and caffeine expectancy among undergraduate medical students. For the dependence domain, the mean score for those who consume coffee is 31.1 while 24.4 for those who does not took coffee and it shows that there is mean difference in dependence score between those who consume coffee with those who does not took coffee. The p value is 0.009 which is less than 0.05, so the result is significant. For the work enhancement domain, the mean score for those who consume coffee is 31.6 while 27.1 for those who does not took coffee and it shows that there is mean difference in work enhancement score between those who consume coffee with those who does not took coffee. The p value is 0.01 which is less than 0.05, so the result is significant. For the mood enhancement domain, the mean score for those who consume coffee is 20.2 while 17.3 for those who does not took coffee and it shows that there is mean difference in mood enhancement score between those who consume coffee with those who does not took coffee. The p value is 0.037 which is less than 0.05, so the result is significant. For the physical enhancement domain, the mean score for those who consume coffee is 9.1 while 7.3 for those who does not took coffee and it shows that there is mean difference in physical enhancement score between those who consume coffee with those who does not took coffee. The p value is 0.019 which is less than 0.05, so the result is significant. While for the appetite suppression, negative effect and sleep disturbance the result is not significant because the p value for each domain is more than 0.05.

Table 8. The Association between Daily Coffee Intake among Students Who Drink Coffee and Caffeine Expectancy.

Variables	Coffee Daily Intake (Daily) (N=58) Mean (SD)	Coffee Daily Intake (Non-Daily) (N=29) Mean (SD)	Mean Difference (95% CI)	P Value
Dependence	35.6 (14.0)	22.2 (6.9)	13.5 (8.0 to 18.9)	0.001
Work Enhancement	33.3 (9.1)	28.3 (9.3)	5.0 (1.0 to 9.0)	0.014
Appetite Suppression	13.5 (5.8)	12.0 (4.3)	1.5 (-0.9 to 3.9)	0.228
Mood Enhancement	21.9 (7.7)	16.9 (5.7)	5.0 (1.8 to 8.2)	0.003
Physical Enhancement	10.0 (4.3)	7.4 (3.31)	2.5 (0.7 to 4.4)	0.007
Negative Effects	20.4 (7.8)	23.6 (9.1)	-3.1 (-6.9 to 0.6)	0.094
Sleep Disturbance	13.6 (6.0)	14.7 (5.2)	-1.1 (-3.7 to 1.5)	0.402

In table 8, for dependence, mean score for daily intake of coffee is 35.6 which is the highest mean score in daily intake of coffee compared to other domains whereas mean score for non-daily intake of coffee is 22.2. Daily intake of coffee has the highest expectancy towards dependence. The p-value is 0.001 which is <0.05, hence it is significant. There is an association between dependence and coffee intake. In work enhancement, mean score of daily intake of coffee is 33.3 whereas mean score of non-daily intake of coffee is 28.3 which is the highest mean score in non-daily intake among

other domains. Non-daily coffee intake has the highest expectancy towards work enhancement. The p-value is 0.014 which is <0.05, hence it is significant. There is an association between coffee intake and work enhancement. In appetite suppression, the mean score of daily coffee intake is 13.5 whereas mean score of non-daily intake is 12.0. In mood enhancement, mean score of daily intake of coffee is 21.9 whereas mean score of non-daily intake of coffee is 16.9. The p-value is 0.003 which is <0.05. Hence it is significant. There is an association between daily coffee intake and mood enhancement. In physical enhancement, mean score daily coffee intake is 10.0 whereas non-daily coffee intake is 7.4. The p-value is 0.007 which is <0.05. Hence it is significant. There is association between daily coffee intake and physical enhancement. In negative effect, mean score of daily intake of coffee is 20.4 whereas non-daily intake of coffee is 23.6. In sleep disturbance, mean score of daily coffee intake is 13.6 whereas non-daily intake of coffee is 14.7.

Table 9. The Association between Soft Drink Consumption with Caffeine Expectancy among Undergraduate Medical Students (n= 127).

Variables	Yes (n=55) Mean (SD)	NO (n=72) Mean (SD)	Mean Difference (95% C.T.)	P Value
Dependence	27.1 (11.8)	30.4 (15.0)	3.3 (-1.6 to 8.2)	0.180
Work Enhancement	29.4 (8.9)	30.8 (9.7)	1.5 (-1.9 to- 4.9)	0.388
Appetite Suppression	11.8 (4.6)	13.1 (5.9)	1.3 (-0.6 to 3.2)	0.163
Mood Enhancement	18.0 (6.9)	20.3 (7.7)	2.2 (-0.4 to 4.8)	0.092
Physical Enhancement	8.8 (3.7)	8.4 (4.3)	-0.4 (-1.8 to 1.1)	0.604
Negative Effects	21.6 (8.0)	21.5 (9.4)	-0.04 (-3.2 to 3.1)	0.975
Sleep Disturbance	13.1 (6.0)	13.1 (6.2)	0.9 (-1.3 to 3.04)	0.418

Table 9 shows the association between soft drink consumption with caffeine expectancy among undergraduate medical students. For the dependence, work enhancement, appetite suppression, mood enhancement, physical enhancement, negative effect and sleep disturbance domain shows there is no significant association between soft drink consumption and caffeine expectancy because the p value for each domain is more than 0.05.

Table 10. The Association between Daily Soft Drink Intake among Students Who Drink Soft Drink and Caffeine Expectancy.

Variable	Consumption Of Soft Drink (DAILY) (n=5) Mean (SD)	Consumption Of Soft Drink (NON -DAILY) (n=50) Mean (SD)	Mean Difference (95% CI)	P Value
Dependence	29.4 (16.7)	26.9 (11.4)	2.5 (-8.7 to 13.7)	0.656
Work Enhancement	26.6 (10.1)	29.6 (8.9)	-3.0 (-11.5 to 5.4)	0.473
Appetite Suppression	11.4 (5.4)	11.8 (4.6)	-0.4 (-4.8 to 4.0)	0.855
Mood Enhancement	18.6 (10.1)	18.0 (6.6)	0.6 (-5.9 to 7.2)	0.845
Physical Enhancement	10.0 (6.0)	8.7 (3.5)	1.3 (-2.2 to 4.8)	0.447
Negative Effects	18.6 (5.6)	21.9 (8.2)	-3.3 (-10.8 to 4.3)	0.392
Sleep Disturbance	11.6 (7.9)	13.3 (5.8)	-1.7 (-7.3 to 4.0)	0.554

Based on the table 10, shows the association between daily soft drink intake among students who drink soft drinks and caffeine expectancy. The results for dependence, work enhancement, appetite suppression, mood enhancement, physical enhancement, negative effects and sleep disturbance shows no significant value because p-value is >0.05. Thus, there is no association between daily soft drink intake among students who drink soft drinks and caffeine expectancy.

Table 11. The Association between Tea Consumption with Caffeine Expectancy among Undergraduate Medical Students (n= 127).

Variables	Yes (n=90) Mean (SD)	No (n= 37) Mean (SD)	Mean Difference (95% CI)	P Value
Dependence	27.0 (11.7)	33.8 (17.0)	6.7 (1.5 to 11.9)	0.012
Work Enhancement	30.6 (9.0)	29.3 (10.2)	-1.3 (-4.9 to 2.3)	0.481
Appetite Suppression	12.1 (4.7)	13.6 (6.7)	1.5 (-0.6 to 3.6)	0.153
Mood Enhancement	19.0 (6.7)	19.9 (8.8)	0.9 (-1.9 to 3.8)	0.519
Physical Enhancement	8.4 (3.9)	9.1 (4.3)	0.7 (-0.9 to 2.3)	0.387
Negative Effects	21.4 (8.8)	21.8 (8.9)	0.4 (-3.0 to 3.8)	0.823
Sleep Disturbance	14.1 (5.9)	12.6 (6.5)	-1.5 (-3.8 to 0.9)	0.220

Based on the table 11, shows the association between tea consumption with caffeine expectancy among undergraduate medical students. In dependence domain, the p-value is 0.012 which is <0.05. Hence, the result is significant. The mean score for yes is 27.0 while no value is 33.8. There is a mean difference between yes and no score in dependence domain. Meanwhile for others domain, such as work enhancement, appetite suppression, mood enhancement, physical enhancement and negative effect, the p-values shows no significant results.

Table 12. Association between Daily Tea Intake among Students Who Drink Tea and Caffeine Expectancy.

Variables	Daily (n=53) Mean (SD)	Non-Daily (n=37) Mean (SD)	Mean Difference (95% CI)	P Value
Dependence	29.0 (13.3)	24.2 (8.2)	4.6 (-0.2 to 9.7)	0.057
Work Enhancement	30.5 (9.7)	30.6 (8.1)	- 0.1 (-4.0 to 3.8)	0.962
Appetite Suppression	12.1 (5.2)	12.1 (4.1)	-0.1 (-2.1 to 1.9)	0.939
Mood Enhancement	19.4 (7.8)	18.4 (4.9)	1.0 (-1.9 to 3.9)	0.499
Physical Enhancement	9.2 (4.3)	7.1 (3.1)	2.1 (0.5 to 3.8)	0.011
Negative Effects	21.3 (9.3)	21.6 (8.2)	-0.4 (-4.2 to 3.4)	0.841
Sleep Disturbance	14.1 (6.0)	14.1 (5.8)	0.003 (-2.5 to 2.5)	0.998

Table 12 shows the association between daily tea intake among students who drink tea and caffeine expectancy. The physical enhancement domain has the p-value of 0.011, which <0.05. Hence, there is significant association value. The mean score for those that take daily tea intake is 9.2 while the score for non-daily is 7.1. Meanwhile for others domain like, dependence, work enhancement, appetite suppression, mood enhancement, negative effects and sleep disturbances has no significant value.

Table 13. Association of Caffeine Containing Medication (CCM) and Caffeine Expectancy.

Variables	Yes (n=2) Mean (SD)	No (n=125) Mean (SD)	Mean Difference (95% CI)	P Value
Dependence	35.0 (9.9)	28.9 (13.8)	6.1 (25.5 to 13.3)	0.536
Work Enhancement	34.0 (9.9)	30.1 (9.4)	3.9 (17.1 to 9.4)	0.564
Appetite Suppression	15.5 (6.4)	12.5 (5.4)	3.0 (10.6 to 4.6)	0.434
Mood Enhancement	20.5 (4.9)	19.3 (7.4)	1.2 (11.7 to 9.2)	0816
Physical Enhancement	13.5 (2.1)	8.5 (4.0)	5.0 (10.7 to 0.7)	0.083
Negative Effects	19.5 (2.1)	21.6 (8.9)	2.1 (10.4 to 14.6)	0.744
Sleep Disturbance	10.5 (2.1)	13.7 (6.1)	3.2 (5.4 to 11.8)	0.466

Table 13 portrays the association between caffeine-containing medication and caffeine expectancy under few domains, positive work enhancement, mood enhancement and physical enhancement. Negative domains are dependence, appetite suppression, negative effects and sleep disturbance. Among the undergraduate medical students, there were only two (n=2) respondents consumed caffeine-containing medication while the others do not. As for 'No' group the highest variable was work enhancement (mean score=30.1) followed by dependence (mean score=28.9) while the lowest is physical enhancement (mean score=8.5). The other domains are fairly affected by caffeine-containing medications in this group. For Yes group the highest score is dependence (mean score=35.0) followed by work enhancement (mean score=34.0) and the lowest score is in sleep disturbance (mean score=10.5). The mean difference for dependence domains is 6.1 while p value is 0.536. All of p values of each domain are more than 0.05 thus none of those associations between caffeine-containing medications and positive or negative domains are significant.

4. Discussion

A cross sectional study was conducted to study the association of gender, ethnicity, type of caffeinated products consumed and frequency with the caffeine expectancy based on domains which includes dependence/withdrawal, work enhancement, appetite suppression, mood enhancement, physical performance, negative physical effects and sleep disturbance among undergraduate medical students of Melaka Manipal Medical College, Malaysia. Upon analyzing our data, we found 68.5% consume coffee, 43.3% consume soft drink or energy drink, 70.9% consume tea and only 1.6% consume caffeine-containing medications. The higher percentage of tea consumers were found from our study compared to other studies that showed higher coffee consumers. Previous study among adults aged between 18 to 75 years who living in German-speaking countries showed 64.8% consume coffee, 19.9% consume tea, 7.2% consume soft drinks, 3.3% consume energy drink, 18.3% consume caffeinated products and 4.8% consume other caffeinated products. [27] Similarly, another study among medical students in Riyadh, Saudi Arabia, showed the main source of caffeine intake was coffee (96.2%), soft drinks (73.5%), and energy drinks (11.1%), however, (74.25%) drink both coffee and soft drinks. [21]

We also obtained mean scores for withdrawal/dependence (29.0), work enhancement (30.2), appetite suppression (12.5), mood enhancement (19.3), physical performance enhancement (8.6), negative physical effects (21.5) and sleep disturbance (13.6) which gives a total mean score of 134.7. The results showed positive caffeine expectancy among the undergraduate medical students towards several domains which includes work enhancement, mood enhancement, and physical performance enhancement. Caffeine has been known to be used to increase alertness and improves performance on tasks that required sustained level of attention. [8] In addition, caffeine beneficial effect is also known to be an effective performance enhancer to remain active throughout exercise by delaying fatigue and increasing

time to exhaustion. [6]

Upon analyzing the association between gender and caffeine expectancy among undergraduate medical students, we found no significant difference in dependence/ withdrawal, work enhancement, appetite suppression, mood enhancement, physical performance, negative physical effects and sleep disturbance between male and female students. In a study conducted among the British general population revealed no gender difference for the overall caffeine consumption although it was found that coffee was consumed in higher amounts by male than females. [28] Besides that, the association between the Malays, Chinese, Indians and others with the caffeine expectancy showed no significant difference with dependence, appetite suppression, mood enhancement, physical performance, negative physical effects and sleep disturbance. However, there is significant difference in work enhancement where by Chinese students have lower mean score compared to Malays, Indians, and the other ethnicities. Based on a study that was conducted among the US military service members, the black ethnicity was found to consume less caffeine from coffee than those of other ethnicities, while those of Hispanic and other ethnicities consumed less caffeine from non-cola sodas than those of white and black ethnicity. [29]

In the association between coffee consumption with the caffeine expectancy, students who drink coffee showed higher mean than those students who don't drink coffee and depicted significant difference in 4 domains which are dependence, work enhancement, mood enhancement, and physical performance. At the same time, students who drink coffee daily also showed higher mean than those who drink coffee less than daily and also depicted significant difference in dependence, work enhancement, mood enhancement, and physical performance domains. The results from the previous study among the participants of various major metropolitan cities in the United States support that coffee to be having strongest expectancies for withdrawal/ dependence and the four positive expectancy scales which includes the energy/work enhancement, appetite suppression, social/ mood enhancement, physical performance enhancement. [2] Based on the research of previous study among adults aged between 18 to 75 years who are living in German-speaking countries revealed significant difference in the dependence domain for the coffee drinkers compared to consumers of other caffeinated products. [27]

As for the association between soft drink consumption with caffeine expectancy, we found no significant differences in all the 7 domains among those who consume or don't consume soft drinks. Besides that, no significant differences were also observed between those who consume soft drink daily and less than daily. it showed no significant difference in all the 7 domains for the soft drink consumption and frequency as expectancies for so- drinks reported the weakest expectancies for all factors relative to coffee. [2] In addition, we found there were no significant difference observed in the association of caffeine containing medication with caffeine expectancy.

Lastly, in this study, there were no significant difference observed in the association between the tea consumption with caffeine expectancy for work enhancement, appetite suppression, mood enhancement, physical performance, negative physical effects and sleep disturbance but significant difference was observed for the dependence domain where by those who don't drink tea has higher mean than those who drink tea. The results could be affected as students might be consuming other caffeinated products as well. As for the association between the daily tea intake with caffeine expectancy, dependence domain showed signification difference in those who consume tea daily compared to those who consume less than daily. Based on the research of previous study among adults aged between 18 to 75 years who are living in German-speaking countries revealed no significant difference between the participants who consumed tea or other caffeinated products as compared to coffee consumers. [27]

Some methodological limitations regarding of our cross sectional study design were observed. First of all, since the study measured the caffeine consumption and caffeine expectancy from the undergraduate medical students from MMMC at the same point of time through questionnaire, we were not able to establish temporal relationship between caffeine consumption and caffeine expectancy. Secondly, we are unable to study the incidence rate of caffeine consumption among the students before our study was carried out. Thirdly, changes over time is not observable since we do not do follow up for this study design. Besides that, the study cannot be generalized to other population or settings since the data was collected from undergraduate medical students of MMMC only. However, the risk of recall bias are negligibly low because students were expected to recall about their consumption of caffeinated beverages during the time the study was conducted.

Since we found the work enhancement domain to have the highest mean score, students may continue to consume caffeinated products to increase or maintain their productivity however, students should not consume caffeinated beverage excessively till they develop dependence or face withdrawal symptoms. Consequently, future research should explore the association between caffeine doses with the caffeine expectancy. Besides, the caffeine expectancy can be future explored along with other psychometric assessment such as anxiety and stress.

5. Conclusion

Among the undergraduates' medical students of MMMC, it was found that there were more tea consumers (70.9%) than coffee consumers (68.5%). Work enhancement domain had the highest mean of caffeine expectancy compared to the other 6 domains as students believes that caffeine can make them more alert, more energetic, and even improves their concentration, attention and motivation towards work. In addition to that, Chinese students had the lowest mean score for the work enhancement domain compared to Malays, Indians and the other ethnicities. Besides that, the results did not show any difference in caffeine expectancy between male and female students as both the genders did not show great mean difference in any of the 7 domains. As expected, coffee consumers had significant caffeine expectancy in dependence, work enhancement, mood enhancement and physical performance domains compared to consumers of other caffeinated products. Although there were many tea consumers among our students, no significant difference in caffeine expectancy between those who consume and don't consume were observed. However, among those who consume tea less than daily, the mean score for dependence domain was higher than those who consume tea daily. Multiple caffeinated products consumption might be the reason for higher mean in dependence domain for those who consume tea less than daily than those who consume tea daily. Consequently, future research should explore the caffeine dose with the caffeine expectancy. Besides, the caffeine expectancy can be future explored along with other psychometric assessment such as anxiety and stress.

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