

CAFFEINE INTAKE AND ITS ASSOCIATION WITH STRESS AND SLEEP QUALITY AMONG UNDERGRADUATE STUDENTS AT INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA (IIUM) KUANTAN

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ABSTRACT

Introduction: Caffeine (1,3,7-trimethyl xanthine) has become one of the most popular and globally distributed ergogenic aids as well as the most used stimulant in the world. University students in Malaysia and globally tend to consume caffeinated beverages to stay up late and complete their daily tasks, especially during examination period and for coursework completion, which lead to stress and trouble getting enough restful sleep due to their irregular bedtime routines. Thus, this cross-sectional study is aimed to determine the frequency of caffeine intake among undergraduate students in International Islamic University Malaysia (IIUM) Kuantan and its association with stress and sleep quality. **Methods:** A convenience sampling involving 290 (n=145 male, n=145 female) undergraduate students aged 19 to 25 years were recruited from six different Kulliyah. A combination of Caffeine Consumption Pattern, Perceived Stress Scale (PSS) and Pittsburgh Sleep Quality Index (PSQI) questionnaires were used to collect the data from the respondents. The data were assessed using SPSS (Version 26.0) using descriptive analysis and Fisher's Exact Test. **Results:** This study found no significant association between the frequency of caffeine intake among male and female students ($p=0.068$). There was also no significant association between the frequency of caffeine intake and stress level ($p=0.548$), and sleep quality ($p=0.349$). **Conclusions:** Although most of the students frequently consumed caffeine in a week, no association between frequency of caffeine intake, stress level and sleep quality among IIUM Kuantan students were identified. It can be concluded that the relationship between frequency of caffeine consumption, stress levels, and sleep quality is complex and varies from person to person due to multiple factors.

Keywords: Caffeine, Stress, Sleep Quality

INTRODUCTION

Caffeine is a chemical that can be found naturally in a variety of plant-based foods and beverages. Caffeine is one of the most used substances in the world. Most caffeine is consumed through food products, such as tea, coffee, energy drinks, and chocolate or cocoa-containing products (Quadra et al., 2020). The expansion of global population is the primary driver behind the rise in the overall consumption of caffeine. The amount of caffeine that is contained in each product varies widely, however when compared to other types of beverages, coffee often contains one of the highest concentrations of caffeine (Mitchell et al., 2014). Nowadays, caffeine consumption is still rising, and it is becoming an incredibly prevalent beverage, especially among young generations (Rahim et al., 2019).

In Malaysia, drinking local coffee has been a cultural tradition for a very long time, and it has now become a habit for the local populace, as in other western nations such as the United States (Ramli et al., 2019). The growth of the Asian coffee market has been acknowledged by the global coffee industry. The coffee shop industry is growing and developing, including both worldwide coffee chains and local cafés. The local aesthetic coffee shops not only sell coffee, but also sell a variety of caffeinated beverages such as tea, chocolate and matcha.

Nowadays, students in Malaysia and throughout the world tend to use caffeinated energy drinks to stay up late and complete their daily tasks, especially during exams and coursework completion (Norshafarina et al., 2018). Several studies have shown that university students deal with stressful academic situations by drinking a lot of caffeinated drinks (Kale & Reddy, 2017). The most often reported reasons for consuming caffeinated beverages were to increase energy, maintain wakefulness, improve mood, enhance productivity, and facilitate social interaction (Malinauskas et al., 2007).

As a result, many university students have trouble getting enough restful sleep due to their irregular bedtime routines. Several students experience sleep disturbances due to poor sleep quality as well as discontent with their sleeping arrangements. The closer it gets to the final week of class, the fewer hours of sleep that students receive because they are typically too busy finishing their assignments and reviewing materials before the exam week (Sakinah et al., 2018). This issue arises as a result of some students consuming caffeine to stay up at night.

Previous research highlighted that excessive caffeine use may result in poor sleep quality (Kerpershoek et al., 2018). There have been numerous studies that show excessive caffeine consumption occurs when there is perceived stress (Richards & Smith, 2015). While it is true that caffeine improves emotions, alertness, and long-term memory, it is best to adhere to the suggested amounts. However, there is limited literature regarding the association between caffeine intake, stress level and sleep quality among undergraduate students in Malaysia. Thus, this research focused to obtain further insights into this topic among IIUM Kuantan students which has never been investigated.

METHODS

Subjects

This study was conducted among male and female undergraduate students at IIUM Kuantan. IIUM Kuantan is the science-based campus that consists of six different kulliyahs (faculties) which are Kulliyah of Allied Health Sciences, Kulliyah of Dentistry, Kulliyah of Sciences, Kulliyah of Nursing, Kulliyah of Pharmacy and Kulliyah of Medicine. The ethical approval was obtained from the Kulliyah Postgraduate and Research Committee (Reference No. KAHS 12/23) and IIUM Research Ethics Committee (IREC).

Study Design

Cross-sectional design was used in this study to find the association between habitual caffeine consumption, stress level, and sleep quality. This study design can be done at one time in one place. Participants in a cross-sectional study are simply selected from a population that may be relevant to the research question.

Sampling Methods

Convenience sampling was implemented for this research considering the accessibility and approachability to the participants (Stratton, 2021). Both inclusion and exclusion criteria have been set in order to choose suitable respondents and to achieve the specific objectives of this research. Inclusion criteria were undergraduate students from all the six kulliyahs aged between 19 to 25 years, whilst postgraduate students and age group beyond specified were excluded.

Instruments

The data were obtained through self-administered questionnaires that consists of four sections: sociodemographic data including self-reported weight and height, caffeine consumption pattern, Perceived Stress Scale (PSS) and Pittsburgh Sleep Quality Index (PSQI). Body mass index (BMI) was categorized according to World Health Organization (2000) guidelines: underweight (<18.50 kg/m²), normal (18.50-24.99 kg/m²), overweight (25.00-29.99 kg/m²), obese class I (30.00-34.99 kg/m²), obese class II (35.00-39.99 kg/m²) and obese class III (≥40.00 kg/m²), which are determined by calculating the weight in kilograms divided by the height in meters squared.

Caffeine Consumption Patterns

The consumption of caffeinated products was asked to the participants through a set of questions. Some questions were adapted from Md Isa et al. (2021), which listed various sources of caffeine and frequency of caffeine intake. In addition, the questions covered a variety of intentions and social practices for consuming coffee and other caffeinated beverages. The questions also addressed caffeine dependence, withdrawal symptoms, and side effects (Kharaba et al., 2022).

Perceived Stress Scale

The level of stress was examined using the Perceived Stress Scale (PSS-10), a 10-question instrument used to evaluate the perception of stress over the previous 30 days. The Perceived Stress Scale (PSS), created by Cohen, Kamarck, and Mermelstein (1983), is a recognized self-report instrument based on the psychological conception of stress.

The shorter 10-item scale (PSS-10) demonstrated marginally enhanced reliability (Cronbach alpha =.78 vs. Cronbach alpha =.75) and similar validity and is therefore recommended for epidemiological and clinical research. It has been shown to have sufficient psychometric qualities to serve as a valid stress questionnaire. The PSS used a five-point Likert scale (“never”, “almost never”, “sometimes”, “fairly often”, and “very often”) to record the responses. A score of 0 to 13 is regarded as low stress, 14 to 26 as moderate stress, and 27 to 40 as severe stress (Cohen et al., 1983).

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a 19-item self-reported questionnaire to examine the sleep quality of students and sleeping disorders over the past month. The PSQI was established by Buysse (1989) and his colleagues to measure sleep quality and help distinguish between those with bad sleep and those with good sleep. With a Cronbach's alpha for the total score of 0.83, the dependability of the scale is regarded as good. The dependability of test-retest is likewise deemed to be satisfactory. Each part is given a score between 0 (no dysfunction) to 3 (severe dysfunction). The component scores were

then added up to produce a global score ranges from 0 to 21, with a score up to 5 indicating good sleep and >5 representing poor sleep quality.

A pilot study with 30 undergraduate students was conducted for the questionnaires with reliable Cronbach's Alpha value of 0.727, 0.874 and 0.768, respectively. The questionnaires were presented in English in Google Form format for all respondents to fill in. The link to the questionnaires was distributed to the participants through online platforms such as WhatsApp, Instagram and Telegram. The participants were required to provide informed consent prior to their participation in the study.

Statistical Analysis

The data were analysed using the SPSS version 26.0 software. Descriptive analysis was used to provide an overview of the sociodemographic data of respondents. Fisher's Exact Test was used to determine the association between caffeine intake frequency, stress level, and sleep quality. Statistically significant value was set at $p < 0.05$.

RESULTS

Sociodemographic Data

The sociodemographic data of the respondents are as shown in Table 1. A total of 290 subjects were recruited among students at IIUM Kuantan, Pahang. The results of the study showed that the number of male respondents ($n=145$) was the same as female ($n=145$). The age of respondents was within the range of 19 to 25 years. Most of the students have normal BMI and none from Obese Class III. Kulliyyah of Allied Health Sciences have the highest respondent rate of 33.1% compared to Kulliyyah of Science, Kulliyyah of Nursing, Kulliyyah of Pharmacy and Kulliyyah of Medicine, and Kulliyyah of Dentistry which were 31.4%, 11.4%, 10.7%, 9.7%, and 3.8% respectively. Most of the students who participated were 3rd year students (38.3%), while the least were 5th year students (1.0%). Only 28.3% did not receive any scholarships while the rest are under the scholarships of either *Jabatan Perkhidmatan Awam (JPA)*, *Majlis Amanah Rakyat (MARA)*, *Perbadanan Tabung Pendidikan Tinggi Nasional (PTPTN)* or others.

Table 1. Sociodemographic data of the respondents (N=290)

Sociodemographic Data	Frequency (n)	Percentage (%)
Gender		
Male	145	50
Female	145	50
Age		
19	4	1.4
20	67	23.1
21	74	25.5
22	91	31.4
23	42	14.5
24	10	3.4
25	2	0.7
BMI		
Underweight	35	12.1
Normal	190	65.5
Overweight	49	16.9
Obese Class I	13	4.5

Obese Class II	3	1.0
Obese Class III	0	0
Kulliyah		
Kulliyah of Allied Health Sciences	96	33.1
Kulliyah of Science	91	31.4
Kulliyah of Nursing	33	11.4
Kulliyah of Pharmacy	31	10.7
Kulliyah of Medicine	28	9.7
Kulliyah of Dentistry	11	3.8
Year of Study		
Year 1	74	25.5
Year 2	70	24.1
Year 3	111	38.3
Year 4	32	11.0
Year 5	3	1.0
Scholarship Status		
Self-sponsored	82	28.3
MARA	73	25.2
PTPTN	67	23.1
JPA	44	15.2
Others	24	8.2

Caffeine Consumption Patterns

Table 2 indicates the patterns of caffeine consumption among undergraduate students at IIUM Kuantan. Overall, nearly half of the respondents consume caffeinated beverages 1 to 3 times per week. Thirty percent (n=87) of the respondents took caffeine once per day. The number of students who consumed caffeinated drinks 2-3 times a day and 4-6 times a week are 36 (12.4%) and 23 (7.9%) students respectively. Only 2.1% (n=6) of students consume 4 to 5 times a day, and all of them are male. None of the respondents consume caffeinated beverages more than 5 times a day. Besides, majority of the students took coffee as a source of caffeine followed by tea, chocolate, caffeinated soft drinks, matcha and only 9.3% of students consume energy drinks. Moreover, most of the students preferred to have caffeine because they like the taste of caffeine and to stay awake. Only a few students consumed caffeine to deal with stress and help the digestion process. Other than that, the respondents usually consumed caffeine at night and the least in the afternoon. Some of them were having withdrawal symptoms such as headaches and drowsiness. Only 2.1% experienced muscle pain after consuming caffeinated beverages. Meanwhile, around 41.0% experienced rapid heartbeat and difficulty falling asleep as side effects after having caffeine.

Table 2 Caffeine consumption patterns among undergraduate students (N=290)

Caffeine consumption patterns	Male	Female	Total
	(n=145)	(n=145)	(n=290)
	n (%)	n (%)	
How often do you consume caffeinated beverages?			
1-3 times weekly	63 (43.4)	75 (51.7)	138 (47.6)
Once daily	42 (29.0)	45 (31.0)	87 (30.0)
2-3 times daily	21 (14.5)	15 (10.3)	36 (12.4)

4-6 times weekly	13 (9.0)	10 (6.9)	23 (7.9)
4-5 times daily	6 (4.1)	0 (0)	6 (2.1)
More than 5 times daily	0 (0)	0 (0)	0 (0)
Sources of caffeine			
Coffee	113 (77.9)	114 (78.6)	227 (78.3)
Tea	99 (68.3)	104 (71.7)	203 (70.0)
Chocolate	96 (66.2)	93 (64.1)	189 (65.2)
Matcha	50 (34.5)	70 (48.3)	120 (21.4)
Caffeinated soft drinks (eg: Pepsi, Coca-cola, Mountain Dew, Sprite, 7-Up)	66 (45.5)	44 (30.3)	110 (37.9)
Energy drinks (eg: Red bull, Livita, Power Root)	21 (14.5)	6 (4.1)	27 (9.3)
Why do you prefer having caffeinated drinks?			
Like the taste	123 (84.4)	129 (89.0)	252 (86.9)
To deal with stress	52 (35.9)	51 (35.2)	103 (35.3)
To stay awake	98 (67.6)	78 (53.8)	176 (60.7)
To help with digestion	21 (14.5)	38 (26.2)	59 (20.3)
What time of the day do you usually consume caffeine?			
Morning	70 (48.3)	82 (56.6)	152 (52.4)
Afternoon	33 (22.8)	44 (30.3)	77 (26.6)
Evening	62 (42.8)	78 (53.8)	140 (48.3)
Night	119 (82.1)	97 (66.9)	216 (74.5)
Do you experience any withdrawal symptoms after having caffeine?			
Headaches	26 (17.9)	50 (34.5)	76 (26.2)
Nausea	6 (4.1)	19 (13.1)	25 (8.6)
Muscle pain	3 (2.1)	3 (2.1)	6 (2.1)
Drowsiness	24 (16.6)	36 (24.8)	60 (20.7)
Fatigue	24 (16.6)	33 (22.8)	57 (19.7)
Irritability/Poor mood	15 (10.3)	28 (19.3)	43 (14.8)
Do you experience any side effects after having caffeine?			
Tense	10 (6.9)	29 (20.0)	39 (13.4)
Shakiness	18 (12.4)	47 (32.4)	65 (22.4)
Anxious	31 (21.4)	52 (35.9)	83 (28.6)
Restless	34 (23.4)	39 (26.9)	73 (25.2)
Rapid heartbeat	49 (33.8)	70 (48.3)	119 (41.0)
Trouble concentrating	16 (11.0)	18 (12.4)	34 (11.7)
Difficulty falling asleep	61 (42.1)	58 (40.0)	119 (41.0)

The Association between Frequency of Caffeine Intake and Gender

Table 3 indicates the association between the study participants' gender and the frequency of caffeine intake. In this study, the frequencies of caffeine consumed by male and female students were approximately the same. Most males and females students consumed caffeine 4 to 6 times weekly, followed by once daily and 1 to 3 times per week. Neither males nor females consumed caffeine more than 5 times a day. As a result, the Fisher's Exact test below showed no statistically significant association between the frequency of caffeine intake and gender, $X^2(4) = 8.610$, $p = 0.068$.

Table 3 Association between frequency of caffeine intake and gender (N=290)

Variable Frequency of Caffeine Intake	Gender		n	X ² -statistic (df)	P-value
	Male n (%)	Female n (%)			
4-6 times weekly	63 (21.7)	75 (25.9)	290	8.610 (4)	0.068
Once daily	42 (14.5)	45 (15.5)			
1-3 times weekly	21 (7.2)	15 (5.2)			
2-3 times daily	13 (4.5)	10 (3.4)			
4-5 times daily	6 (2.1)	0 (0)			
> 5 times daily	0 (0)	0 (0)			

The Association between Caffeine Intake and Stress Level

Table 4 below indicates the association between the subjects' caffeine consumption pattern and the stress level. Most of the students who experienced moderate stress level only consume caffeinated beverages once per day and 1 to 3 times a week. However, the number of students who consumed caffeinated drinks as much as 4 to 6 times a week and experienced poor and high stress levels were the same (1.0%). As a result, the Fisher's Exact test showed no statistically significant association between caffeine consumption patterns and stress level among undergraduate students at IIUM Kuantan, $X^2(8) = 6.637, p = 0.548$.

Table 4 Association between frequency of caffeine intake and stress level (N=290)

Variable Frequency of Caffeine Intake	Stress Level			n	X ² -statistic (df)	P-value
	Poor n (%)	Moderate n (%)	High n (%)			
1-3 times weekly	30 (10.3)	90 (31.0)	18 (6.2)	290	6.637 (8)	0.548
Once daily	15 (5.2)	63 (21.7)	9 (3.1)			
2-3 times daily	10 (3.4)	20 (6.9)	6 (2.1)			
4-6 times weekly	3 (1.0)	17 (5.9)	3 (1.0)			
4-5 times daily	1 (0.3)	3 (1.0)	2 (0.7)			
> 5 times daily	0 (0)	0 (0)	0 (0)			

The Association between Caffeine Intake and Sleep Quality

Table 5 shows the association between subjects' caffeine consumption pattern and sleep quality. The result showed that most of the students who experienced poor sleep quality only consume caffeinated beverages once per day and 1 to 3 times a week. However, there were 1.4% of students who consumed caffeinated drinks 4 to 5 times a day but experienced good quality of sleep. The Fisher's Exact test below showed no statistically significant association between caffeine consumption patterns and sleep quality among undergraduate students at IIUM Kuantan, $X^2(4) = 4.437, p = 0.349$.

Table 5. Association between frequency of caffeine intake and sleep quality (N=290)

Variable Frequency of Caffeine Intake	Sleep Quality		n	X ² -statistic (df)	P-value
	Poor n (%)	Good n (%)			
1-3 times weekly	87 (30.0)	51 (17.6)	290	4.437 (4)	0.349
Once daily	54 (18.6)	33 (11.4)			
2-3 times daily	27 (9.3)	9 (3.1)			
4-6 times weekly	15 (5.2)	8 (2.8)			

4-5 times daily	2 (0.7)	4 (1.4)
> 5 times daily	0 (0)	0 (0)

DISCUSSIONS

The Frequency of Caffeine Intake among Male and Female Students

Caffeine is widely used among students in IIUM Kuantan. The current findings revealed that male and female students, on average, predominantly consume caffeine on a weekly basis, ranging from one to three occasions. In this study, no significant association was detected in the frequency of caffeinated beverages intake between male and female undergraduate students in IIUM Kuantan. Upon comparing the findings of the present study with those of the previous one, it is evident that a significant proportion of male and female students regularly consumed caffeine. The consumption of caffeinated beverages was a common practice for both male and female. This result is consistent with a previous study conducted by Knapik et al. (2022), where there was only minimal disparity between genders with reported slightly higher percentages \pm SE intake among male (87.0 ± 0.2) than female (86.1 ± 0.6) in terms of the prevalence of caffeine consumption.

Furthermore, with regard to specific sources of caffeine, such as coffee, variations exist in consumption habits between gender. According to previous research, males indicate a higher average coffee intake in comparison to females (Demura et al., 2013). However, in this study, coffee has been identified as the primary source of caffeine consumption among both male and female students. In addition, a previous finding highlighted that males are more likely to consume higher caffeine contents from other sources such as energy drinks, which could contribute to higher overall consumption (Demura et al., 2013; Dillon et al., 2019). This is consistent with our study where male students consumed more energy drink and caffeinated soft drinks as compared to female students. Females, on the other hand, show a greater preference for green tea or other lower-caffeine options.

Caffeine Intake and its Association with Stress

University education, particularly the undergraduate phase, is a crucial stage in a student's development. It is a challenging journey for them, as evidenced by the annual increasing psychological distress rates associated with tertiary education. Therefore, students might consume caffeine to counteract the effects of stress and weariness because it is a stimulant that can briefly improve cognitive performance and boost alertness. While individuals may have habits and coping mechanisms that involve caffeine consumption during periods of stress, but there was no significant evidence from this study that demonstrated stress being directly associated with the frequency of caffeine consumption.

A study conducted by Al-Ateeq et al., (2021) found that there was a significant positive relationship between the frequency of caffeine consumption and the level of perceived stress. The researchers added that students who consumed caffeine frequently had substantially higher mean perceived stress scores than those with a low caffeine intake. This is also supported by other study that found a significant positive relationship between the frequency of caffeine consumption and stress level (Pettit & DeBarr, 2011). Nevertheless, the result from present study does not conform with the previous findings, where the undergraduate students at IIUM Kuantan consumed caffeine frequently regardless of their stress level and it might be due to the addictive taste of caffeine as well as its accessibility. It has been demonstrated that students' caffeine use is driven more by their routine, taste preferences, and daily habits than by their stress levels (Simpson, 2016).

Caffeine Intake and its Association with Sleep Quality

University students frequently report poor sleep quality due to sleep disturbances caused by insufficient sleep, early morning awakening, and trouble falling asleep. The findings of this study indicated that 2/3 undergraduate students in IIUM Kuantan suffered from a suboptimal level of overall sleep quality, with 63.8% out of 290 students having poor sleep quality according to the PSQI criteria. The results corresponded with those of another study, which revealed that students frequently

experienced poor sleep quality (Kabrita et al., 2014). Based on most of the previous research findings, the frequency of consuming caffeinated beverages is significantly associated with quality of sleep especially among students. According to Al-Sharif et al. (2018), the study found that there was a statistically significant difference in sleep quality between students who consumed higher amounts of caffeinated beverages and those who did not ($p= 0.003$); which is consistent with results from Lemma et al. (2012). In the present study, the results indicate opposite finding with no significant association between both variables.

Among the studies that support this argument is the research conducted by Lohsoonthorn et al., (2013) which demonstrated that there was no significant association between frequency of caffeine intake and sleep quality. In addition, the researchers added information on the variables such as consumption time that would contribute to poor sleep quality. Caffeine consumption in the hours before bed or in the evening might make it difficult to fall asleep and may disturb sleep patterns. However, once an appropriate amount of time has elapsed since caffeine consumption, the amount of caffeine consumed does not appear to have a significant effect on sleep quality. This suggests that as long as caffeine is consumed earlier in the day and sufficient time is allowed for it to be metabolised and eliminated from the body before sleep, the exact amount consumed becomes less of a factor in sleep quality.

Limitation and Strength

The limitation in this study included the scope of the subjects which was limited to undergraduate students at IIUM Kuantan only, where all of them were science-based students. Despite the limitation, one of the strengths in this study is that it has an equal number of male and female respondents although it is quite difficult to recruit male respondents due to the smaller population size of male compared to female students. Moreover, the questionnaires used in this study were used worldwide and have been validated.

CONCLUSION

The frequency of caffeine consumption has been found to be unaffected by either male or female based on no statistically significant finding. Besides, this present study demonstrated that the level of stress and quality of sleep are not influenced by the frequency of caffeine consumption. These may infer that the relationship between frequency of caffeine consumption, stress levels, and sleep quality is complex and varies from person to person due to multiple factors, including individual differences, caffeine sensitivity, metabolism, and overall well-being. It is important for students to be mindful of how their daily caffeine intake affects their stress levels and ability to sleep. Thus, future research is warranted to explore other potential factors that cause consumption of caffeine, high stress level and poor sleep quality experienced by students.

ACKNOWLEDGEMENT

The authors would like to extend their gratitude to all the participants of the study for their time and commitment as well as other individuals who have been involved in this study, whether directly or indirectly.

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