


Assessment of caffeine consumption behavior among Jazan University students in the south of Saudi Arabia

A cross-sectional study

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Abstract

Caffeine is a central nervous system stimulant. High consumption levels of caffeine can lead to intoxication and serious side effects. Saudi Arabia is witnessing a rise in the commercialization and consumption of caffeine. Young adults such as university students may exhibit high levels of caffeine consumption. This investigation aims to assess caffeine consumption habits among a sample of Jazan University students in the south of Saudi Arabia. This study was a cross-sectional investigation that utilized multistage sampling to recruit the students. Data was collected via a self-administered questionnaire that measured student demographics, their frequency of consuming caffeine-containing food, portion sizes, and patterns of consumption during different times of the day. Caffeine consumption levels were estimated based on a cutoff point of 400 mg per day. A chi-squared test was used to investigate the association between levels of caffeine consumption and measured study characteristics. A sample of 964 students was recruited with a mean age of 21.8 years. The most frequently consumed product among the recruited students was coffee (32%), followed by chocolate bars (16%) and soft drinks (12%). The median total consumed caffeine amount was 185 mg per day. 194 (20%) students of the sample exceeded the recommended level of daily caffeine consumption (>400 mg/day). Among the measured demographics, only the year of study was associated with caffeine consumption (P value of .003), suggesting that students in their earlier years of university are likely to exceed the recommended daily consumption of caffeine in comparison with those who are in their later years of study. Our investigation identified high levels of caffeine consumption among some students. The findings imply the need to enhance the awareness of students who exceed the recommended daily intake of caffeine regarding the harmful impacts of caffeine toxicity.

Keywords: caffeine, Jazan, Saudi Arabia, students, university

1. Introduction

Caffeine is a central nervous system stimulant that has several pharmacological and physiological consequences. Its consumption has been reported to impact bodily processes such as the cardiovascular and respiratory systems. Additionally, caffeine consumption can have a mental influence and can impact people's mood and cognitive performance.^[1] The impact of caffeine is dependent on the level of consumption, where moderate caffeine intake has been suggested to have a minimal impact on health.^[2,3] However, high consumption levels can lead to intoxication and serious side effects.^[1]

Caffeine is present in several commonly consumed food and beverages. It is naturally present in coffee beans, cacao beans, and tea leaves. Soft drinks and energy drinks are also sources of caffeine.^[4] Nonetheless, levels of caffeine concentration

have been reported to vary significantly. For example, caffeine concentration is higher in coffee beans than in tea leaves. Furthermore, caffeine in coffee beans has been reported to vary according to the type of plant, growing conditions, and brewing method.^[4]

Caffeine consumption has been suggested to have increased during the last years and to vary between populations. A recent review by Quadra et al that investigated global trends in caffeine consumption over the last 3 decades indicated that global caffeine consumption is increasing, mainly due to population growth. Furthermore, Quadra et al indicated that caffeine consumption is higher in certain countries, such as Brazil and Italy, than in others.^[5] On an individual level, caffeine consumption can vary according to several demographic characteristics such as age, gender, and preferred sources of caffeine.^[6]

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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Saudi Arabia is one of the countries that is witnessing a rise in caffeine consumption. Although there is no data available to indicate trends of caffeine consumption in the country, there are multiple signals that suggest a growing interest of Saudis in the coffee industry. According to the Observatory of Economic Complexity, Saudi Arabia became the 18th largest importer of coffee in the world in 2020.^[7] This demand for imported coffee can be partially explained by the growing cafe industry, which has expanded during recent years.^[8] Furthermore, in addition to the private sector's investment in the coffee industry, the growing demand for coffee is recognized by governmental initiatives, such as the decision to name 2022 as "The Year of Saudi Coffee,"^[9] and the recent initiative of the Saudi Public Investment Fund to launch the Saudi Coffee Company with an investment reaching 1.2 billion Saudi Arabian Riyal.^[10]

Several cross-sectional investigations have been conducted in Saudi Arabia to assess the levels of caffeine consumption among different populations. These investigations were conducted in Riyadh,^[11-14] Jeddah,^[15] the northern borders,^[16] and Madinah.^[17] Among the identified studies that assessed preferred sources of caffeine, coffee was found to be favored.^[11,13,14] Among the studies that provided estimates of caffeine consumption, the mean daily consumption of caffeine varied between 424 mg^[12] and 1599 mg per day.^[11]

According to the Department of Health in Canada and the US Food and Drug Administration, the recommended maximum daily intake of caffeine among adults was cited at 400 mg per day.^[18,19] Although data concerning the average daily intake of caffeine among Saudis is limited, the current growth of the coffee industry in Saudi Arabia may suggest increases of caffeine that exceed the maximum recommended daily amount. Furthermore, evidence concerning consumption of caffeine in the south of Saudi Arabia is currently lacking. The current investigation aims to assess caffeine consumption habits among a sample of Jazan University students in the south of Saudi Arabia.

2. Methods

2.1. Study context

This study was a cross-sectional investigation that targeted Jazan University students. Data was collected between March and April of 2022. Ethical approval to perform the study was granted via the Standing Committee of Scientific Research of Jazan University (Approval number REC-43/04/067, dated 17/11/2021). Participation was voluntary and anonymous, and the students had the right to refuse to participate or withdraw. The study was performed in accordance with the Declaration of Helsinki.

2.2. Data collection tool

Data was collected via a self-administered questionnaire that measured sample demographics and daily caffeine intakes. The collected demographic details were related to the participants' age, gender, college, year of study, and social status. Information about caffeine intake was adopted from a study conducted by AlSharif et al that measured caffeine consumption among a sample of university students from Jeddah, Saudi Arabia.^[15] The caffeine intake was assessed by asking about the caffeine-containing food or beverages that had been consumed by participants in the previous day. Their portion sizes and frequencies of consumption during breakfast, between breakfast and lunch, during lunch, between lunch and dinner, during dinner, and after dinner were also obtained. The process of development of the questionnaire and its validity are detailed elsewhere.^[20]

2.3. Data collection process

Students registered at Jazan University at the time of recruitment were included in this investigation. Those who were not

Jazan University students were excluded. Multistage sampling was utilized to ensure the recruitment of students from different specialties in Jazan University's campus. In the first stage of sampling, 12 colleges were targeted, ensuring the equal representation of health and non-health related specialties. Secondly, it was ensured that the identified sample of participants represented different stages of students' university trajectories. The final unit of sampling was distributing the questionnaire among conveniently selected classes while ensuring the equal representation of male and female students. To collect the required sample size, 24 questionnaire distributors aided in distributing the questionnaire according to the planned sampling process. Questionnaires were completed while students were present in their classes, and the questionnaire distributors collected the questionnaires upon completion.

The sample size estimation of the current study was based on the findings of similar investigations conducted in Saudi Arabia. According to AlSharif et al, 51.5% of university students from Jeddah were presumed to be excessive caffeine consumers,^[15] while AlAteeq et al reported that 59% of a sample of university students from Riyadh were presumed to be high caffeine consumers.^[12] Depending on the 2 reported values, a mid-point prevalence of high caffeine consumption of 55% was used to estimate the required sample size of the current investigation. The declared number of students registered at Jazan University at the time of conducting the study was 60,000 students. The StatCalc function of EpiInfo was utilized to estimate the required sample size of the current investigation, assuming a population size of 60,000 students, an expected prevalence of 55% of students with a high caffeine consumption, a 5% acceptable margin of error, and a 99% of confidence level. The required sample was deemed to be 650 participants, which was increased to 975 assuming a 50% non-response rate to the distributed questionnaire.

2.4. Data analysis

Data was analyzed via the Statistical Package for Social Sciences software (version 21). Descriptive statistics were presented via frequencies and proportions for binary and categorical variables, while means, standard deviations, medians, 25 to 75 percentiles, and minimum and maximum values were used to summarize continuous variables depending on the data distribution.

The caffeine consumption of each student was dependent on the number and portions of consumed items per day. The caffeine content of each item was retrieved from the Food Data Central website by the United States Department of Agriculture,^[21] with the exception of the caffeine level in Arabic Coffee, which was retrieved from the study by Rezk et al.^[22] Table 1 describes the caffeine level of each item. A cutoff point of 400 mg was used to classify the level of caffeine consumption among the recruited sample of students. A chi-squared test was used to investigate the association between levels of caffeine consumption and measured study characteristics. A *P* value of .05 was presumed as the statistically significant value for the applied statistical test.

3. Results

A total of 964 students were recruited in the current investigation. The demographic characteristics of this sample are depicted in Table 2. The mean age of the students was 21.8 years and the distribution between male and female students was nearly similar. A higher representation of students that are related to health specialties was noted (nearly 50%) compared with students that were related to science (34%) or art specialties (16.2%). Nearly 50% of the participants were in their second or third years of study. Finally, most of the recruited students were single (92%).

Table 1**Caffeine-containing food items included in the questionnaire, portion sizes, and levels of caffeine.**

Food name	Portion size	Caffeine content
Coffee	150 mL	61 mg
Coffee	250 mL	101 mg
Decaffeinated coffee	150 mL	1.5 mg
Decaffeinated coffee	250 mL	2.5 mg
Espresso	60 mL	129 mg
Tea	150 mL	30 mg
Tea	250 mL	51 mg
Hot chocolate	150 mL	3 mg
Hot chocolate	250 mL	5 mg
Iced tea	150 mL	14 mg
Iced tea	250 mL	24 mg
Soft drink	150 mL	14 mg
Soft drink	250 mL	24 mg
Energy drink	250 mL	76 mg
Energy drink	500 mL	152 mg
Energy drink shot	60 mL	18 mg
Chocolate bar	20 g	11 mg
Arabic coffee	25 mL	10 mg

Table 2**Demographic characteristics of 964 students from Jazan University, Saudi Arabia.**

Variable	
Age: Mean [Standard Deviation]	21.8 [1.6]
Gender: Frequency [proportion]	
Male	485 [50.3%]
Female	479 [49.7%]
College: Frequency [proportion]	
Health	480 [49.8%]
Science	328 [34%]
Art	156 [16.2%]
Year of study: Frequency [proportion]	
Second yr	274 [28.4%]
Third yr	202 [21%]
Fourth yr	245 [25.4%]
Fifth yr	135 [14%]
Sixth yr	108 [11.2%]
Social status: Frequency [proportion]	
Single	886 [91.9%]
Married	68 [7.1%]
Widowed	1 [0.1%]
Divorced	9 [0.9%]

Table 3 and Figure 1 describe the consumption of caffeine-containing products among the recruited students. The most frequently consumed product among the recruited students was coffee (32%), followed by chocolate bars (16%) and soft drinks (12%). The presented maximum values of consuming certain products indicate excessive consumption among some students. For example, some reported a consumption of 12 cups of coffee during a day, and others reported a consumption of 10 cans of soft drinks or energy drinks, suggesting high levels of caffeine consumption.

Table 4 displays the findings of the caffeine content analysis according to the time of consumption and the total caffeine consumption per day. The median total consumed amount of caffeine is 185 mg per day. The highest median of consumed caffeine is detected in the morning time. Nonetheless, the depicted maximum values of caffeine consumption suggest that some students prefer to consume high amounts of caffeine either during dinner time or after dinner. Finally, the 0 values indicate that some students do not consume any form of caffeine.

When the sample was classified according to the recommended levels of caffeine consumption for adults, 194 (20%) sample participants exceeded the recommended level. Additionally, 40 students (4%) consumed more than the double (>800 mg) of the daily recommended amount of caffeine. Table 5 displays the findings of the association analysis between the measured sample characteristics and the recommended levels of caffeine consumption. Only the year of study was associated with the classification according to the recommended level of caffeine consumption (P value of .003), suggesting that students in their earlier years of university are likely to exceed the recommended daily consumption of caffeine compared with those who are at their later years of study. Male students, art students, and students less than 22 years old showed slightly higher proportions of excessive caffeine consumption per day, but with no statistically significant differences (P values > .05).

4. Discussion

This study was a cross-sectional investigation that targeted Jazan university students to assess their caffeine consumption habits. The most frequently consumed caffeine-containing item was coffee. Although only 20% of the students exhibited consumption habits exceeding the daily recommended amount of caffeine, there is a high inter-individual variation that suggests

Table 3**Medians, 25 to 75 IQR, minimum and maximum values, and sum of frequencies of consuming caffeine-containing food items per day among 964 students from Jazan University, Saudi Arabia.**

	Median: 25-75 IQR	Minimum-maximum	Sum
Coffee	1 [0–3]	0–12	1636
Decaffeinated coffee	0 [0–0]	0–10	199
Espresso	0 [0–0]	0–6	300
Tea	2.5 [2–4]	1–11	228
Hot cocoa drink ups	0 [0–0]	0–4	146
Iced tea	0 [0–0]	0–6	234
Soft Drink	0 [0–1]	0–10	621
Energy drinks	0 [0–0]	0–10	468
Chocolate bars	0 [0–1]	0–6	816
Arabic coffee	0 [0–1]	0–6	469

IQR = interquartile range.

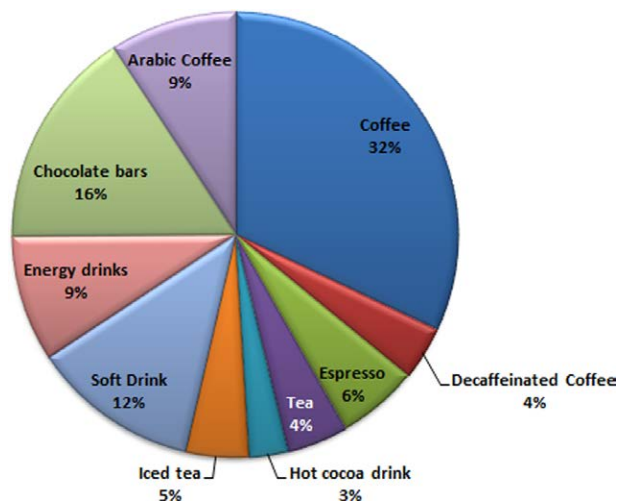


Figure 1. Distribution of consumption of caffeine-containing food items among 964 students from Jazan University, Saudi Arabia.

Table 4

Total levels of consumed caffeine (mg) and distribution of consumption among 964 students from Jazan University, Saudi Arabia.

Time of caffeine consumption	Median: 25–75 IQR	Minimum–maximum
Breakfast	61 [11–101]	0–393
Between breakfast and lunch	14 [0–72]	0–359
Lunch	11 [0–35]	0–317
Between lunch and dinner	14 [0–65]	0–365
Dinner	11 [0–59.75]	0–505
After dinner	11 [0–61]	0–486
Total caffeine per day	184.75 [72–354.25]	0–1566

IQR = interquartile range.

a very high caffeine consumption among some students. When assessing caffeine consumption habits according to the time of the day, a majority consume their caffeine in the morning, but some do consume high amounts of caffeine in the nighttime. Among the factors that were assessed to indicate association

with high caffeine intake, only the year of study was statistically significant, suggesting a higher level of consumption among those in their early years of study.

The findings of our investigation can be compared to similar national, regional, and international investigations. Although multiple investigations have been conducted in Saudi Arabia to assess caffeine consumption among different populations, the studies that provided a quantification of the daily intakes of caffeine were limited. The median of daily caffeine consumption identified in our sample of students was 185 mg. However, in a study conducted by AlAteeq et al that targeted 547 female university students in Riyadh, a mean of 424 mg per day of caffeine consumption was reported.^[12] The findings in AlAteeq et al indicate a relatively higher consumption of caffeine than in our findings. This variation can be explained by the variation of the demographics and the methodology of assessing caffeine intake (such as the list of food items and the differences in portion size). Nonetheless, the average caffeine intake identified in our study is similar to the average of caffeine consumption detected in other American^[23,24] and European populations.^[25] For example, a mean daily caffeine consumption of 169 mg was identified among a sample of US adult participants.^[26]

The findings of the current investigation indicate that 20% of the sampled students consume more than the recommended amount of 400 mg of caffeine per day. It was noted that different cutoff points were used to classify levels of caffeine consumption in the literature. Therefore, our findings are compared to the studies that used 400 mg/day of caffeine intake as a cutoff point. In a study conducted in Bahrain that sampled 727 university students, it was reported that 18% of the participants consumed more than 400 mg of caffeine per day,^[27] which is similar to our findings. However, in a similar study conducted among 467 university students in the United Arab Emirates, nearly a third of the sample reported a consumption of more than 400 mg per day, which is relatively higher than in our study.^[28]

Although the majority of students recruited in our investigation reported either no consumption or a normal consumption of caffeine, some students exhibited extreme daily consumption levels that reached up to 1566 mg/day. These excessive values have also been reported in similar investigations. In a study that recruited 395 Egyptian university students, extreme values of daily caffeine consumption were reported that reached up to 2435 mg/day.^[29] Furthermore, a study conducted in Lebanon among 146 university students indicated a temporal variation in caffeine consumption, where the proportion of students who exceeded the recommended daily intake of caffeine was

Table 5

Association between demographic characteristics and levels of caffeine consumption among 964 students from Jazan University, Saudi Arabia.

Variable	Caffeine consumption		Total	P value
	400 mg or less	More than 400 mg		
Gender				.177
Male	379 [78.1%]	106 [21.9%]	485 [100%]	
Female	391 [81.6%]	88 [18.4%]	479 [100%]	
College				.451
Health	385 [80.2%]	95 [19.8%]	480 [100%]	
Science	266 [81.1%]	62 [18.9%]	328 [100%]	
Art	119 [76.3%]	37 [23.7%]	156 [100%]	
Yr of study				.003
Second yr	205 [74.8%]	69 [25.2%]	274 [100%]	
Third yr	153 [75.7%]	49 [24.3%]	202 [100%]	
Fourth yr	213 [86.9%]	32 [13.1%]	245 [100%]	
Fifth yr	107 [79.3%]	28 [20.7%]	135 [100%]	
Sixth yr	92 [85.2%]	16 [14.8%]	108 [100%]	
Age				.428
Less than 22	325 [78.7%]	88 [21.3%]	413 [100%]	
22 yrs or more	445 [80.8%]	106 [19.2%]	551 [100%]	

the highest during exam periods (46.6%) in comparison with other periods (34.9%).^[30] Although the variation in students' consumption of caffeine depending on different periods was not assessed in our sample, we cannot neglect the potential impact of exam periods on increasing caffeine consumption among some of the students recruited in our sample.

The pattern of consuming higher levels of caffeine during the morning that was identified in our sample is similar to the findings of other international investigations.^[23,26] However, some students in our sample reported high levels of caffeine consumption in the nighttime. A study that assessed the consumption of psychostimulants (including caffeine) according to chronotypes indicated that evening-type individuals tend to consume more stimulants during the nighttime.^[31] Although chronotypes were not assessed in our investigation, this tendency may partially explain the high consumption of caffeine during the evening among some students in Jazan University. Though not measured in the current investigation, it is possible to argue that the late consumption of caffeine can have harmful effects on sleep patterns. This notion is supported by an investigation by Drake et al that concluded that consuming a dose of 400 mg within 6 hours before sleep is likely to have a disruptive effect on sleep pattern.^[32]

The current investigation had multiple strengths and weaknesses. The main strengths are related to the sampling and recruitment method that enabled the recruitment of students from different specialties and years of study. Furthermore, the utilization of a validated questionnaire enabled the estimation of participants' daily caffeine intake and its times of consumption during the day. The limitations of this study are inherent due to the nature of the assessment method that relies on the recall of the participants. Furthermore, the assessment of the caffeine intake is subject to error due to the potential impact of factors related to the variation of portion sizes that are available from different market outlets and manufacturers as well as the variation in the preparation of caffeine-containing products. Finally, the generalizability of the study's findings are limited to similar university settings or young adults and does not represent the population of Jazan.

5. Conclusion

Our investigation identified high levels of caffeine consumption among some students. The main sources of caffeine among the recruited sample were coffee, soft drinks, and energy drinks. The majority of the sample consumed most of their caffeine during the morning, but some students exhibited high levels of caffeine consumption during the night. Participants' year of study was associated with exceeding the recommended daily amount of caffeine, where those in their early years of study consumed higher amounts of caffeine compared with those later in their university trajectories. The high consumption of caffeine among some Jazan students may impact their sleep quality and mental health and may warrant further investigations. The findings of our study carry implications regarding the need to enhance the awareness of students who exceed the recommended daily intake of caffeine about the harmful impacts of caffeine toxicity.

Author contributions

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