Original Article

Coffee Consumption and Sleep Quality: A Cross-Sectional Study among Saudi Adults

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ABSTRACT

Background: Caffeine is one of the most commonly consumed stimulants in Saudi Arabia. We aim to examine the relationship between caffeine consumption and sleep quality among Saudi Arabian residents.

Methods: This cross-sectional study uses the Pittsburgh Sleep Quality Index (PSQI). Data was collected through social media platforms such as WhatsApp, Twitter, LinkedIn, and Facebook. The study included Saudi Arabian adults 18 years and older. Descriptive statistics were performed to examine the population characteristics, and the logistic regression model was used to investigate the association between caffeine consumption and sleep quality.

Results: A total of 636 respondents participated in the study. Nine out of ten respondents reported consuming caffeine (90%). The respondents were predominately aged 30 to 44 (52.04%), females (63.11%), married (62.89%), and overweight/obese (60.47%). Around two-thirds were Saudi nationals (69.68%). More than half of the respondents reported a good quality sleep score (56.88%). In multivariate analysis adjusted for potential confounders, body mass index was the only statistically significant demographic predictor for sleep quality. Overweight/obese respondents had a statistically significantly lower sleep quality score mean than non-overweight/obese respondents (coefficient -0.48; P-value 0.05).

Conclusion: Caffeine consumption was highly prevalent among Saudis; however, it was not associated with poor sleep quality. On the contrary, those with high body mass index, particularly in obese individuals, were significantly associated with poor sleep quality. Caffeine consumers must monitor their caffeine consumption carefully and set a daily consumption limit.

Keyword: Caffeine, Coffee, Sleep quality, Stimulants, Saudi Arabia.

Introduction

Caffeine, an alkaloid compound, is a widely consumed stimulant globally, and it is frequently added to many drinks and various foods [1].The U.S. Food and Drug Administration considers 400 milligrams of caffeine a safe daily intake for healthy adults. There is rising concern around the globe about the increased consumption of caffeinated foods and drinks due to reports of adverse events, especially when compared to non-caffeinated beverages [2].

Caffeine plays a significant role in the daily lives of many individuals, particularly in Saudi Arabia, where its consumption among the population is high. The prevalence of coffee consumption among Saudi females is as high as 88% [3]. When compared to other nations such as Bahrain (76%), the US (70%), and Brazil (68.3%), Saudis had the highest rate of coffee consumption [3].

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Over the past decade, coffee shops in Saudi Arabia have increased significantly, which has fueled caffeine consumption, particularly among the middle-aged. Additionally, caffeine consumption through energy drinks has increased, especially among teenagers and young adults [4]. The benefits of caffeine consumption have been documented in the literature. Some studies argue that caffeine reduces fatigue, increases alertness, improves performance, and increases mental functioning [5]. Caffeine has also been found to be negatively associated with depressive symptoms [6]. Some studies have also shown that drinking Arabic coffee reduces halitosis, mainly because of the cardamom present in it [7]. On the other hand, some of the negative effects of caffeine include impairments in sleep quality, anxiety, and restlessness, all of which can affect people's performance [8]. Seizures, hallucinations, psychosis, and arrhythmias have also been reported as severe adverse effects of high coffee consumption [8]. As mentioned above, reduced sleep quality is one of the adverse effects of increased coffee consumption. Sleep quality has become a global public health concern, with public health professionals recognizing the importance of having good sleep quality and its impact on our overall mental and physical health. The four dimensions of sleep quality are efficiency, latency, duration, and wake after sleep onset [9]. Sleep efficiency is the total amount of sleep in a day's hours, decreasing as a person ages. Sleep latency is the transition from the awareness stage to the sleep state. Sleep duration varies depending on the person and the age. The last dimension of sleep is waking up. The impact of caffeine on sleep quality varies among individuals because of different factors such as age, gender, and socioeconomic status. A systematic review of 24 studies revealed that caffeine consumption reduced total sleep time and sleep efficiency and increased sleep onset latency and wake-after-sleep onset [10]. As a result of this effect, caffeine is thought to play a role in the development of sleep disorders. Conversely, a study in Asia concluded that caffeine consumption was not a significant risk factor for sleep disorders [11]. High caffeine intake, particularly among college students in Saudi, has been associated with poor sleep quality [12]. Another study among patients in primary healthcare centers in Aseer region reported that insomnia was significantly higher in adults drinking > 3 cups of coffee [13]. On the other hand, some evidence showed that coffee intake was not associated with the frequency of insomnia [14]. Overall, studies conducted in this domain are conflicting, and thus far, there has been no definite association between caffeine consumption and sleep disorders. Saudi society has health and behavioral characteristics that differ from those of other populations. Saudi coffee, also called Ghahwa, is integral to the local culture. Therefore, it is vital to understand the impact of high caffeine intake on this particular population. Our study uses data from Saudi respondents that represent Saudi culture and will add a valuable contribution to the existing literature regarding caffeinated beverages among Saudis.

Methods

This study aims to examine the relationship between caffeine consumption and sleep quality among adult Saudis using the Pittsburgh Sleep Quality Index (PSQI) and identify any demographic indicators of poor sleep quality.

Sample Size and Inclusion/Exclusion Criteria: A cross-sectional study design was used. The study's target population was adults over 18 years old who resided in Saudi Arabia. Other participants were excluded.

The minimum required sample size was calculated using Raosoft, Inc.'s online software. The result was a minimum sample size of 385, 95% confidence intervals, and a 5% margin error.

Survey Tools: A Google Form survey was utilized to construct the survey questionnaire. Various social media platforms, including WhatsApp, LinkedIn, Facebook, and X, were employed to collect the data. We used a previously conducted survey [15] with modifications tailored to our study population, geographical location, and languages of the respondents. The survey had both Arabic and English versions, which expert translators validated. We further pretested the survey among ten participants to validate the Arabic version. The three major sections of the survey:

1- Demographic questions include age, gender, income, employment, marital status, weight, height, and nationality.

2- Caffeine consumption routine based on questions adapted from another study [15]

3- Sleep quality assessment using PSQI (The Pittsburgh Sleep Quality Index)

Convenience sampling and snowball sampling techniques were used to collect participant data [16].

Statistical Analysis

The sociodemographic features were assessed via Chi-square, Fisher exact test, and t-test where appropriate. Multivariate analyses using purposeful variable selection for model building and backward elimination showed a $P < 0.3$. Analysis of covariance (ANCOVA)

was used to examine the association between sleep quality and caffeine consumption. Assumptions of homogeneity of variance and dependent variable normality were assessed. Statistical significance was considered at $p < 0.05$. All the analysis was conducted using SAS statistical software version 9.4 (SAS Institute Inc. Cary, NC).

Ethical Consideration: The participants' identities and personal information were kept entirely anonymous and confidential. The researcher stored the data in a secure device accessible only to the research team. Participation was voluntary, and informed consent was obtained from all participants. The study received approval from the Institutional Review Board at Alfaisal University (IRB-20141).

Results

A total of 636 respondents participated in the study. (Table 1) presents sociodemographic characteristics and participants' scores of sleep quality. The respondents were predominately aged 30 to 44 (52.04%), females (63.11%), married (62.89%), and overweight/obese (60.47%). Nearly two-thirds of the respondents were employed (66.93%), while most respondents were of Saudi nationality (96.68%). For sleep quality according to the Global Pittsburg Sleep Quality Index score, 43.13% of respondents reported poor quality of sleep. In comparison, a higher proportion of the respondents reported good sleep quality (56.88%). (Figure 1) presents the caffeinated beverages that the respondents consumed. Three out of ten respondents reported drinking Arabic/Turkish Coffee (32.45%), while one-fourth reported drinking American Coffee (25.86%). (Table 2) presents the characteristics of caffeine consumption among the respondents. Many respondents reported using 1-2 regular coffee cups daily (42.39%) and small cups of coffee (65.52%). Also, nearly half of the respondents reported consuming caffeinated beverages during the morning (wake-up time and start of a new day) (48.66%). (Table 3) presented an association between sleep quality, demographics, and coffee consumption. The only significant demographic indicator of sleep quality was body mass index. Normal-weight has a lower number of suffering sleep quality than overweight/obese responders (coefficient -0.48; P-value 0.05). Regarding coffee consumption, respondents who reported no coffee intake had statistically significantly lower sleep quality scores than those who reported more than 5 cups (factor -1.42; P-value 0.05). As shown in (figure 2), there is no significant association between the type of caffeinated drink and sleep quality score (p-value of 0.44). (Figure3) illustrated the time of caffeinated drink consumption and quality of sleep score. Time of the day and type of coffee consumption was not associated with sleep quality.

However, in terms of coffee consumption, univariate analysis showed a statistically significant difference between males and females (p-value 0.03), as seen in (Table 4). The percentage of males consuming more than 5 cups of coffee daily (5.91%) is twice that of females (2.49%). Similar patterns were observed in respondents who reported 3-5 cups of coffee daily. Males reported slightly higher coffee consumption than females (18.64% and 13.02%, respectively). A statistically significant difference exists between males and females in preference for drinking locations (p-value 0.004).

Discussion

In our cross-sectional study, the researchers aimed to examine the association between caffeine consumption and sleep quality among individuals residing in Saudi Arabia. In our study, the majority of the respondents reported good quality of sleep. These findings conflict with the findings of another study that assessed sleep quality and also used the Pittsburgh measurements among Saudis. In that study, more than half (63.9%) of respondents reported poor sleep quality [17]. However, these differences can be attributed to the difference in the study population. Mahfouz et al.'s study focuses on students, primarily young adults, and it is common for people of this age to sleep late in Saudi society. Additionally, the study was conducted on students with different stressors, such as their assignments, exams, and future, which can also affect their sleep quality. This was different than our study population, which was mixed of students, employed adults, and retired individuals. In our findings, respondents who did not drink caffeinated beverages reported better sleep quality than caffeinated drinkers. Many studies in the literature have confirmed the effect of caffeine on sleep quality. One large cross-sectional study with more than 15,000 participants concluded that individuals who reported high caffeine consumption were likelier to be tired in the morning and reported lower sleep quality than those who reported lower consumption [18]. Caffeine consumption is linked to reduced sleeping hours compared to non-caffeine drinkers and can also affect the quality of sleep [19]. The most apparent effect of caffeine as a stimulant is that it can make it challenging for consumers to fall asleep quickly. However, to understand the dynamic mechanism of caffeine in the brain, we need to

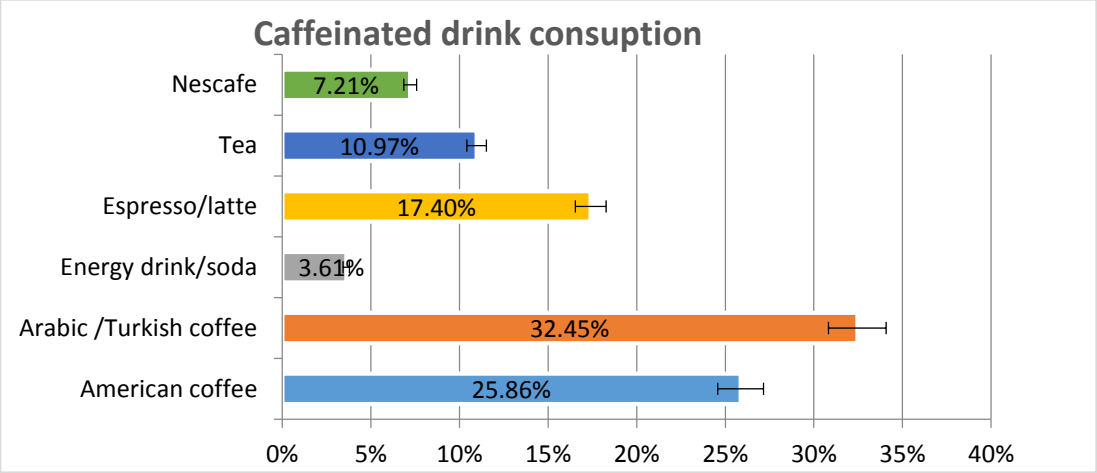

Figure 1: Types of caffeinated drink consumed.

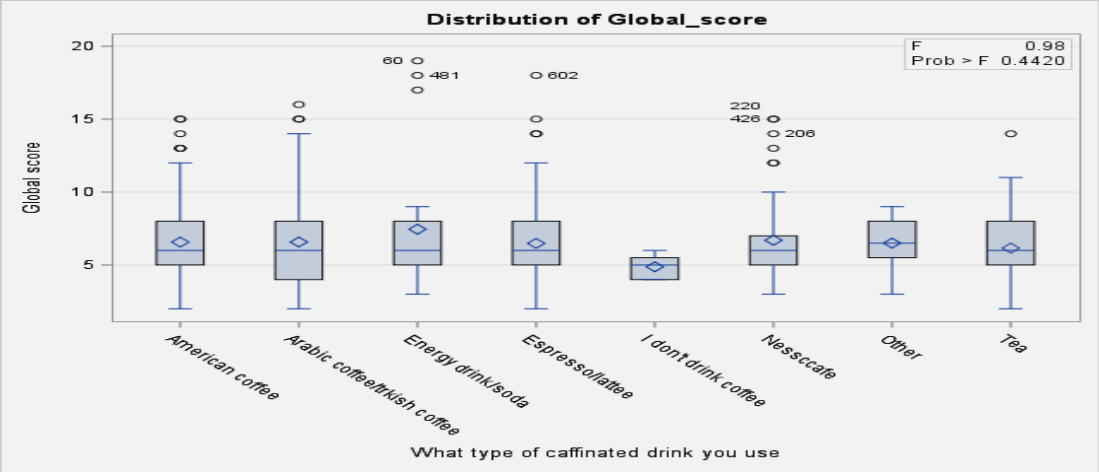

Figure 2: Type of caffeinated drink used by global sleep score.

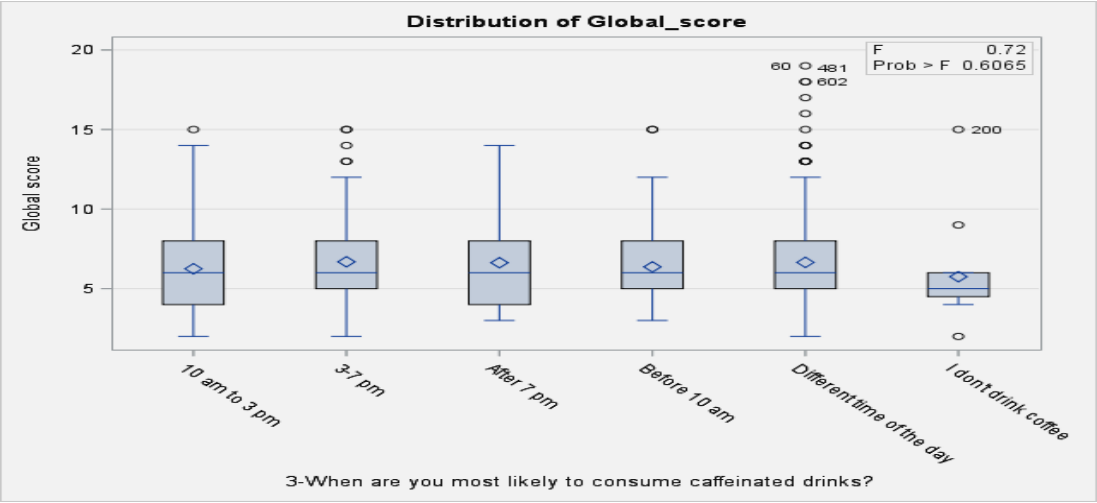

Figure 3: Time of the caffeinated drink consumption during the day & quality of sleep.

Table 1: Demographic characteristics of the survey respondents.

Characteristics	Total participants (N=636) n (%)
Age	
18-29	164 (25.71)
30-44	332 (52.04)
45-54	101 (15.83)
>55	41 (6.43)
Gender	
Male	235 (36.89)
Female	402 (63.11)
Marital status	
Married	400 (62.89)
Unmarried	236 (37.11)
Weight status	
Overweight/obese	387 (60.47)
Not Overweight/obese	253 (39.53)
Employment status	
Yes	421 (66.93)
No	208 (33.07)
Nationality	
Saudi	612 (96.68)
Non- Saudi	21 (3.32)
Monthly income	
9,999 Saudi Riyal or less	123 (19.43)
10,000-19,999 Saudi Riyal	180 (28.44)
More than 20,000 Saudi Riyal	98 (15.48)
I prefer not to answer	130 (20.54)
I don't have a monthly income	102 (16.11)
Mother's education	
High school or less	157 (24.76)
Undergraduate degree	363 (57.26)
Graduate degree	114 (17.98)

Table 2: Caffeine consumption characteristics of the survey respondents.

Caffeine consumption	**Total (N= 636) n (%)**
How many cups (regular size) of caffeinated drink do you consume every day?	
1-2 cups	270 (42.39)
3-5 cups	183 (28.73)
I don't drink coffee	65 (10.2)
More than 5 cups	119 (18.68)
How many small cups of caffeinated drink do you consume every day?	
1-2 cups	382 (65.52)
3-5 cups	88 (15.09)
I don't drink coffee	91 (15.61)
More than 5 cups	22 (3.77)
When are you most likely to consume caffeinated drinks?	
When wake upstart new day	308 (48.66)
After eating/work/workout	48 (7.58)
Family friends and relax	218 (34.44)
Feel tired/anxious	38 (6.00)
I don't drink coffee	21 (3.32)

Table 3: Association between sleep quality and coffee consumption.

	Coefficient Estimate [1]	**Standard error (SE)**	**p-value**
Total			
Body Mass Index			
Overweight/obese	Reference	Reference	Reference
Non-Overweight/obese	-0.48	0.25	0.05
How many small cups of caffeinated drink do you consume every day			
1-2 cups	-1.41	0.67	0.09
3-5 cups	-0.34	0.71	0.62
I don't drink coffee	-1.42	0.73	0.05
More than 5 cups	Reference	Reference	Reference
1 ANCOVA analysis of covariance A score of "5" or higher is expressive of poor sleep quality			

Table 4: Sleep quality and coffee consumption stratified by gender.

	Male	**Female**	**p-value** [1]
Global score (sleep quality score) mean (SD)	6.43 (2.61)	6.57 (2.85)	0.13 [2]
How many small cups of caffeinated drink do you consume every day?			0.03
1-2 cups	136 (61.82)	245 (67.87)	
3-5 cups	41 (18.64)	47 (13.02)	
I don't drink coffee	30 (13.64)	60 (16.62)	
More than 5 cups	13 (5.91)	9 (2.49)	
Do you prefer drinking at work, study, relax			0.004
All the time	77 (32.77)	151 (37.75)	
I don’t drink coffee	6 (2.55)	13 (3.25)	
Relax at home	34 (14.47)	87 (21.75)	
Studying	4 (1.7)	16 (4)	
When I go out	24 (10.21)	33 (8.25)	
Work	90 (38.3)	100 (25)	
1 chi-square test 2 t-test			

Elaborate more on how caffeine affects our brain. Caffeine primarily blocks adenosine receptors in the brain [19, 20]. Adenosine is a crucial sleep-regulatory substance that promotes sleep and relaxation [20]. By inhibiting its action, caffeine increases alertness and can delay the onset of sleep, leading to poorer sleep quality. Sleep latency was also consistently prolonged when caffeine was taken before bedtime [20]. Moreover, caffeine consumption can reduce melatonin levels, a hormone that regulates sleep-wake cycles. Lower melatonin levels can disrupt the natural circadian rhythm [19]. Our findings revealed that more than half of our population was overweight or obese. In multivariate analysis, we found that individuals who reported overweight or obesity have significantly lower sleep quality compared to non-obese individuals. Obesity has been long associated with several adverse outcomes, such as poor sleeping quality. Pearson et al. and Krističević et al. found a strong association between troubled sleeping, poor sleep quality, and obesity [21, 22]. A study conducted in Saudi Arabia also concluded that the Pittsburg Sleep Quality Index (PSQI) scores were higher for obese and overweight respondents, indicating an association [23]. It is worth noting that one link between poor quality sleep and obesity is obstructive sleep apnea (OSA), as obesity is one of the most vital risk factors for OSA [24]. The study has some limitations, including recall bias, given that it was a self-administered survey. Selection bias could also be present, given that the survey was distributed online. Moreover, the cross-sectional nature of the study limits causality.

Conclusion

The study finds caffeine consumption is prevalent in the Saudi population, with 90% of our respondents reporting consuming caffeine. Caffeine can be attributed to positive and negative impacts on our daily functions. It can effectively improve our attention, concentration, alertness, and energy. However, it can also reduce sleep quality by reducing sleeping hours. Additionally, increased body weight is attributed to poor sleep quality, as we have seen in our findings. Caffeine consumers should carefully monitor their caffeine consumption and develop a personal daily consumption limit. We also recommend that caffeine consumers increase their awareness level and educate themselves with updated information about caffeine studies and experiments.

Conflict of Interest

None

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None

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