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ORIGINAL RESEARCH

THE IMPACT OF CAFFEINE ON SLEEP QUALITY AND MENTAL HEALTH AMONG DENTAL STUDENTS IN ERBIL CITY, KRG/IRAQ

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ABSTRACT

Background: Caffeine is a widely consumed psychoactive substance, often used by university students to enhance alertness and cognitive performance. However, excessive caffeine intake may negatively impact sleep quality and mental health, particularly among students in demanding academic fields such as dentistry.

Objective: This study aims to assess the impact of caffeine consumption on sleep quality and mental health among dental students in Erbil City, Kurdistan Region of Iraq. It examines caffeine intake patterns and their association with sleep disturbances and psychological well-being.

Methods: A cross-sectional study was conducted among 450 dental students from universities in Erbil. Data were collected through a self-administered questionnaire consisting of four sections: socio-demographic characteristics, caffeine intake assessment (Modified Caffeine Intake Questionnaire), sleep quality evaluation (Pittsburgh Sleep Quality Index), and mental health assessment (Depression, Anxiety, and Stress Scale-21). Statistical analysis was performed using SPSS version 28, with significance set at $p \leq 0.05$.

Results: The majority of participants (68.2%) were female, and most (65.6%) were aged 21-23 years. About 62% consumed ≤400 mg of caffeine daily, with coffee and tea being the most common sources. Sleep disturbances were prevalent, with 46% of students reporting ≤6 hours of sleep per night. Mental health assessment revealed that 42.9% of participants experienced varying degrees of dysphoria, hopelessness, and anxiety. A significant association was found between high caffeine intake and poor sleep quality, as well as increased symptoms of depression, anxiety, and stress ($p < 0.05$).

Conclusion: Excessive caffeine consumption among dental students in Erbil is associated with poor sleep quality and negative mental health outcomes. Awareness programs and strategies promoting healthier sleep hygiene and responsible caffeine use are recommended to mitigate these effects.

Keywords: Caffeine, Sleep Quality, Mental Health, Dental Students, Erbil, Iraq

INTRODUCTION

Caffeine, a widely consumed psychoactive substance, plays a significant role in the daily routines of many individuals worldwide. It is commonly found in beverages such as coffee, tea, energy drinks, and soft drinks, as well as in certain medications. While moderate caffeine consumption is often associated with enhanced alertness and improved cognitive performance, excessive intake can have adverse effects, particularly on sleep quality and mental health.[1] University students, especially those in demanding academic fields such as dentistry, frequently consume caffeine to combat fatigue and maintain focus during long study hours. However, this coping mechanism may lead

to disrupted sleep patterns and contribute to mental health issues, including anxiety and depression.[2, 3]

Studies have indicated that chronic sleep deprivation can exacerbate mental health challenges, creating a potentially harmful cycle for students relying on caffeine to manage their academic demands.[4] Sleep quality is a critical determinant of overall health and well-being, directly influencing cognitive performance, emotional regulation, and physical health. Poor sleep hygiene and insufficient rest are associated with a range of negative outcomes, including reduced academic performance and increased risk of developing psychiatric disorders.[5, 6] Caffeine, while beneficial in small doses, can interfere with the ability to achieve restorative sleep by delaying sleep onset, reducing sleep duration, and altering sleep architecture.[7] Mental health is another vital concern, particularly among students who face the dual pressures of academic and personal responsibilities. Research suggests a bidirectional relationship between caffeine consumption and mental health, where high intake levels may exacerbate symptoms of stress and anxiety, while individuals with existing mental health issues may consume caffeine to self-medicate,further complicating their conditions.[8, 9] Moreover, studies highlight that gender differences may influence caffeine's effects, with females reporting greater sensitivity to its impact on sleep and mood compared to males.[10] The timing and frequency of caffeine intake also play a significant role, as late-day consumption is more likely to disrupt sleep patterns and increase daytime fatigue.[11] Evidence suggests that students with pre-existing poor sleep hygiene are more prone to excessive caffeine use, compounding their sleep and mental health challenges.[12] In addition, heavy caffeine users often report higher levels of academic-related stress, indicating a complex interaction between lifestyle factors and psychological well-being.[13]

This study aims to assess the impact of caffeine consumption on sleep quality and mental health outcomes among dental students in Erbil City, Kurdistan Region of Iraq. The objectives were to characterize the habitual caffeine intake within this group. It will further investigate the potential association between these caffeine consumption patterns and sleep quality and mental health status, according to researchers' knowledge no similar study had been done in Erbil city among this group of population.

MATERIALS AND METHODS

Study design and setting: Cross sectional study was designed for the current study in which a convenience sample of students aged 18 years or older presented with the impact of caffeine on sleep quality and mental health. The study conducted at dentistry colleges in Erbil-Kurdistan region of Iraq and carried out from 5th of July 2024 to 15th of December 2024.The researchers investigated the potential association between caffeine consumption patterns and sleep quality and mental health status among dental students.

Method and data collection: The study conducted with enrolling a convenience sample size of from medical university students across Erbil city. The process of data collection was done via using self- administered questionnaire including four sections first section A: socio-demographic data comprising (gender, age, year of study, household income, marital status), following by section B: modified caffeine intake (MCI) questionnaire, section C: Pittsburgh sleep quality index (PSQI) for measuring sleep quality and finally section D: depression, anxiety, and stress 21 scale (DASS-21) for assessing negative emotional states. Caffeine intake was assessed using MCI, with daily caffeine intake calculated based on total consumption of coffee, tea, caffeinated beverages, and energy drinks. PSQI measured sleep quality over the previous four weeks, while DASS-21 evaluated depression, anxiety, and stress levels. Data were collected using a convenience sampling technique to collect information on target population in an approachable manner.

Data management and statistical analysis: The data recorded on a specially designed questionnaire, collected and entered in the computer via Microsoft Excel worksheet (Excel 2016) and then analyzed using appropriate data system which is called Statistical Package for Social Sciences (SPSS) version 28 and the results were compared between patients with different variables, with a statistical significance level of ≤ 0.05. The results presented as rates, ratio, frequencies, percentages in tables and figures and analyzed using t-test, and Chi square tests.

Inclusion criteria: Inclusion criteria comprised of medical students aged more than 18 years who were intaking caffeine regardless of their gender were enrolled. Participants who were interested in taking part in the study and those who met the specified criteria were included in the study.

Exclusion criteria: Exclusion criteria included students outside medical fields who aged less than 18 years old. Respondents who did not give consents to participate in the research, furthermore students who did not meet the criteria were excluded in the study.

Ethical considerations: This study was submitted to the Ethics and Scientific committees of Family Medicine Research Ethics Committee at Kurdistan Higher council of Medical Specialties for scientific and ethical approval. This study was explained and a verbal consent was obtained from each student. Confidentiality and anonymity of data were ensured.

RESULTS

A total of 450 participants enrolled in our study, most (68.2%) of them were female and 21-23 year group had the highest (65.6%) age amount following by 26.7% of them were 18-20 years old and the least amount (0.7%) categorized under 27 years and above, the vast majority (97.3%) of cases were single, more than one third 34.2% of them were studying at fourth grade and only 8.7% were fifth graders, more than half (52.2%) of students had high (more than 1 million IDQ) income and lowest income (Less than 250.000 IDQ) was for 14.2% of students, the majority (82%) of them were unemployed, 46% of them were sleeping for ≤6 hours and finally 17.3% of students had normal schedule of sleep (6-8 hours) (Table 1 and Figure 1).

Table 1. Sociodemographic characteristics of participants.

Variables	Categories	Frequency	Percent
Gender	Male	143	31.8
	Female	307	68.2
Age	18 - 20	120	26.7
	21 - 23	295	65.6
	24 - 26	32	7.1
	27 and above	3	0.7
Marital status	single	438	97.3
	married	12	2.7
Grade	First	56	12.4
	Second	86	19.1
	Third	115	25.6
	Fourth	154	34.2
	Fifth	39	8.7
Income	Low (Less than 250.000) IDQ	64	14.2
	Moderate(250-1Million) IDQ	151	33.6
	High (More than 1Million)	235	52.2
Job	Yes	81	18
	No	369	82
sleeping	≤6 hours	207	46
	6 - 8 hours	78	17.3
	>8 hours	165	36.7
Total		450	100%

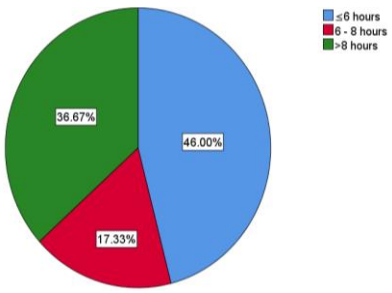

Figure 1. Sleeping hours of participants.

Table 2 shows that most (72.7%) of students were smokers, 62% of them were drinking caffeine (MCI) ≤ 400mg/day, 28.7% of participants were drinking coffee four times/day and 19.5% were consuming only one time/day, the highest tea consumption was 37.6% among students one time/day and lowest consumption was three times/ day for 2.7% of students, 23.6% of respondents were involved with energy drinks four times a day and only 7.8% had energy drinks twice a day, 23.6% of the sample size were having carbonated drinks four times a day and finally only 3.3% of them had soft drinks once a day.

Table 2. Smoking and consuming beverages among students.

Variables	Categories	Frequency	Percent
Smoking	Yes	327	72.7
	No	123	27.3
Caffeine (MCI)	0 mg/day	57	12.7
	≤ 400mg/day	279	62
	> 400mg/day	114	25.3
Coffee consumption	0 times a day	95	21.1
	1 Time/ day	88	19.6
	2 Times/day	60	13.3
	3Times/day	78	17.3
	4 Times/day	129	28.7
Tea consumption	0 times a day	122	27.1
	1 Time/ day	169	37.6
	2 Times/day	41	9.1
	3Times/day	12	2.7
	4 Times/day	106	23.6
Energy drinks	0 times a day	256	56.9
	1 Time/ day	52	11.6
	2 Times/day	35	7.8
	3Times/day	1	0.2
	4 Times/day	106	23.6
Carbonated drinks	0 times a day	262	58.2
	1 Time/ day	15	3.3
	2 Times/day	58	12.9
	3Times/day	9	2
	4 Times/day	106	23.6
Total		450	100%

Table 3 reveals that dysphoria condition applied to 19.8% of students to some degree, and 9.3% of them dysphoria applied most of the time, hopelessness, devaluation, self-deprecation, Anhedonia and inertia applied to 20.9% of students to some degree following by applied to 12.7% to a considerable degree and 9.3% of them experienced the conditions most of the time or very much, finally more than half 57.1% of respondents did not apply any sort of mental issues on them.

Table 3. Mental issues among participants.

Variables	Categories	Frequency	Percent
Dysphoria	Did not apply to me at all	262	58.2
	Applied to me to some degree, or some of the time	89	19.8
	Applied to me to a considerable degree or a good part of the time	57	12.7
	Applied to me very much, or most of the time	42	9.3
Hopelessness	Did not apply to me at all	257	57.1
	Applied to me to some degree, or some of the time	94	20.9
	Applied to me to a considerable degree or a good part of the time	57	12.7
	Applied to me very much, or most of the time	42	9.3
Devaluation	Did not apply to me at all	257	57.1
	Applied to me to some degree, or some of the time	94	20.9
	Applied to me to a considerable degree or a good part of the time	57	12.7
	Applied to me very much, or most of the time	42	9.3
Self-deprecation	Did not apply to me at all	257	57.1
	Applied to me to some degree, or some of the time	94	20.9
	Applied to me to a considerable degree or a good part of the time	57	12.7
	Applied to me very much, or most of the time	42	9.3
Anhedonia	Did not apply to me at all	257	57.1
	Applied to me to some degree, or some of the time	94	20.9
	Applied to me to a considerable degree or a good part of the time	57	12.7
	Applied to me very much, or most of the time	42	9.3
Inertia	Did not apply to me at all	257	57.1
	Applied to me to some degree, or some of the time	94	20.9
	Applied to me to a considerable degree or a good part of the time	56	12.4
	Applied to me very much, or most of the time	43	9.6
Total		450	100%

Table 4 shows that autonomic arousal, muscle effect and situational anxiety appealed to 18.2% of students some of the time, 12.2% of cases had autonomic arousal also 12.7% for each muscle effect and situational anxiety applied most of the time, more than half (53.1%) of respondents did not experience any subjective anxiety, difficulty relaxing and nervous arousal while 18.2% of students faced all three conditions to some degree, 14% of cases had subjective anxiety to a considerable degree following by difficulty relaxing had a population of 9.3% and nervous arousal 10.2% to a considerable degree.

Table 4. Mental disorders among students

Variables	Categories	Frequency	Percent
Autonomic arousal	Did not apply to me at all	247	54.9
	Applied to me to some degree, or some of the time	82	18.2
	Applied to me to a considerable degree or a good part of the time	66	14.7
	Applied to me very much, or most of the time	55	12.2
Muscle Effect	Did not apply to me at all	247	54.9
	Applied to me to some degree, or some of the time	82	18.2
	Applied to me to a considerable degree or a good part of the time	64	14.2
	Applied to me very much, or most of the time	57	12.7
Situational anxiety	Did not apply to me at all	247	54.9
	Applied to me to some degree, or some of the time	82	18.2
	Applied to me to a considerable degree or a good part of the time	64	14.2
	Applied to me very much, or most of the time	57	12.7
Subjective anxiety	Did not apply to me at all	239	53.1
	Applied to me to some degree, or some of the time	89	19.8
	Applied to me to a considerable degree or a good part of the time	63	14
	Applied to me very much, or most of the time	59	13.1
Difficulty relaxing	Did not apply to me at all	285	63.3
	Applied to me to some degree, or some of the time	89	19.8
	Applied to me to a considerable degree or a good part of the time	42	9.3
	Applied to me very much, or most of the time	34	7.6
Nervous arousal	Did not apply to me at all	285	63.3
	Applied to me to some degree, or some of the time	89	19.8
	Applied to me to a considerable degree or a good part of the time	46	10.2
	Applied to me very much, or most of the time	30	6.7
Total		450	100%

Issues as upset agitated, irritable and impatient appealed to 19.6% of cases to some degree tracking the situation applied a good part of the time to 10.2% of them, most of the time all three mentioned experienced by only 6.9% and finally most (63.3%) of the sample size did not have the conditions at all. (Table 5)

Table 5. Psychological problems among respondents

Variables	Categories	Frequency	Percent
Upset agitated	Did not apply to me at all	285	63.3
	Applied to me to some degree, or some of the time	88	19.6
	Applied to me to a considerable degree or a good part of the time	46	10.2
	Applied to me very much, or most of the time	31	6.9
Irritable	Did not apply to me at all	285	63.3
	Applied to me to some degree, or some of the time	88	19.6
	Applied to me to a considerable degree or a good part of the time	46	10.2
	Applied to me very much, or most of the time	31	6.9
Impatient	Did not apply to me at all	285	63.3
	Applied to me to some degree, or some of the time	88	19.6
	Applied to me to a considerable degree or a good part of the time	46	10.2
	Applied to me very much, or most of the time	31	6.9
Total		450	100%

Results of Table 6 discover that there was a statistically significant association between sleeping and caffeine, most (59.6%) of those who consumed > 400mg/day had ≤6 hours while 48.7% of ≤ 400mg/day group consumers had the same amount of sleeping. There was a statistically significant association between sleeping and coffee consumption, most (59.1%) of students with one time a day drinking coffee had >8 hours of sleeping while only 4.7% of four times a day coffee drinkers had the same sleeping hours.

According to tea consumption there was a significant statistical association with sleeping hours, those who were drinking tea four times a day were divided into first the majority (95.3%) who slept ≤6 hours and second only 4.7% of them had more than eight hours of sleep. There was a significant statistical association between sleeping and energy drinks, all (100%) of participants who consumed energy drinks three and four times a day had ≤6 hours of sleep while none (0%) of them had regular 6-8 hours or more than eight hours of sleep.

There was a significant statistical association between sleeping and carbonated drinks, 46.7% of those who were drinking soft drinks once a day had 6-8 hours of sleep while only 6.9% of those who were drinking carbonated drinks twice a day had regular 6-8 sleeping hours. Chi square test was significant and p-value was < 0.05.

Table 6. Association between sleep disturbance and coffee, caffeine, energy and carbonated drinks

Variable	Categories	Sleeping			p-value
		≤6 hours	6 - 8 hours	>8 hours	
Caffeine (MCI)	0 mg/day	3 (5.3%)	12 (21.1%)	42 (73.7%)	0.001
	≤ 400mg/day	136 (48.7%)	51 (18.3%)	92 (33%)	
	> 400mg/day	68 (59.6%)	15 (13.2%)	31 (27.2%)	
Coffee consumption	0 times a day	4 (4.2%)	28 (29.5%)	63 (66.3%)	0.001
	1 Time/ day	5 (5.7%)	31 (35.2%)	52 (59.1%)	
	2 Times/day	15 (25%)	17 (28.3%)	28 (46.7%)	
	3Times/day	60 (76.9%)	2 (2.6%)	16 (20.5%)	
	4 Times/day	123 (95.3%)	0 (0%)	6 (4.7%)	
Tea consumption	0 times a day	28 (23%)	43 (35.2%)	51 (41.8%)	0.034
	1 Time/ day	63 (37.3%)	26 (15.4%)	80 (47.3%)	
	2 Times/day	10 (24.4%)	6 (14.6%)	25 (61%)	
	3Times/day	5 (41.7%)	3 (25%)	4 (33.3%)	
	4 Times/day	101 (95.3%)	0 (0%)	5 (4.7%)	
Energy drinks	0 times a day	53 (20.7%)	64 (25%)	13 (54.3%)	
	1 Time/ day	14 (26.9%)	14 (26.9%)	24 (46.2%)	
	2 Times/day	33 (94.3%)	0 (0%)	2 (5.7%)	
	3Times/day	1 (100%)	0 (0%)	0 (0%)	
	4 Times/day	106 (100%)	0 (0%)	0 (0%)	
Carbonated drinks	0 times a day	73 (27.9%)	67 (25.6%)	122 (46.6%)	0.001
	1 Time/ day	6 (40%)	7 (46.7%)	2 (13.3%)	
	2 Times/day	17 (29.3%)	4 (6.9%)	37 (63.8%)	
	3Times/day	5 (55.6%)	0 (0%)	4 (44.4%)	
	4 Times/day	106 (100%)	0 (0%)	0 (0%)	
Total		207 (46%)	78 (17.3%)	165(36.7%)	

DISCUSSION

The findings of this study highlight several important sociodemographic and behavioral factors associated with sleep patterns and mental health among university students. The majority of participants were female (68.2%), single (97.3%), and aged between 21–23 years (65.6%). A significant proportion (46%) reported sleeping ≤6 hours per night, which is below the recommended 7–9 hours for young adults.[14] Only 17.3% had a normal sleep duration (6–8 hours), suggesting widespread sleep deprivation in this population.

The findings of this study provide valuable insights into the impact of caffeine consumption on sleep quality and mental health among dental students in Erbil. The results suggest a significant relationship between caffeine intake and various sleep disturbances, including reduced sleep duration, increased sleep latency, and poorer overall sleep quality this was inline with many other studies.[15, 16] Additionally, higher caffeine consumption was associated with increased levels of anxiety and stress among students. These findings are consistent with previous studies indicating that excessive caffeine intake can disrupt sleep patterns and negatively affect mental well-being.[17]

A strong association was found between high caffeine intake (>400 mg/day) and short sleep duration (≤6 hours), with 59.6% of high caffeine consumers reporting insufficient sleep. This aligns with previous research indicating that excessive caffeine intake, particularly in the afternoon or evening, disrupts sleep latency and quality.[18]

Additionally, coffee consumption frequency was significantly linked to sleep disturbances; 95.3% of students drinking coffee four times a day slept ≤6 hours,

whereas those consuming it once a day were more likely to sleep >8 hours (59.1%). This supports evidence that caffeine's half-life (5–6 hours) can delay sleep onset and reduce total sleep time.[7] This aligns with our findings, which indicate that dental students who consume caffeine regularly report difficulty falling asleep and experience fragmented sleep.

Furthermore, studies have established a link between caffeine and increased anxiety levels due to its stimulant effects on the central nervous system.[19] This was also observed in our study, where students with higher caffeine intake reported elevated stress and anxiety levels, supporting the hypothesis that caffeine exacerbates mental health challenges.

The impact of caffeine on sleep can be attributed to its antagonistic effects on adenosine receptors, which play a crucial role in promoting sleep. By blocking these receptors, caffeine increases alertness and reduces the sensation of fatigue, leading to prolonged wakefulness and disrupted sleep cycles.[20] Additionally, caffeine consumption, particularly in high doses, is associated with increased secretion of stress hormones such as cortisol, which may contribute to heightened anxiety and stress levels in students facing academic pressure.[21]

Energy drink consumption showed a particularly strong correlation with poor sleep, as all students consuming energy drinks 3–4 times daily reported ≤6 hours of sleep. This is consistent with studies linking energy drinks to increased insomnia and sleep fragmentation.[22] Similarly, carbonated drink intake was associated with reduced sleep duration, with 100% of those consuming them four times a day sleeping ≤6 hours. The high sugar and caffeine content in these beverages may contribute to sleep disturbances.[23]

A concerning proportion of students reported mental health issues, including dysphoria (19.8%), hopelessness (20.9%), and anxiety-related symptoms (18.2%). Poor sleep has been consistently linked to depression and anxiety in young adults.[24] The high prevalence of ≤6-hour sleepers (46%) may exacerbate these conditions, as sleep deprivation impairs emotional regulation and cognitive function.[25]

Implications for Dental Students

Given the demanding nature of dental education, students often rely on caffeine to enhance alertness and sustain academic performance. However, the findings of this study highlight the potential drawbacks of excessive caffeine consumption, particularly its detrimental effects on sleep quality and mental health. Poor sleep hygiene can negatively impact cognitive function, concentration, and academic performance, creating a vicious cycle where students resort to even higher caffeine intake to compensate for sleep deprivation.

Limitations and Future Directions

Despite the valuable insights provided by this study, certain limitations must be acknowledged. First, the cross-sectional nature of the study limits the ability to establish causality between caffeine consumption and sleep/mental health outcomes. Longitudinal studies are recommended to explore the long-term effects of caffeine on sleep patterns and mental well-being. Additionally, self-reported data on caffeine intake and sleep quality may be subject to recall bias. Future research could incorporate objective measures, such as actigraphy or polysomnography, to obtain more precise sleep assessments.

CONCLUSION

Sleep disturbances among university students are strongly associated with high caffeine intake, frequent energy drink consumption, and poor mental health. Interventions promoting sleep hygiene, caffeine moderation, and mental health support could mitigate these issues.

DECLARATIONS

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no conflict of interest.

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