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Original Article

Association of Depression and Anxiety with Consumption of Caffeine-Containing Beverages in University Students of Lahore, Pakistan

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Abstract

Background: The prevalence of depression and anxiety among university students worldwide is a growing concern. Concurrently, caffeine consumption has increased, attributed to perceived benefits. While moderate caffeine intake might offer protective effects, excessive consumption has been linked to anxiety and depression. Although studies have explored this relationship globally, research specific to Pakistan remains limited.

Objective: This study aimed to evaluate the impact of excessive caffeine consumption on the levels of anxiety and depression among university students in Lahore, Pakistan.

Methods: A cross-sectional observational study was conducted over eight weeks from June 20th to August 15th, 2023, among 324 university students in Lahore, Pakistan. Participants were selected through convenient sampling from both medical and non-medical universities. Data were collected using a validated questionnaire, which included sections on socio-demographic information, academic history, mental health history, and caffeine intake. The Patient Health Questionnaire-9 (PHQ-9) and the Generalized Anxiety Disorder-7 (GAD-7) scales were used to assess depression and anxiety, respectively. Ethical approval was obtained from the Research and Ethics Committee of Gulab Devi Institute of Pharmacy (REC/GDIP/23/DCP/16). Statistical analysis was performed using SPSS Version 25, with Pearson's correlation coefficient employed to evaluate the relationship between caffeine consumption and mental health outcomes.

Results: Of the 324 participants, 238 were female (73.5%) and 86 were male (26.5%). The majority were in their fifth year or higher (52.5%). Tea was the primary source of caffeine (75.9%), followed by coffee (22.8%) and energy drinks (17.9%). Significant positive correlations were found between caffeine consumption and PHQ-9 scores ($r = .216$, $p < .001$) as well as GAD-7 scores ($r = .258$, $p < .001$).

Conclusion: Excessive consumption of caffeine-containing beverages is significantly associated with higher levels of depression and anxiety among university students in Lahore. These findings highlight the need for awareness and preventive measures to mitigate the mental health risks associated with high caffeine intake in this population.

1 Introduction

The prevalence of depression and anxiety among university students worldwide has become an increasing concern, reflecting a significant and escalating public health issue. According to the World Health Organization (WHO), the global number of people suffering from depression exceeded 300 million in 2015, with nearly the same number experiencing a range of anxiety disorders (1). Mental health problems among university students are particularly alarming, as they frequently experience stress, anxiety, and depression at rates higher than the general population. For instance, a cross-sectional study in Malaysia revealed that stress, anxiety, and depression were present in 39.7%, 67.1%, and 44.9% of students, respectively (2). Similar findings have been reported in other countries, including Iraq, where a survey of 48,720 secondary school pupils found stress, anxiety, and depression symptoms in 29%, 40%, and 51.1% of participants, respectively (3). In China, a survey indicated prevalence rates of 43.7% for depression and 37.4% for anxiety among teenagers (4), while studies in India reported rates as high as 65.53% for anxiety among students in Chandigarh (5, 6).

In Saudi Arabia, a cross-sectional study of high school girls showed prevalence rates of 41.5% for depression, 66.2% for anxiety, and 52.5% for stress (7). Among teenage male students, the rates were 38.2% for depression, 48.9% for anxiety, and 35.5% for stress (8). Similarly, in Ethiopia, a study found that 52.3%, 60.8%, and 40.4% of undergraduate students experienced depression, anxiety, and stress, respectively (9). In Pakistan, mental health issues have also been on the rise. A 2004 survey estimated that about 6% of the population exhibited signs of depression or anxiety (10). Subsequent studies have shown an increasing prevalence of stress and depression, particularly among children (11, 12). These findings underscore the urgent need to address mental health problems among the youth in Pakistan.

Concurrent with the rise in mental health issues, caffeine consumption has significantly increased over the past decade. Caffeine's appeal is largely due to its perceived benefits, such as enhanced mood, delayed sleep onset, and greater attentiveness and alertness (13). University students, facing academic pressures, often consume caffeine to boost concentration and performance (14). Common sources of caffeine include coffee, tea, caffeinated soft drinks, and energy drinks, all popular among university students. While moderate caffeine intake has been associated with protective effects against depressive mood disorders and a reduced risk of suicide (15), excessive consumption (defined as 750 mg/day and above) has been linked to various adverse effects, including anxiety, depression, restlessness, tachycardia, insomnia, nausea, and diuresis (16). In rare instances, caffeine intoxication can lead to panic attacks and psychotic or manic symptoms (16).

Despite numerous studies exploring the relationship between caffeine consumption and mental health, the findings have been inconsistent. Some research suggests a protective effect of caffeine against depression, while other studies find no significant association or even a positive correlation with mental health issues (17, 18, 19). For example, a cohort study reported a negative correlation between depression and caffeine intake (24), whereas other studies claimed no relation (25, 26). Recent studies, however, have concluded that high caffeine consumption increases the risk of anxiety and depression (27, 28). Most of this research has been conducted in the United States and other countries, such as the UAE, Saudi Arabia, and Iran, indicating a correlation between caffeine intake and mental health issues among students (29 to 32). In Pakistan, a study in Karachi showed an increased prevalence of depression due to various socio-economic factors (11). Additionally, a survey in Lahore examined the frequency and pattern of caffeine usage among university students, highlighting their knowledge of its benefits and drawbacks (33).

To date, no study has specifically investigated the impact of caffeine consumption on mental health among university students in Pakistan. This research aims to fill this gap by evaluating the association between excessive caffeine consumption and the prevalence of anxiety and depression among university students in Lahore. The findings of this study are expected to contribute valuable insights into the mental health risks associated with high caffeine intake in this population, emphasizing the need for awareness and preventive measures to mitigate these risks.

2 Material and methods

A cross-sectional observational study was conducted among students from various universities in Lahore, Pakistan, over eight weeks, from June 20th to August 15th, 2023. The ethical approval for the study was granted by the Research and Ethics Committee of Gulab Devi Institute of Pharmacy, in accordance with the Declaration of Helsinki, under the letter number REC/GDIP/23/DCP/16. A sample of 324 students was selected through convenient sampling from both medical and non-medical universities. The sample size was determined using the Raosoft sample size calculator to ensure adequate representation.

Participants included in the study were university students who consumed more than 400mg of caffeine per day. This threshold was equivalent to more than four cups of brewed coffee, five servings of energy drinks, eight cups of black tea, or a combination where the total caffeine intake exceeded 400mg/day. Data were collected using a validated data collection form, which comprised three sections: general questions, the Patient Health Questionnaire-9 (PHQ-9), and the Generalized Anxiety Disorder-7 (GAD-7) scale.

The general questions section gathered socio-demographic information, academic history, mental health history, and details related to caffeine intake, including sources, frequency, and reasons for consumption. The PHQ-9 and GAD-7 scales assessed the levels of depression and anxiety, respectively. Each item in the PHQ-9 and GAD-7 had four possible responses: 0 (not at all), 1 (several days), 2 (over half the days), and 3 (nearly every day). The total scores for each scale were calculated to classify the severity of depression and anxiety, with higher scores indicating greater severity. A score of 10 or higher on the GAD-7 and PHQ-9 scales was used to diagnose anxiety and depression. For scores below 10, the overall higher score on each questionnaire was considered for analysis.

The researchers personally visited different universities to collect data directly from the participants. The collected data were then subjected to statistical analysis using SPSS Version 25 (IBM Corp., Armonk, NY, USA). The Pearson product-moment correlation coefficient (r) was employed to evaluate the correlation between caffeine consumption and the scores on the PHQ-9 and GAD-7 scales. Descriptive statistics were used to summarize the demographic characteristics of the participants, and inferential statistics were applied to determine the significance of the correlations between caffeine intake and mental health outcomes.

All participants provided informed consent before participating in the study, and their confidentiality was maintained throughout the research process. The study adhered to ethical guidelines to ensure the well-being and rights of the participants were protected.

3 Results

A total of 324 university students participated in the study, with 238 females (73.5%) and 86 males (26.5%). The demographic characteristics of the participants are detailed in Table 1. The majority of participants (52.5%) were in their fifth year or higher, and the primary source of caffeine was tea (75.9%), followed by coffee (22.8%) and energy drinks (17.9%). The most common reason for caffeine consumption was for pleasure or enjoyment (67.3%).

Table 1: Demographics of the Participants

Characteristic	Total (N = 324)	No. (%)
School year		
Freshman	32	9.9
Sophomore	16	4.9
Junior	24	7.4
Senior	82	25.3
Super senior or 5th year	170	52.5
Sex		
Female	238	73.5
Male	86	26.5
Previous diagnosis of depression or anxiety		
Never	170	52.5
Both	84	25.9
Anxiety	46	14.2
Depression	24	7.4
Source of caffeine		
Coffee	74	22.8
Tea	246	75.9
Energy drinks	58	17.9
Other	20	6.2
Reason for caffeine consumption		
To stay awake in class	36	11.1
Studying/homework	70	21.6
For pleasure or enjoyment	218	67.3
Other	0	0
Grade point average (GPA)		
<2.0	4	1.2
2.0-2.4	28	8.6
2.5-2.9	54	16.7
3.0-3.4	144	44.4
3.5-4.0	94	29.0

Caffeine Consumption and Depression

The correlation between caffeine consumption and PHQ-9 scores was analyzed using Pearson's correlation. The results indicated a significant positive correlation ($r = .216$, $p < .001$), suggesting that higher caffeine consumption was associated with higher depression scores.

Table 2: Correlation Between Caffeine Consumption and PHQ-9 Scores

Variable	Caffeine Consumption	PHQ-9 Score
Caffeine per day > 400mg	1	.216**
PHQ-9 Score	.216**	1

Note: Correlation is significant at the 0.01 level (2-tailed).

Caffeine Consumption and Anxiety

Similarly, the correlation between caffeine consumption and GAD-7 scores was significant ($r = .258$, $p < .001$), indicating that higher caffeine consumption was associated with higher anxiety scores.

Table 3: Correlation Between Caffeine Consumption and GAD-7 Scores

Variable	Caffeine Consumption	GAD-7 Score
Caffeine per day > 400mg	1	.258**
GAD-7 Score	.258**	1

Note: Correlation is significant at the 0.01 level (2-tailed).

Detailed Demographics and Caffeine Consumption Patterns

Further analysis of the data revealed that the majority of students consuming high levels of caffeine were in their fifth year or higher, with a GPA range of 3.0 to 3.4 being the most common (44.4%). The primary reasons for caffeine consumption were for pleasure or enjoyment (67.3%), with tea being the predominant source.

Table 4: Detailed Demographics and Caffeine Consumption Patterns

Characteristic	Total (N = 324)	No. (%)
School year		
Freshman	32	9.9
Sophomore	16	4.9
Junior	24	7.4
Senior	82	25.3
Super senior or 5th year	170	52.5
Previous diagnosis of depression or anxiety		
Never	170	52.5
Both	84	25.9
Anxiety	46	14.2
Depression	24	7.4
Source of caffeine		
Coffee	74	22.8
Tea	246	75.9
Energy drinks	58	17.9
Reason for caffeine consumption		
To stay awake in class	36	11.1
Studying/homework	70	21.6
For pleasure or enjoyment	218	67.3

The results of this study underscore a significant association between caffeine consumption and increased levels of anxiety and depression among university students. These findings highlight the potential mental health implications of high caffeine intake in this population, suggesting the need for increased awareness and preventive measures.

4 Discussion

The results of this study indicated a significant positive correlation between caffeine consumption and both depression and anxiety among university students in Lahore, Pakistan. These findings align with previous research that has demonstrated similar associations in various populations. For instance, a study in Malaysia reported high prevalence rates of stress, anxiety, and depression among students (2). Similarly, research in Iraq, China, India, Saudi Arabia, and Ethiopia has highlighted the widespread nature of mental health issues among students, with considerable rates of anxiety and depression (3, 4, 5, 6, 7, 8, 9). The consistency of these findings across different countries underscores the global relevance of addressing mental health concerns in academic environments.

The current study's finding of a significant correlation between caffeine consumption and mental health issues is supported by several studies conducted globally. For example, a cohort study reported a negative correlation between depression and caffeine intake (24). However, other studies have found either no significant association or a positive correlation between high caffeine consumption and mental health problems (25, 26, 27, 28). These discrepancies in findings may be attributed to differences in study populations, methodologies, and the measures of caffeine intake and mental health outcomes used.

The significant positive correlation between caffeine consumption and anxiety found in this study is consistent with research indicating that excessive caffeine intake can exacerbate anxiety symptoms. Caffeine is known to inhibit adenosine receptors in the central nervous system, which can lead to increased arousal and anxiety (50, 51, 52). This effect may be particularly pronounced in individuals who are genetically predisposed to anxiety or who consume high levels of caffeine regularly. The findings of this study suggest that university students who consume caffeine to cope with academic pressures may be at risk of developing or exacerbating anxiety and depression symptoms.

One of the strengths of this study was its focus on a specific population of university students in Lahore, providing valuable insights into the mental health implications of caffeine consumption in this demographic. The use of validated scales (PHQ-9 and GAD-7) to assess depression and anxiety levels added robustness to the findings. Additionally, the direct collection of data by researchers ensured the reliability of the responses.

However, the study also had several limitations. The cross-sectional design precluded the establishment of causality between caffeine consumption and mental health outcomes. The reliance on self-reported data may have introduced response biases, and the convenient sampling method may limit the generalizability of the findings to the broader student population. Furthermore, the study did not account for other potential confounding factors, such as lifestyle habits, genetic predispositions, or concurrent use of other substances, which may influence mental health.

Despite these limitations, the study provided important evidence of the association between high caffeine consumption and mental health issues among university students. These findings highlight the need for awareness programs and preventive measures to address the potential risks associated with excessive caffeine intake. University health services should consider implementing educational campaigns to inform students about the possible mental health implications of high caffeine consumption. Additionally, further research is recommended to explore the causal relationships between caffeine intake and mental health, including longitudinal studies that can track changes over time and account for potential confounding factors.

In conclusion, this study demonstrated a significant positive correlation between caffeine consumption and both depression and anxiety among university students in Lahore. These findings contribute to the growing body of evidence on the mental health implications of caffeine intake and underscore the need for targeted interventions to mitigate these risks in academic settings.

5 Conclusion

In conclusion, excessive consumption of caffeine-containing beverages is significantly associated with higher levels of depression and anxiety among university students in Lahore. These findings underscore the urgent need for increased awareness and preventive measures to address the mental health risks linked to high caffeine intake in this population. University health services should implement educational campaigns to inform students about the potential adverse effects of excessive caffeine consumption on mental health. Additionally, providing access to mental health resources and support can help mitigate these risks. By promoting informed consumption habits and offering robust mental health support, universities can play a crucial role in improving the overall well-being of their students.

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Disclaimers	
Author Contributions	Ayesha Aleem was responsible for the study design and manuscript writing. Iram Amanullah contributed to the study design and reviewing. Muhammad Abubakar Ali handled manuscript writing and statistical analysis. Muhammad Hamza Masud Ghumman was involved in data collection and statistical analysis. Iqra Tahir participated in data collection and drafting. Rida Tahir contributed to data collection and the compilation of results. Aqsa Yaqoob and Momina Tariq Qureshi assisted with data collection. Mobasher Ahmad Butt was involved in reviewing the manuscript.
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