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The Effect of Caffeine Consumption on the Level of Anxiety Disorders in Medical Students

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ABSTRACT

This study aimed to analyze the effect of caffeine consumption on anxiety levels in students. A quantitative cross-sectional design with an analytical survey approach was employed. Sampling was conducted using total sampling based on inclusion and exclusion criteria. Data were collected through a caffeine consumption frequency questionnaire and the Hamilton Anxiety Rating Scale (HARS), and analyzed using the Chi-Square test. The results showed that most respondents experienced mild anxiety. The most commonly consumed sources of caffeine were ready-to-drink coffee and green tea. Statistical analysis indicated a significant relationship between caffeine consumption and anxiety levels, both for coffee ($p = 0.008$) and tea ($p = 0.029$). These findings suggest that increased caffeine intake is associated with higher anxiety levels in students. Therefore, it is recommended that students limit their daily caffeine consumption to maintain sleep quality and emotional balance.

Keywords: caffeine, coffee, tea, anxiety level, medical students

INTRODUCTION

Coffee is one of the most widely consumed caffeinated beverages in the world and is an important global commodity [1]. Generally, the most widely cultivated and traded coffee varieties are Arabica (Coffea arabica) and Robusta (Coffea canephora) [2]. Recent studies indicate that coffee and other caffeinated beverages are highly popular among adolescents and young adults [3]. Among students, coffee and caffeine consumption is commonly used to enhance alertness and reduce sleepiness while studying [4].

Caffeine is the main component of coffee and acts as a pharmacologically active compound [5]. Chemically, caffeine is classified as a methylxanthine alkaloid, known as 1,3,7-trimethylxanthine, with the molecular formula $C_8H_{10}N_4O_2$ [6]. A chemical review reports that pure caffeine appears as odorless white crystals with a characteristic bitter taste [7]. Various studies show that most students consume caffeine daily, with coffee being the primary source [8]. As a psychostimulant, caffeine can increase alertness, reduce fatigue, and enhance short-term cognitive performance by inhibiting adenosine receptors.

Anxiety is one of the most significant mental health issues among students. It can be defined as an emotional response characterized by worry, tension, and apprehension toward perceived real or potential threats. At low to moderate levels, anxiety can be adaptive, helping individuals remain alert and adequately prepare for academic or social demands. However, when anxiety symptoms are persistent, intense, and disruptive to daily activities, they can develop into a mental disorder that impairs productivity and psychological well-being. Students are particularly vulnerable to anxiety due to numerous stressors, including academic workload, performance expectations, uncertainty about the future, and lifestyle changes. Students engaged in remote learning during the COVID-19 pandemic exhibited very high anxiety prevalence, with the combination of academic pressure and social isolation significantly impacting their anxiety levels [9].

Globally, anxiety disorders are among the most common mental health conditions. The World Health Organization (WHO) has reported a significant increase in anxiety cases, particularly among adolescents and young adults over the past decade [10]. Similar findings have been reported by [11] showing a substantial rise in anxiety symptoms among young populations, especially following the COVID-19 pandemic, which has impacted psychological, social, and academic well-being. These observations highlight that anxiety has become a critical mental health issue, particularly among university students who are in the young adult developmental phase and frequently encounter various stressors.

Among students, multiple studies have reported relatively high levels of anxiety. Students, especially those in health-related fields such as medicine, are more vulnerable to anxiety compared to their peers in other disciplines. [12] reported that the prevalence of anxiety among medical students ranges from 33% to 63%, influenced by high academic demands, intense competition, and exposure to complex learning materials. The competitive learning environment and rigorous curriculum in medical education often create psychological pressure, triggering anxiety symptoms that can range from mild to severe.

Several factors are known to contribute to an increased risk of anxiety among students and can be categorized as internal and external factors. Internal factors include age, gender, neurotic personality traits, emotion regulation abilities, and individual coping strategies. Numerous studies have shown that females tend to exhibit higher levels of anxiety compared to males, influenced by both biological and socio-psychological differences [13]. Late adolescence to young adulthood is also a vulnerable period, as individuals are transitioning toward independence, making them more susceptible to academic and social pressures that can significantly affect psychological well-being.

Meanwhile, external factors include academic pressure, workload, performance demands, economic conditions, lifestyle, and social relationships. For instance, final-year students often face thesis or capstone project requirements, which demand perseverance, time management skills, and research competence. [6] in their systematic review, found that academic stressors such as thesis preparation, inconsistent supervision, time constraints, and uncertainty of research outcomes are major contributors to anxiety among final-year students. Pressure to graduate on time and family expectations further exacerbate these conditions. Other literature also indicates that final-year students experience increased anxiety symptoms during the thesis process. At this stage, students are more susceptible to concentration difficulties, excessive worry, and disrupted sleep patterns. These conditions can impair academic performance and negatively impact the completion of their studies [14]. Anxiety symptoms in students are not only psychological but also somatic, including headaches, palpitations, gastrointestinal disturbances, and muscle tension, which can further deteriorate physical and mental health [15].

In addition to academic factors, lifestyle also plays a significant role in influencing the onset of anxiety. Unhealthy lifestyle habits, such as insufficient sleep, excessive caffeine consumption, irregular eating patterns, and low physical activity, have been shown to contribute to increased anxiety symptoms. Several studies indicate that students frequently consume caffeine, particularly from coffee and energy drinks, as a means to enhance focus and maintain study stamina. However, high caffeine intake can overstimulate the central nervous system, further increasing the risk of anxiety [16]. Another study by [17] confirmed that excessive caffeine consumption can trigger symptoms such as restlessness, tremors, increased heart rate, and sleep disturbances, all of which can exacerbate anxiety in already vulnerable individuals. Medical students are known for their long study hours, often staying up late to prepare for exams or practical sessions while consuming caffeine to stay awake. These habits can create a recurring stress-caffeine cycle, where caffeine is used to combat fatigue but subsequently induces anxiety, which further disrupts sleep quality. Social and economic pressures also influence students' anxiety levels. Uncertainty about the future, job competition, and family expectations can add psychological burdens. For medical students, these pressures are particularly intense, as the medical profession demands high competency standards and requires a longer period of study compared to other educational programs.

In the context of Indonesian medical students, anxiety has been increasingly reported, particularly with the rising academic demands associated with the development of competency-based medical education curricula. Changes in learning methods, such as problem-based learning (PBL) and objective structured clinical examinations (OSCEs), while educationally beneficial, have also been shown to increase stress and anxiety among students [18]. This highlights the need for greater attention to student mental health as part of efforts to create a healthy and productive academic environment.

Overall, the increasing prevalence of anxiety among students, particularly medical students, has become a significant issue in the field of mental health. Anxiety not only affects emotional well-being but also impacts academic performance, the quality of interpersonal relationships, and the ability to complete studies optimally. Therefore, research on student anxiety, including factors that may influence its severity, is highly relevant for deeper investigation.

The novelty of this study lies in its focus on investigating caffeine consumptiona common habit among medical students as a potential predictor of anxiety levels. While various studies have evaluated academic stressors and curriculum load as triggers for anxiety, research specifically assessing the contribution of caffeine consumption to anxiety disorders in the medical student population remains limited. This approach provides a new perspective by linking stimulant consumption patterns with mental health within the context of medical education.

Based on this urgency, the present study aims to analyze the effect of caffeine consumption on anxiety levels in medical students, so that the findings can provide a scientific basis for designing intervention strategies, behavioral education on consumption, and mental health support programs within higher education settings.

RESEARCH METHODS

This study is quantitative research with a cross-sectional design and an analytical survey approach,

aimed at analyzing the effect of caffeine consumption on anxiety levels among the 2022 cohort of medical students at Universitas Prima Indonesia. The study population consisted of all 153 medical students from the 2022 cohort, all of whom were included as participants using a total sampling technique. Inclusion criteria were: active 2022 cohort medical students aged 20–25 years, willing to participate as respondents, consuming caffeinated beverages at least 2–3 times per week, and completing the questionnaire in full. Exclusion criteria included students with a clinical history of anxiety disorders, psychiatric disorders, or sleep disorders; those with medical conditions affecting the nervous system (e.g., epilepsy or certain heart conditions); individuals routinely taking anxiolytic or psychotropic medications; those who did not consume coffee; and incomplete questionnaire responses. The study was conducted at the Faculty of Medicine, Universitas Prima Indonesia, Medan, from March to June 2025.

The independent variable in this study was caffeine consumption, defined as the frequency and number of caffeinated beverages, particularly coffee and tea, consumed by students in their daily lives. Data were collected using a caffeine consumption frequency questionnaire assessing beverage type (e.g., ready-to-drink coffee, brewed coffee, green tea, black tea, herbal tea) and consumption frequency. The dependent variable was anxiety level, measured using the Hamilton Anxiety Rating Scale (HARS). HARS consists of several items assessing psychological and somatic symptoms of anxiety, rated on a 0–4 scale (0 = none, 1 = mild, 2 = moderate, 3 = severe, 4 = very severe). Total scores were then categorized into anxiety levels (mild, moderate, severe, and very severe) according to scale guidelines. In addition, respondents' sociodemographic data, such as age and gender, were collected to describe the sample characteristics.

Data collection was carried out by distributing questionnaires to all respondents who met the inclusion criteria. Participants were first provided with an explanation of the study objectives and procedures, then asked to provide consent and complete the questionnaire independently. The questionnaire consisted of three sections: sociodemographic data, caffeine consumption frequency questionnaire, and the HARS scale. Upon completion, researchers checked the completeness of the responses, and incomplete questionnaires were excluded according to the exclusion criteria.

The collected data were then coded and analyzed using the Statistical Package for the Social Sciences (SPSS). Univariate analysis was conducted to describe respondent characteristics, caffeine consumption distribution, and anxiety level distribution in the form of frequency tables and percentages. Bivariate analysis was performed to assess the relationship between caffeine consumption and anxiety level using the Chi-Square test (χ^2), with a significance level of $p < 0.05$. The results of this analysis were used to determine whether there was a significant association between the level of caffeine consumption and anxiety levels among medical students.

RESULT AND DISCUSSION

As an initial step in analyzing the relationship between caffeine consumption and anxiety levels, this study first mapped the basic characteristics of the respondents to provide context for interpreting the results. The study involved 153 students from the 2022 cohort of the Faculty of Medicine, Universitas Prima Indonesia. Respondent characteristics showed that the majority were aged 20–22 years (69.3%), while those aged 23–25 years accounted for 30.7%. In terms of gender, most respondents were female (63.4%), with males representing 36.6%. This distribution indicates that the sample was dominated by early adult female students, a group generally experiencing high academic pressure and increased vulnerability to anxiety-related issues. Correspondingly, coffee consumption tended to be more dominant among 21-year-old students or those in the final semesters. This phenomenon is attributed to the trend of coffee consumption among senior students, intended to boost energy, enhance concentration, and reduce sleepiness during exams and completion of final projects [19]. The basic characteristics of the respondents are presented in Table 1.

Table 1. Respondent Characteristics Based on Sociodemographic Factors (n = 153)

Respondent Characteristics	Frequency	Percentage (%)
Age		
20–22 years	106	69.3
23–25 years	47	30.7
Gender		
Male	56	36.6
Female	97	63.4

Anxiety levels measured using the Hamilton Anxiety Rating Scale (HARS) indicated that the majority of respondents experienced mild anxiety, accounting for 55.6% of the total sample. Moderate anxiety was reported by 32.7% of respondents, while severe and very severe anxiety were experienced by 10.5% and 1.3% of respondents, respectively. This distribution shows that although most students were not classified as having severe anxiety, the proportion experiencing moderate to severe anxiety remains substantial and may affect academic functioning, concentration, and psychological well-being. It should be noted, however, that uncontrolled caffeine consumption can be associated with various psychological disturbances, including anxiety, sleep difficulties, and even depressive symptoms, particularly in adult male individuals [20]. A summary of the anxiety level distribution is presented in Table 2.

Table 2. Distribution of Anxiety Levels Among Students (n = 153)

Anxiety Level	Frequency (f)	Percentage (%)
Mild	85	55.6
Moderate	50	32.7
Severe	16	10.5
Very Severe	2	1.3
Total	153	100.0

Caffeine consumption patterns show that almost all respondents consume caffeinated beverages in their daily lives. Among coffee types, the intake of ready-to-drink coffee was slightly higher (50.3%) compared to freshly brewed coffee (49.7%). Meanwhile, within the tea category, the most frequently consumed type was green tea (51.6%), followed by black tea (25.5%) and herbal tea (22.9%). These findings illustrate that caffeine, whether sourced from coffee or tea, has become an integral part of student lifestyle. It is most likely used to enhance alertness, reduce sleepiness, and help maintain focus, especially during periods of high academic demands. Coffee not only alleviates stress but also reduces drowsiness and provides an energy boost [21], [22]. However, caffeine consumption has varying effects depending on the dose consumed. At low to moderate doses, caffeine acts as a psychostimulant, including enhancing psychomotor performance, increasing alertness, reducing sleepiness, and boosting energy. At higher doses, caffeine can have effects opposite to those observed at low doses [23]. The distribution of caffeine consumption is presented in Table 3.

Table 3. Distribution of Caffeine Consumption Frequency (Coffee and Tea) (n = 153)

Category	Type	Frequency (f)	Percentage (%)	Total
Caffeine Consumption	Coffee			153
	Ready-to-drink	77	50.3	
	Freshly brewed	76	49.7	
	Tea			153
	Green tea	79	51.6	
	Herbal tea	35	22.9	
	Black tea	39	25.5	

Based on the results of this study, it was found that the majority of 2022 cohort students at the Faculty of Medicine, Universitas Prima Indonesia, experienced anxiety at a mild level (55.6%), while severe and very severe anxiety were reported by only a small proportion of respondents. This condition indicates that, in general, students are still able to manage the academic pressures they face. However, the relatively high proportion of students experiencing moderate anxiety suggests that some students still face psychological burdens in carrying out their academic activities. These findings are consistent with research by [24], which reported that 51.4% of medical students experienced mild to moderate anxiety due to academic pressures and irregular sleep patterns. Thus, the phenomenon of anxiety among medical students can be linked to the demanding and intensive nature of medical education.

This study also found that the majority of students consume caffeine, both in the form of coffee and tea, with ready-to-drink coffee (50.3%) being slightly more popular than freshly brewed coffee (49.7%). In addition, green tea was the most frequently consumed type of tea (51.6%), while herbal tea was the least consumed (22.9%). These findings indicate that caffeine consumption has become a common habit among students, particularly as a means to maintain alertness during study activities. Research by [25] also reported that students with a high academic workload tend to consume caffeinated beverages to enhance focus and reduce sleepiness. Therefore, caffeine consumption among students can be understood as an adaptation to academic pressure and demanding study activities.

From a physiological perspective, excessive caffeine intake can stimulate the central nervous system and increase adrenaline secretion, which may trigger anxiety symptoms. The findings of this study indicate a tendency for respondents who consume caffeine more frequently, particularly from ready-to-drink coffee, to exhibit higher levels of anxiety compared to those who consume it less often. This is consistent with the study by [17], which found that high caffeine consumption (>400 mg/day) significantly increases the risk of anxiety, with a standardized mean difference (SMD = 0.94; $p < 0.05$). Therefore, although caffeine can enhance alertness, uncontrolled consumption may negatively impact students' psychological balance.

In addition, students' caffeine consumption patterns are often associated with late-night study sessions and demanding academic activities, which can potentially disrupt sleep patterns. Such sleep disturbances may contribute to increased levels of anxiety. [26] reported that students who frequently consume caffeine at night experience poorer sleep quality and higher anxiety levels compared to those who limit caffeine intake to daytime. A similar situation likely occurred among respondents in this study, where some students used caffeine as a means to stay awake, but this behavior produced physiological effects that could exacerbate their anxiety. Therefore, it is important for students to manage both the timing and amount of caffeine consumption to avoid disrupting emotional balance.

Overall, the univariate results of this study indicate that caffeine consumption among medical

students is relatively high and is associated with varying levels of anxiety. Students consume coffee and tea not only due to preference but also as a strategy to cope with academic demands. These findings are consistent with the study by [27], which reported increased caffeine consumption among students before exams or during periods of heavy academic workload. Therefore, it is important to provide education on safe caffeine intake limits, as this habit, although common, can negatively affect mental health if not properly managed.

Bivariate analysis showed a significant relationship between caffeine consumption and anxiety levels. For coffee consumption, the Chi-Square test yielded p-values of 0.008 for the 20–22 age group and 0.029 for the 23–25 age group ($p < 0.05$), indicating a significant association between the type and pattern of coffee consumption and students' anxiety levels. Overall, respondents with higher coffee intake, particularly ready-to-drink coffee, tended to exhibit higher levels of anxiety compared to those with lower consumption. Details of the relationship between anxiety levels and coffee consumption by age group are presented in Table 4.

Table 4. Relationship between Anxiety Levels and Caffeine Consumption (Coffee) by Age Group (n = 153)

Age (years)	Anxiety level	Caffeine				Total		*P-Value*
		Coffee						
		Ready-to-drink		Freshly brewed				
		F	*%*	*f*	*%*	*F*	*%*	
20–22	Mild	47	44.3	20	18.9	67	63.2	0.008
	Moderate	8	7.5	16	15.1	24	22.6	
	Severe	7	6.6	6	5.7	13	12.3	
	Very Severe	1	0.9	1	0.9	2	1.9	
23–25	Mild	8	17.0	10	21.3	18	38.3	0.029
	Moderate	4	8.5	22	46.8	26	55.3	
	Severe	2	4.3	1	2.1	3	6.4	
	Very Severe	0	0.0	0	0.0	0	0.0	
Total		77	50.3	76	49.7	153	100.0	

This demonstrates that coffee consumption, whether ready-to-drink or freshly brewed, is significantly associated with anxiety levels among students, particularly in the mild to moderate anxiety categories. These findings are consistent across both age groups, reinforcing the notion that caffeine is a contributing factor to students' anxiety

Several factors may explain this pattern, including the physiological effects of caffeine as a stimulant, which works by blocking adenosine receptors, thereby increasing sympathetic nervous system activity and triggering symptoms such as palpitations, restlessness, and difficulty sleeping. All of these symptoms are related to anxiety. Additionally, students' habits of consuming coffee during late-night study sessions or prior to exams may further disrupt sleep patterns and increase psychological burden, strengthening the relationship between caffeine intake and anxiety. Age and individual tolerance to caffeine may also contribute to variations in anxiety levels. Excessive coffee consumption can lead to dependence with symptoms of caffeine intoxication and may cause various disturbances such as insomnia, anxiety, and digestive problems [28]. Moreover, high caffeine intake can negatively impact sleep quality [29]. The level of coffee consumption can influence concentration ability, as frequent caffeine intake has the potential to induce anxiety and overstimulation, ultimately affecting focus [30].

Regarding tea consumption, the Chi-Square test also revealed significant results, with p-values of 0.007 for the 20–22-year-old group and 0.032 for the 23–25-year-old group ($p < 0.05$). This indicates that tea consumption, whether green, herbal, or black, is associated with variations in anxiety levels. Specifically, in the older age group (23–25 years), higher herbal tea consumption appears to be linked with a higher proportion of moderate anxiety. The relationship between anxiety levels and tea consumption by age group is presented in Table 5.

Table 5. Relationship Between Anxiety Levels and Caffeine Consumption (Tea) by Age Group (n = 153)

Age (years)	Anxiety level	Caffeine						Total		*P-Value*
		Coffee								
		Green tea		Herbal tea		Black tea				
		f	*%*	*f*	*%*	*F*	*%*	*f*	*%*	
20–22	Mild	48	45.3	10	9.4	9	8.5	67	63.2	0.007
	Moderate	9	8.5	4	3.8	11	10.4	24	22.6	
	Severe	6	5.7	1	0.9	6	5.7	13	12.3	
	Very Severe	1	0.9	0	0.0	1	0.9	2	1.9	
23–25	Mild	9	19.1	3	6.4	6	12.8	18	38.3	0.032
	Moderate	5	10.6	15	31.9	6	12.8	26	55.3	
	Severe	1	2.1	2	4.3	0	0.0	3	6.4	
	Very Severe	0	0.0	0	0.0	0	0.0	0	0.0	
Total		79	51.6	35	22.9	39	25.5	153	100.0	

The bivariate analysis using the Chi-Square test showed a significant relationship between caffeine consumption and the level of anxiety among students (p = 0.008 for coffee and p = 0.029 for tea). These findings indicate that the higher the caffeine intake, particularly from ready-to-drink coffee and herbal tea, the higher the level of anxiety experienced by the students. This can be explained by the physiological effects of caffeine, which increase central nervous system activity through adenosine receptor antagonism, potentially causing symptoms such as restlessness, palpitations, and difficulty sleeping. Consistent with this, [31] stated that caffeine not only affects how quickly a person can fall asleep but also impacts sleep quality, leading to restlessness that makes falling asleep difficult or excessively deep sleep that is hard to wake from. [32] also reported a positive relationship between caffeine consumption and levels of anxiety and stress among medical students in Korea. Thus, the results of this study support previous findings that excessive caffeine intake can be a risk factor for increased anxiety among students.

Among students aged 20–22 years, the findings showed that most experienced mild anxiety, with a dominant pattern of consuming freshly brewed coffee. Conversely, among those aged 23–25 years, moderate anxiety was more frequently observed in individuals who consumed ready-to-drink coffee. These findings suggest that the type and pattern of caffeine consumption can influence the intensity of anxiety. [33] noted that instant or ready-to-drink coffee usually contains added sugar and higher caffeine content, which can amplify stress responses and anxiety. This may explain why older respondents, who may have more frequent consumption patterns and prefer ready-to-drink products, exhibited higher levels of anxiety.

In addition to coffee, a significant relationship was also found between tea consumption and anxiety, particularly with herbal and black tea (p = 0.032). According to [34], herbal teas containing moderate to high levels of caffeine can produce stimulant effects similar to coffee, especially when consumed in large quantities. Although green tea is often associated with calming effects due to its L-theanine content, excessive intake can still increase nervous system stimulation. This is consistent with the findings of this study, which showed that among the older age group (23–25 years), higher consumption of herbal tea was accompanied by an increase in moderate to severe anxiety. Thus, the type of caffeinated beverage consumed also plays a role in the psychological effects experienced.

These findings support the theory that caffeine has a dual effect on the central nervous system: at low doses, it can enhance concentration and alertness, but at high doses, caffeine can cause anxiety, tremors, and sleep disturbances. [35] found that individuals consuming more than 400 mg of caffeine per day had a 1.5 times higher risk of experiencing anxiety disorders compared to those consuming below this threshold. In the context of medical students, who generally have long study hours and high stress levels, high caffeine intake can exacerbate existing anxiety symptoms. Therefore, although caffeine may help improve study focus, its use needs to be monitored and adjusted according to the individual's psychological condition.

Based on the overall findings, it can be concluded that there is a significant relationship between caffeine consumption and anxiety levels among medical students. This result aligns with [27], which reported that students who drank coffee more than twice a day had higher anxiety scores compared to those who rarely consumed caffeine. Therefore, this study confirms that caffeine consumption is an important factor to consider in the context of student mental health. Education on safe caffeine intake limits and the importance of maintaining healthy sleep patterns can serve as preventive measures to reduce the risk of anxiety among medical students.

CONCLUSION

This study indicates that the majority of 2022 medical students at Universitas Prima Indonesia experience mild levels of anxiety, with their primary sources of caffeine coming from ready-to-drink coffee and green tea. A significant relationship was found between caffeine consumption and anxiety levels, both for coffee (p = 0.008) and tea (p = 0.029). This suggests that higher caffeine intake, particularly from ready-to-drink coffee and herbal tea, is associated with increased anxiety among students. Therefore, caffeine consumption can be considered a contributing factor to anxiety disorders in medical students. These findings highlight the importance of educating students on safe caffeine intake limits, managing consumption timing to prevent sleep disturbances, and integrating mental health promotion within the academic environment. Further research using longitudinal or intervention-based designs is needed to strengthen causal evidence and evaluate the impact of reducing caffeine consumption on lowering anxiety levels among the student population.

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