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ASSOCIATION BETWEEN CAFFEINE, PSYCHOACTIVE SUBSTANCES, AND ACADEMIC PERFORMANCE IN MEDICAL STUDENTS: AN ANALYTICAL CROSS-SECTIONAL STUDY

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Abstract: Coffee is widely consumed in Brazil and around the world, being a beverage of cultural, social, and economic importance. Its stimulating effect is attributed to caffeine, which blocks adenosine receptors and increases the release of neurotransmitters, promoting heightened alertness. Among medical students, coffee consumption is common due to the heavy study load and the need to maintain attention. This cross-sectional, quantitative, and analytical study investigated the relationship between coffee consumption and the use of psychoactive substances, as well as its impact on the academic performance of medical students. The study included 100 students from a medical school in southern Minas Gerais, with 25 students selected from each academic period (2nd to 5th), based on a similar curriculum that includes the courses SOI (Integrated Organic Systems), IESC (Teaching-Service-Community Integration), and HAM (Medical Skills and Attitudes). Data collection was conducted through in-person questionnaires after participants signed the Informed Consent Form (ICF). Data analysis was performed using the PRISMA platform, with descriptive statistics and inferential tests, adopting a significance level of $p < 0.05$. The results showed that 70% of participants consumed coffee regularly. Among students who did not consume coffee, no significant differences in academic performance were observed, regardless of the use of psychoactive substances. However, among students who drank coffee, those who used psychoactive substances had significantly lower semester averages compared to those who did not use such substances ($p < 0.05$). These findings suggest that caffeine consumption, regardless of the amount, does not directly affect academic performance, but

when combined with the use of psychoactive substances, it has a significant negative impact on students' performance. The results highlight the need for attention to the concomitant use of psychoactive substances among university students and suggest that future investigations into the combined effects of coffee, psychoactive substances, and academic performance are essential.

Keywords: Caffeine; Academic Performance; Medical Students; Medical School; Learning; Psychotropic Substances.

INTRODUCTION

Coffee is currently consumed throughout Brazil and around the world, holding high commercial as well as cultural value (MOREIRA et al., 2018). The earliest reports of its use point to the nomadic tribes of Ethiopia, who consumed the sweet pulp of the fruit or mixed it with fat in their meals. The modern reinterpretation of coffee as a domestic or social tradition originates from Turkey, which was responsible for transforming the "coffee habit" into a ritual of sociability (MEHARI; REDI-ABSHIRO; CHANDRAVANSHI, 2016).

The energizing characteristic of coffee is due to the presence of caffeine (a compound belonging to the trimethylxanthine group) in its composition (LIMA; FARAH, 2019). This molecule is a psychotropic drug that stimulates the central nervous system, increasing alertness and reducing the sensation of fatigue. In addition, it exerts effects on inotropism, increases heart rate, promotes bronchiolar dilation, and stimulates gastric secretion (FARAH, 2017). However, at high doses, caffeine can cause insomnia, anxiety, and excitability (LIMA; FARAH, 2019), and its regular consumption may lead to the development of tolerance (AEPLI et al., 2015).

From a molecular perspective, the stimulant effect of caffeine arises from its structural similarity to the endogenous neuromodulator adenosine, whose function is to reduce neuronal excitability by inhibiting the release of excitatory neurotransmitters, inducing sleepiness, and promoting relaxation through cerebral vasodilation (MONTEIRO et al., 2016). Due to this similarity, caffeine competes for the same receptors, binding to them and blocking the inhibitory action of adenosine, which results in increased neurotransmitter release and heightened alertness (BOUTREL; KOOB, 2004).

It is worth noting that caffeine does not accumulate in the body, as it is generally metabolized and excreted within a few hours after ingestion. For this reason, daily consumption becomes necessary for its effects to be perceived. Scientific evidence suggests that regular caffeine intake may contribute to learning, productivity, and concentration in tasks requiring cognitive effort (MCLELLAN; CALDWELL; LIEBERMAN, 2016). Furthermore, studies emphasize that moderate consumption, equivalent to approximately two to three 225 mL cups per day, corresponds to a prudent daily dose of 200 to 300 mg, which is considered ideal (HIGDON; FREI, 2006).

Moreover, it is noteworthy that medical students face a heavy academic workload, stemming both from curricular requirements and extracurricular activities. This scenario can lead to intense fatigue due to the long hours dedicated to studying, as well as strong self-imposed pressure to meet their own expectations and those of family

and society. Consequently, medical students represent a group with higher stress levels compared to the general population. To cope with this pressure, many resort to the consumption of caffeinated beverages, such as coffee and energy drinks, in an effort to increase alertness and productivity in their study routines (OLIVEIRA; CARVALHO; FIGUEREDO, 2015).

Another relevant aspect concerns the relationship between psychoactive substance use and academic performance, a multifaceted issue that has been extensively documented in recent medical literature. These substances include medications used to treat ADHD (Attention Deficit Hyperactivity Disorder) and other attention disorders, anxiolytics, antidepressants, taurine-based energy drinks, as well as illicit drugs such as cocaine, crack, marijuana, and ecstasy (BULFONE et al., 2025). The use of these substances, whether legal or illegal, among adolescents and young adults has been associated with significant impairments in academic performance, including lower grade point averages, increased risk of dropout, reduced likelihood of completing secondary or higher education, and higher rates of absenteeism (CHAN et al., 2024).

In summary, significant gaps still exist in the scientific literature regarding the relationship between caffeine consumption, psychoactive substance use, and the academic performance of students. Considering that university students, in particular, exhibit high rates of caffeine intake and frequent use of psychoactive substances, factors that can directly impact their academic performance, it is essential to develop research specifically addressing this topic.

OBJECTIVES

To investigate the relationship between caffeine consumption, both in terms of quantity and frequency, and the use of psychoactive substances, aiming to identify possible influences on the academic performance of medical students.

METHODS

Type and Study Design

The present study was an analytical, cross-sectional, and quantitative observational study. The STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) tool was used, a checklist designed to guide the proper reporting of observational, longitudinal, or cross-sectional studies (VON ELM et al., 2007).

Setting, Population, and Sampling

The study was conducted at a medical school in southern Minas Gerais with 100 students enrolled in 2024. The sample was randomly selected, including 25 students from each academic year from the 2nd to the 5th, who have a similar disciplinary division: SOI (Integrated Organic Systems), IESC (Teaching-Service-Community Integration), and HAM (Medical Skills and Attitudes).

Inclusion criteria were students from the 2nd, 3rd, 4th, and 5th years, regularly enrolled in the medical program during the 2024 academic year, who voluntarily agreed to participate. Exclusion criteria were students under 18 years of age, students not enrolled in the 2nd to 5th years, and parti-

cipants who refused to participate. This design allowed for an equitable analysis of the association between caffeine consumption, psychoactive substance use, and academic performance across the different stages of the program.

Ethical Considerations

Participation in the study was voluntary, with informed consent (ICF) obtained from all participants, ensuring confidentiality. The study was approved by the Research Ethics Committee of the institution, following national and international ethical guidelines. All data were securely stored and used solely for research purposes.

Data Collection Instrument

Data were collected through an in-person questionnaire, including closed-ended questions on coffee consumption (quantity and frequency) and open-ended questions on grades in IESC, SOI, and HAM, as well as information on age, sex, and psychoactive substance use. Participation was voluntary, with informed consent (ICF) obtained, ensuring confidentiality. Data were securely stored and used solely for research purposes, in accordance with ethical and legal standards.

Study Variables of Interest

Regarding caffeine consumption, the variable of interest included the average daily amount consumed, calculated using data collected through the questionnaire, in which students could report their daily intake in milliliters (American cups) and the frequency (number of times caffeine is consumed per week). As for the outcome variable, academic performance was compared, assessed by the average grades obtained in courses throughout the academic year, between groups of caffeine consumers and non-consumers, also taking into account the use of other psychoactive substances.

Statistical Analysis

The collected data were organized and analyzed using the PRISMA platform, a statistical analysis software commonly used in research.. Initially, descriptive statistics were performed for the variables of interest. Subsequently, inferential tests were applied to examine associations between caffeine consumption, psychoactive substance use, and academic performance, considering a significance level of $p < 0.05$.

To ensure greater consistency in the results, the analysis focused on the categories of coffee consumption with the highest representation in the sample, including only students who consumed 0, 7, 14, 21, or 28 cups per week. Data from sporadic or infrequent intake, such as 1, 2, or 3 cups per week, were excluded due to their very small sample size and potential to bias the results. Additionally, extreme values (outliers) that disproportionately affected the data distribution were identified and removed from the final analysis.

RESULTS

Of the 100 students included in the study, 30% reported not consuming coffee, while 70% consumed at least one cup per week. As illustrated in Figure 1, the distribution of weekly coffee intake was as follows: 9% for 7 cups, 8% for 14 cups, 10% for 21 cups, and 8% for 28 cups, in-

dicating that most participants had moderate coffee consumption. It is worth noting that, as detailed in the methodology, some less frequent intake categories were excluded from the analysis due to the small number of participants, in order to ensure that the presented data more accurately reflected the predominant consumption patterns in the sample without distortion.

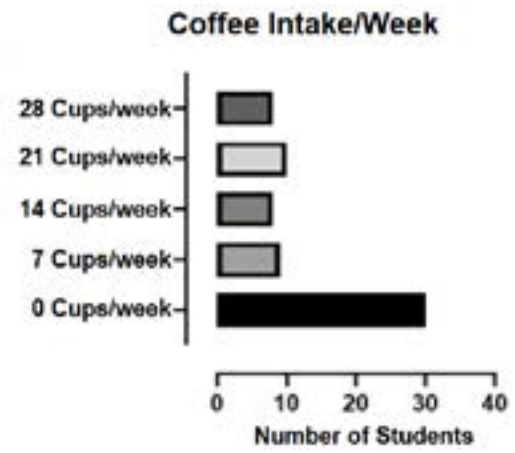

Figure 1 – Horizontal bar chart representing the weekly coffee intake among students, indicating the number of cups consumed per week and the corresponding number of students in each consumption category. Figure created by the researchers.

The analysis of academic performance in relation to psychoactive substance use among coffee-consuming students revealed a statistically significant difference ($p < 0.05$), showing that those who do not use psychoactive substances have higher semester grade averages than users of psychoactive substances (Figure 2).

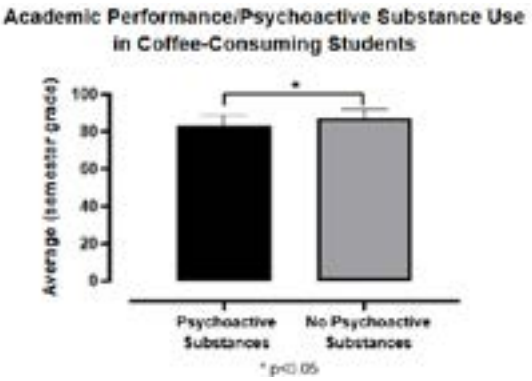

Figure 2 – Bar chart comparing the academic performance (semester average) of coffee-consuming students, distinguishing between those who use psychoactive substances and those who do not. Figure created by the researchers.

Nevertheless, the results indicated that among students who do not consume coffee, the use of psychoactive substances was not associated with statistically significant differences in grade averages. In contrast, as previously mentioned, among students who consume coffee, a significant difference in grades was observed between users and non-users of psychoactive substances, suggesting that the effect of coffee consumption on academic performance may depend on the concomitant use of these substances (Figure 3).

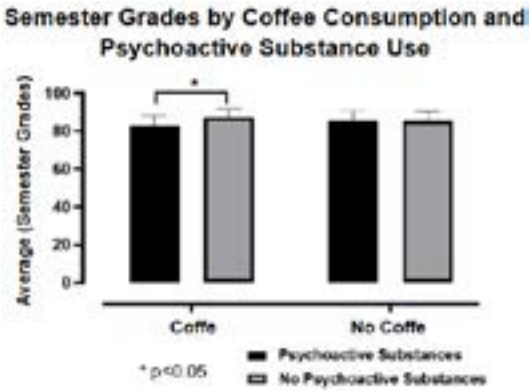

Figure 3 – Bar chart comparing academic performance (average semester grades) according to coffee consumption and psychoactive substance use. Figure created by the researchers.

Still, it is important to highlight that the levels of coffee consumption did not show statistically significant differences in relation to the students' grade averages. Regardless of whether the consumption was low, moderate, or high, no significant variation in academic performance was observed, indicating that the amount of coffee consumed did not have a relevant impact on the participants' grades.

DISCUSSION

The results obtained show that the majority of participating university students (70%) consume coffee regularly, while 30% reported not drinking the beverage. This consumption pattern is consistent with previous findings in academic populations, which report prevalences between 60% and 80%, often associated with the use of caffeine as a stimulating resource to cope with long study hours (SMITH, 2019; MARTINS et al., 2021).

The analysis of the consumed quantity revealed that most participants ingest moderate amounts of coffee, corresponding to up to 28 cups per week (approximately 3 to 4 cups per day). According to the European Food Safety Authority (2015), moderate caffeine consumption is associated with beneficial effects, such as temporary improvements in attention, short-term memory, and performance in simple cognitive tasks. Similarly, Ribeiro and Pereira (2020) identified positive impacts of moderate coffee use in activities requiring focus and concentration. However, the authors emphasize that excessive caffeine consumption (> 400 mg/day) may lead to adverse effects, such as insomnia, irritability, and increased heart rate, factors that can negatively affect academic performance (HIGDON; FREI, 2006).

In the present study, when correlating coffee consumption, the use of psychoactive substances, and academic performance, a statistically significant difference was identified: students who did not use psychoactive substances had higher semester grade averages compared to those who used these substances. This result is in line with previous studies that show that the consumption of psychoactive substances, such as alcohol, cannabis, and non-prescribed stimulants, can impair cognitive functions, reduce motivation, and compromise sleep quality – factors intrinsically linked to academic performance (ARRIA et al., 2013; SOUZA et al., 2018).

Although coffee is a widely consumed stimulant, the results of the present study did not identify a direct relationship between the amount consumed and a reduction in academic performance, nor did they show that higher doses of consumption were associated with improved performance.

Therefore, it is suggested that the most determining variable for the decline in academic performance may be the concomitant use of psychoactive substances, rather than moderate caffeine consumption. It is important to highlight, however, that the cross-sectional design used limits the ability to establish causal relationships. Therefore, longitudinal studies are recommended, as they would allow for the monitoring of effects over time, as well as the expansion of the sample size, in order to obtain a more robust and representative database.

CONCLUSION

The present study showed that the majority of the university students assessed consume coffee regularly in quantities considered moderate, a pattern consistent with previous findings in academic populations. The results indicate that coffee consumption, within safe limits, is not directly associated with a reduction in academic performance. In contrast, among the coffee consumers, a statistically significant difference was observed between the academic performance averages of students who use psychoactive substances and those who do not, with superior performance found in the abstinent group. These findings suggest that the use of psychoactive substances may represent a more critical factor for academic performance than the isolated consumption of caffeine.

In summary, the results suggest that the negative impact on academic performance is more strongly associated with the use of psychoactive substances than with the isolated and moderate consumption of caffeine. Future investigations, preferably with a longitudinal design, are recommended to further analyze the interaction between caffeine use, other psychoactive substances, and academic performance, considering mediating variables such as sleep patterns, study workload, and mental health-related aspects.

REFERENCES

AEPLI A, KURTH S, TESLER N, JENNI OG, HUBER R. **Caffeine consuming children and adolescents show altered sleep behavior and deep sleep**. Brain Sciences. 2015; 5:441-55.

ARRIA AM, et al. **Drug use patterns and continuous enrollment in college: Results from a longitudinal study**. Journal of Studies on Alcohol and Drugs. 2013; 74(1):71-83.

BOUTREL B, KOOB GF. **What keeps us awake: the neuropharmacology of stimulants and wakefulness-promoting medications**. Sleep. 2004; 27(6):1181-94.

BULFONE G, INGRAVALLE F, SCERBO F, et al. **Substance use and academic performance among university students: systematic review and meta-analysis**. BMC Medical Education. 2025; 25(1):959. Available at: https://doi.org/10.1186/s12909-025-07530-y

CHAN O, DAUDI A, JI D, et al. **Cannabis use during adolescence and young adulthood and academic achievement: a systematic review and meta-analysis**. JAMA Pediatrics. 2024; 178(12):1280-9. Available at:: https://doi.org/10.1001/jamapediatrics.2024.3674

EUROPEAN FOOD SAFETY AUTHORITY (EFSA). **Scientific opinion on the safety of caffeine**. EFSA Journal. 2015; 13(5):4102.

FARAH A. **Nutritional and health effects of coffee**. In: LASHERMES P, editor. *Achieving sustainable cultivation of coffee*. Cambridge: Burleigh Dodds Science Publishing; 2017. p. 1-31.

HIGDON JV, FREI B. **Coffee and health: a review of recent human research**. Critical Reviews in Food Science and Nutrition. 2006; 46(2):101-23.

LIMA JP, FARAH A. **Caffeine and minor methylxanthines in coffee**. In: FARAH A, editor. *Coffee: consumption and health implications*. London: Royal Society of Chemistry; 2019. ISBN: 978-1782620044.

MARTINS CA, LIMA RM, SANTOS JL. **Consumo de cafeína entre universitários brasileiros: perfil e fatores associados**. Revista Brasileira de Nutrição Esportiva. 2021; 15(93):504-13.

MCLELLAN TM, CALDWELL JA, LIEBERMAN HR. **A review of caffeine's effects on cognitive, physical and occupational performance**. Neuroscience & Biobehavioral Reviews. 2016; 71:294-312.

MEHARI B, REDI-ABSHIRO M, CHANDRAVANSHI BS. **Simultaneous determination of alkaloids in green coffee beans from Ethiopia: chemometric evaluation of geographical origin**. Food Analytical Methods. 2016; 9:1627-37.

MONTEIRO JP, ALVES GM, OLIVEIRA PF, SILVA BM. **Structure-bioactivity relationships of methylxanthines: trying to make sense of all the promises and the drawbacks**. Molecules. 2016; 21:974.

MOREIRA PC, MOREIRA GC, CASTRO NR, SILVA RP. **Produtividade e economia de fatores de produção na cafeicultura brasileira**. Revista EMBRAPA. 2018. Available at: https://seer.sede.embrapa.br/index.php/RPA/article/download/1368/1162. Accessed on: Aug 14, 2025.

OLIVEIRA JCB, CARVALHO LC, FIGUEREDO PMV. **O estresse dos estudantes universitários de enfermagem de uma instituição privada do Rio de Janeiro**. Revista Presença. 2015; 1(2):39-55.

RIBEIRO RS, PEREIRA JM. **Efeitos do consumo de cafeína no desempenho cognitivo: revisão integrativa**. Revista Psicologia & Saúde. 2020; 12(2):45-56.

SMITH A. **The effects of caffeine on human behavior**. Food and Chemical Toxicology. 2019; 123:1-12.

SOUZA LM, et al. **Uso de substâncias psicoativas e desempenho acadêmico: revisão sistemática**. Revista de Saúde Pública. 2018; 52:85.

VON ELM E, ALTMAN DG, EGGER M, POCOCK SJ, GØTZSCHE PC, VANDENBROUCKE JP; STROBE Initiative. **Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies**. BMJ. 2007; 335(7624):806-8.