

Substance use to enhance study performance among college preparatory course students: a cross-sectional study

Uso de substâncias para melhorar o desempenho acadêmico entre estudantes de curso preparatório: estudo transversal

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ABSTRACT

Introduction: Admission to medical school is highly competitive, particularly among college preparatory course students, who often face intense academic pressure. To cope with these challenges, some students turn to substances such as psychostimulants and medications to enhance study performance.

Objective: This study aimed to identify the prevalence and factors associated with substance use to enhance study performance among college preparatory course students preparing for medical school entrance exams.

Methods: A cross-sectional, descriptive study was conducted with students enrolled in a private college preparatory course in the Northeast region of Minas Gerais, Brazil. Participants completed a self-administered, anonymous questionnaire covering sociodemographic data and substance use for study enhancement. Data were analyzed using descriptive and inferential statistics, including the Mann-Whitney and chi-square tests.

Results: Among participants, 28.4% reported using substances to enhance study performance. The most used substances were methylphenidate (40%), lisdexamfetamine (28%), caffeine (16%), guarana powder (8%), multivitamins (4%), and sertraline (4%). Older students, scholarship recipients from private schools, and those who had attempted medical school entrance exams more than three times were more likely to use these substances. Most participants used medications without a medical prescription.

Conclusion: These findings indicate the necessity for targeted interventions to mitigate the risks associated with unsupervised substance use, particularly medication, among college preparatory course students.

Keywords: Substance use; Psychostimulants; Psychotropic Drugs; Medical Students; Mental Health.

RESUMO

Introdução: A admissão à faculdade de medicina é altamente competitiva, particularmente entre estudantes de cursos preparatórios (cursinhos), que frequentemente enfrentam intensa pressão acadêmica. Para lidar com esses desafios, alguns estudantes recorrerem ao uso de substâncias como psicoestimulantes e medicamentos para melhorar o desempenho nos estudos.

Objetivo: Identificar a prevalência e os fatores associados ao uso de substâncias para melhorar o desempenho nos estudos entre estudantes de um curso preparatório para o vestibular de medicina.

Métodos: Trata-se de um estudo transversal e descritivo com estudantes matriculados em um curso preparatório privado localizado na região Nordeste de Minas Gerais, Brasil. Os participantes responderam a um questionário autoaplicável e anônimo, abrangendo dados sociodemográficos e uso de substâncias com a finalidade de melhorar o desempenho nos estudos. Os dados foram analisados utilizando estatística descritiva e inferencial, incluindo os testes Mann-Whitney e qui-quadrado.

Resultados: Entre os participantes, 28,4% relataram usar ou ter usado substâncias para melhorar o desempenho nos estudos. As substâncias mais utilizadas foram metilfenidato (40%), lisdexanfetamina (28%), cafeína (16%), guaraná em pó (8%), multivitaminas (4%) e sertralina (4%). O uso de substâncias para estudar melhor foi associado aos estudantes mais velhos, bolsistas de escolas particulares e aqueles que já haviam tentado o vestibular de medicina mais de três vezes. Entre os participantes que usaram medicamentos, a maioria não possuía prescrição médica.

Conclusão: Os resultados indicam a necessidade de intervenções direcionadas para mitigar os riscos associados ao uso não supervisionado de substâncias, particularmente medicamentos, entre os estudantes de cursos preparatórios.

Palavras-chave: Uso de Substâncias; Psicoestimulantes; Drogas Psicotrópicas; Estudantes de Medicina; Saúde Mental.

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INTRODUCTION

The medical school selection process in Brazil is highly competitive¹. After completing high school, students may attend medical school if they pass the entrance exam. However, due to the high number of candidates applying for the medical course, the selection process is considered difficult and selective, which can cause psychological distress among students who feel pressured to achieve better results². In this context, some students attending college preparatory courses turn to substances, particularly psychostimulants, to enhance their study efforts and meet the demands of this highly competitive environment.

Psychostimulants are substances that can increase alertness, motivation, improve mood, and cognitive performance. These substances can be classified into two main classes: natural substances obtained from plant sources, such as caffeine, and synthetic substances produced in laboratories, exemplified by methylphenidate. The most common brain stimulants include caffeine, 3,4-methylenedioxymethamphetamine (MDMA), modafinil, piracetam, energy drinks, and amphetamines. Although specific mechanisms of action may vary, psychostimulants generally affect dopamine, a neurotransmitter related to reward, motivation, attention, and arousal. These substances are used to increase wakefulness, stimulate the Central Nervous System (CNS), and promote antidepressant effects³⁻⁵.

College preparatory course students may use psychostimulants for various reasons, including seeking improvements in academic performance, cognitive enhancement, reduction of daily fatigue, and enhancement of concentration in studies³. However, the indiscriminate use of psychostimulants can lead to side effects such as reduced appetite, insomnia, high blood pressure, headache, abdominal pain, cramps, kidney failure, and addiction³. This can constitute a public health problem since these substances can be obtained illicitly or improperly without adequate control and guidance.

Studies have shown a significant prevalence of psychotropic drug use among college preparatory course students. This high consumption may be associated with the lifestyle and vulnerability of young people facing competitive pressures, social demands, and uncertainties regarding career choices^{6,7}. Santana et al.⁵ found a higher prevalence of psychostimulant use among college preparatory course students compared to undergraduate university students. Similarly, Feitoza et al.⁸ found that many public school students have a positive perception of using medication to enhance academic performance.

Therefore, the aim of this research is to identify the prevalence and factors associated with substance use to

enhance study performance among college preparatory course students preparing for medical school entrance exams.

METHODS

In drafting the results of this research, we followed the principles of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement. The STROBE statement provides recommendations to improve the quality of the description of observational studies^{9,10}.

Study design and participants

This descriptive, cross-sectional study was conducted with students enrolled in a college preparatory course at a private educational institution in a municipality in the Northeast region of Minas Gerais, Brazil. The sample size calculation determined that a minimum of 79 participants would be sufficient to achieve a 5% margin of error at a 95% confidence level, with a population size of 100 students¹¹. Sampling was conducted randomly, and all students in the classroom preparing to take an entrance exam for medical school were invited to participate in the research.

Setting

Admission to higher education in Brazil is determined through a selection process. Each public or private university has the autonomy to determine how this process will be conducted. In public universities, in addition to their own selection process, the Unified Selection System (*Sistema de Seleção Unificada - Sisu*) is also used. The Ministry of Education (MEC) organizes this national system and uses scores from the National High School Exam (*Exame Nacional do Ensino Médio - Enem*) to allocate places in higher education courses, mainly in federal universities¹². State and Federal Universities in Brazil offer tuition-free courses and are recognized nationally¹³ and internationally¹⁴ for their excellent teaching and research quality. The selection process for students accepted to study at public universities is rigorous and demands months or years of study to achieve a good score. Medical school admission in Brazil occurs directly after high school. After being approved, students are accepted directly into a six-year undergraduate program focused entirely on medicine.

Due to the advantages of attending public institutions, competition for acceptance is fierce. This is especially true for medical courses, where the prestige of public medical colleges and the opportunity for free tuition make them highly desirable for students who cannot afford the high fees of private institutions. As a result, many students turn to college preparatory courses to increase their chances of acceptance.

College preparatory courses are frequently provided by private educational institutions. They aim to review and deepen the knowledge acquired during high school and provide specific preparation for entrance exams. These courses are not affiliated with any higher education institution. Students can attend preparatory courses while attending regular public or private schools, where they will graduate from high school.

The college preparatory course of the students participating in this research operates in a private educational institution in a medium-sized city. Although students can apply for medical school entrance exams in other cities in Brazil, those who wish to remain in their current city may experience more significant pressure for approval, as up to the data collection for this research, there was only one medical course in the city offered by a federal public institution.

Procedures

Data were collected for the research from September 30, 2019, to October 1, 2019. Students completed a printed questionnaire distributed in the classroom during breaks between classes.

The inclusion criterion was being a college preparatory course student intending to take an entrance exam for the medical course. Students interested in other courses were excluded from the study.

Ethical considerations

The research obtained approval from the Research Ethics Committee of the Universidade Federal dos Vales Jequitinhonha e Mucuri (UFVJM) (n . 4.307.319). All students were informed about the research purpose, risks, benefits, and questionnaire anonymity. The Informed Consent Form was signed by students over 18 years old and legal guardians of students under 18 years old, while students under 18 years old signed the Assent Form.

INSTRUMENTS

The self-administered and anonymous questionnaire used in this study comprised both objective and open-ended questions. It was developed based on the research conducted by Cassimiro⁶. The questionnaire consisted of two main sections: I) Sociodemographic and academic information (age, gender, marital status, family income, type of school attended during high school), and the number of attempts in the medical school selection process), and II) Substance use to enhance study performance.

Data analysis

The completed questionnaires were entered and incorporated for analysis using the statistical software Jamovi (version 2.3.2.1)¹⁵. In the descriptive analysis, we used mean

(M) and standard deviation (SD) for continuous variables and absolute and relative frequency for categorical variables.

The Shapiro-Wilk test was employed to assess the normality of the data distribution, revealing a deviation from normality. Consequently, non-parametric tests were utilized for subsequent inferential analyses.

The Mann-Whitney test was used to assess whether there was a difference in age between students who did and did not use substances to enhance study performance. To assess effect size, Rank-biserial correlation coefficient (r_b) was used¹⁶. Effect size for the Mann-Whitney test was calculated using the following references: very small (<0.10), small (0.10-0.29), moderate (0.30-0.49), and large (>0.50)¹⁷.

The Pearson chi-square test or Fisher's Exact Test (for analyses where 20% of the expected frequencies were less than 5) were used to assess the association between categorical variables and the use of substances to enhance study performance. The effect size for significant results was calculated with Cramer's V using the following references: <0.10 (small), >0.30 (medium), and >0.50 (large) for 1 degree of freedom, and <0.07 (small), >0.21 (medium), and >0.35 (large) for 2 degrees of freedom¹⁷.

Missing data were not considered in the statistical analysis. All tests were two-tailed, and a p-value ≤ 0.05 was considered significant for all statistical analyses.

RESULTS

Sociodemographic data

The research included 88 college preparatory course students between 17 and 35 years old (M = 19.9; SD = ± 2.83). Most of the participants were female (69.3%), single (95.3%), had a family income of 1 to 4 minimum wages (34.1%), and attended public schools (52.3%). At the time of the data collection, most students had attempted to pass the medical school entrance exam at least twice (77.3%). Table 1 shows the sociodemographic characteristics of the college preparatory course students.

Substance use to enhance study performance by college preparatory course students

Among the participants, 28.4% reported using substances to enhance study performance. The most used substances were methylphenidate (40%), lisdexamfetamine (28%), caffeine (16%), guarana powder (8%), multivitamins (4%), and sertraline (4%).

Regarding the frequency of use, participants reported using the substances every day (37.5%), on special occasions (exams and practice tests) (33.3%), 1 to 3 times per week (20.8%), and 4 to 6 times per week (8.3%). Concerning the

duration of use, the data revealed that most participants used the substances for 7 to 12 months (34.8%).

Regarding medical assistance, 52% of the participants used substances without a medical prescription, and 64% lacked a medical diagnosis justifying medication use. Among the participants with a medical diagnosis (36%), the most common self-reported diagnoses were Attention-Deficit/Hyperactivity Disorder (ADHD) (55.5%), attention difficulty (33.3%), and anxiety (11.1%). Table 2 shows the results related to the substances used to enhance study performance.

Table 3 shows that there is a significant difference between age and substance use, indicating that use is more common among older students ($U = 467$, $p = 0.002$, $r_b = 0.40$).

Table 1. Sociodemographic characteristics of the college preparatory students, Minas Gerais, Brazil, 2019.

Participants' characteristics	N	%
Age (mean; SD)	19,9	±2,83
Sex (n=88)		
Female	61	69,3
Male	27	30,7
Marital status (n=86)		
Single	82	95,3
Married	4	4,7
Family income (n=88)		
Up to 1 MW ^a	13	14,8
1 to 4 MW	30	34,1
4 to 7 MW	25	28,4
Above 7 MW	20	22,7
Type of school attended during high school (n=86)		
Public	45	52,3
Private	27	31,4
Private with scholarship	14	16,3
Attempts to pass the medical school (n=88)		
0 to 2	68	77,3
More than 3	20	22,7

^aMW: Minimum wage (reference value in 2019: R\$998,00 or approximately US\$239,43). Source: Developed by the authors, 2024.

Table 2. Substance use to enhance study performance by college preparatory course students, Minas Gerais, Brazil, 2019.

Variables	N	%
<i>Uses or has used substances to enhance study performance (n=88)</i>		
No	63	71,6
Yes	25	28,4
<i>Substance use or previously used (n=25)</i>		
Methylphenidate	10	40
Lisdexamfetamine	7	28
Caffeine	4	16
Guarana powder	2	8
Multivitamins	1	4
Sertraline	1	4
<i>Frequency of use (n=24)</i>		
Everyday	9	37,5
On special occasions (exams and practice tests)	8	33,3
1 to 3 times per week	5	20,8
4 to 6 times per week	2	8,3
<i>Duration of use (n=23)</i>		
Less than 1 month	3	13
1 to 6 months	6	26,1
7 to 12 months	8	34,8
1 to 3 years	5	21,7
4 years or more	1	4,3
<i>Medical prescription (n=25)</i>		
No	13	52
Yes	12	48
<i>Medical diagnosis (n=25)</i>		
No	16	64
Yes	9	36
<i>Self-reported diagnosis (n=9)</i>		
ADHD	5	55,5
Attention difficulty	3	33,3
Anxiety	1	11,1

Source: Developed by the authors, 2024.

Table 3. Association between age and substance use to enhance study performance by college preparatory course students, Minas Gerais, Brazil, 2019.

Variable	Group	N	Mean	Median	Standard Deviation	U p-value
Age	Yes	25	21.2	20.0	3.93	U = 467 0.002
	No	63	19.4	19.0	2.07	

Source: Developed by the authors, 2024.

Moderate associations were found between substance use and two variables: type of school attended during high school ($\chi^2_{(2, N = 86)} = 6.93, p = 0.031, \text{Cramer's } V = 0.28$) and the number of attempts to pass the medical school entrance exam ($\chi^2_{(2, N = 88)} = 9.00, p = 0.003, \text{Cramer's } V = 0.32$). The highest prevalence of substance use was observed among scholarship recipients from private schools (57.1%) and students who had attempted the entrance exam more than three times (55%). Table 4 presents the associations between sociodemographic and academic variables and substance use for study enhancement.

DISCUSSION

This study revealed that students attending college preparatory courses for medical school admissions frequently use substances to enhance study performance. Methylphenidate emerged as the most often used substance. Older students, scholarship recipients from private schools, and those who had attempted medical school entrance exams more than three times were more likely to use these substances. Notably, most students using these substances lacked a medical prescription or diagnosis justifying their use.

The prevalence of medication use for academic enhancement appears to be linked to the intense pressure faced by college preparatory course students competing for limited spots in higher education⁵. Previous research reported 21% and 37.6% medication usage rates among entrance exam candidates^{6,7,18}. Additionally, some studies have also evaluated students' perceptions and predispositions to use medication. For instance, Trigueiro and Leme¹⁹ found that 65.3% of students were predisposed to using medication, with 55.2% viewing its use for cognitive enhancement positively. Similarly, Souza and Teixeira² showed that 54.5% of students would use psychotropic drugs to enhance their learning. These findings suggest that students consider medication acceptable for enhancing academic performance.

Regarding students' age and medication use, Cassimiro⁶ identified a trend among students older than 21 years, indicating they are more likely to use medication for cognitive enhancement. Our findings support this association, demonstrating that older students may use medication to address academic challenges and secure quicker admission. For some older students, entering the job market sooner may be a critical consideration, whether for professional fulfillment in medicine or financial support for their families. This context underscores the multifaceted pressures driving substance use among this group.

Previous research has shown that private school students perceive using medication to improve study performance

Table 4. Association between sociodemographic and academic variables and substance use to enhance study performance by college preparatory course students, Minas Gerais, Brazil, 2019.

Variable	Group		χ^2 (df) p-value
	Yes N (%)	No N (%)	
<i>Sex (n=88)</i>			0.733 (1) 0.392
Female	19 (31.1)	42 (68.9)	
Male	6 (22.2)	21 (77.8)	
<i>Marital status (n=86)</i>			1.02 (1) 0.310b
Single	22 (26.8)	60 (73.2)	
Married	2 (50)	2 (50)	
<i>Family income (n=88)</i>			4.25 (1) 0.236
Up to 1 MW ^c	3 (23.1)	10 (76.9)	
1 to 4 MW	7 (23.3)	23 (76.7)	
4 to 7 MW	11 (44)	14 (56)	
Above 7 MW	4 (20)	16 (80)	
<i>Type of school attended during high school (n=86)</i>			6.93 (2) 0.031
Public	12 (26.7)	33 (73.3)	
Private	5 (18.5)	22 (81.5)	
Private with scholarship	8 (57.1)	6 (42.9)	
<i>Attempts to pass the medical school (n=88)</i>			9.00 (1) 0.003
0 to 2	14 (20.6)	54 (79.4)	
More than 3	11 (55)	9 (45)	

^bFisher's Exact Test.

^cMW: Minimum wage (reference value in 2019: R\$998,00 or approximately US\$239,43).

Source: Developed by the authors, 2024.

positively, while public school students tend to express a more critical perception¹⁹. Our study adds to this by highlighting the unique pressures faced by scholarship students, who may feel compelled to maintain high performance in entrance exams to retain their scholarships. Poor performance may put their scholarship at risk, creating additional motivation to seek academic enhancement through substance use.

In relation to attempts to pass the entrance exam, our findings align with earlier research showing that students often begin using psychotropic medications after enrolling in preparatory courses⁷. The pre-entrance exam period is marked by heightened pressure and competition, which may drive students to seek cognitive enhancers. This underscores the need for targeted interventions during this critical phase to address the risks associated with unsupervised substance use.

In the present study, methylphenidate, commonly marketed as Ritalin, was identified as the most prevalent

substance used among college preparatory course students. We found usage rates higher than those reported by Cassimiro⁶ (15%) but lower than those observed by Wachholz and Santos (49%)¹⁸. Although methylphenidate is indicated for ADHD and narcolepsy, its off-label use is prevalent among college preparatory course students, public service candidates, and university students^{18,20,21}. While appropriate use can improve concentration, attention, and learning, unsupervised use poses significant risks, including abuse, dependence, and adverse effects such as decreased appetite, sleep disturbances, and transient cardiovascular issues²¹. Methylphenidate is the most commonly used drug for neuroenhancement among Brazilian university students²², particularly among medical students^{4,20,23}. The use of Ritalin as a 'smart drug' has been shown to have no benefit, as it increased motivation but decreased the effort to complete a task²⁴. Methylphenidate improves the feeling of well-being but not cognitive function, which does not justify methylphenidate use by healthy individuals²⁵. Our findings confirm that psychostimulant use among medical students often begins before they enter medical school²⁶, highlighting the need for early interventions to address this issue.

In addition to methylphenidate, students reported using other substances, including lisdexamfetamine, caffeine, guarana powder, multivitamins, and sertraline, to enhance study performance.

Lisdexamfetamine, a therapeutically inactive amphetamine, is commonly prescribed for ADHD in children and adults^{27,28}. The use of lisdexamfetamine in patients with ADHD can improve executive functioning in academic environment²⁹. In healthy individuals, lisdexamfetamine enhanced aspects of cognitive performance³⁰, but these cognitive effects are considered inconsistent³¹, uncertain³², and not supported by evidence³³.

Caffeine, a methylxanthine, is the most widely consumed psychoactive stimulant, primarily ingested as coffee^{34,35}. The US Food and Drug Administration (FDA) has approved oral caffeine for restoring mental alertness or wakefulness in fatigue or drowsiness states³⁴. Caffeine enhances psychophysiological performance at appropriate doses, depending on the context and population³⁶. Medical students commonly use caffeine or high-caffeinated energy drinks to cope with academic stress and wakefulness³⁷. We believe this same type of use occurs with college preparatory course students. Since Brazil is the world's largest producer and the second-largest coffee consumer³⁸, it is an inexpensive substance that is accessible to students. While caffeine consumption is generally safe in healthy adults, toxic doses of caffeine can produce cardiovascular, gastrointestinal, and psychological/neurological symptoms³⁵.

Guarana (*Paullinia sorbilis* and *Paullinia cupana*) is a species native to the Amazon region known for its stimulant and medicinal properties^{39,40}. Guarana powder contains up to four times more caffeine than coffee powder⁴¹. Benefits attributed to guarana include improved alertness, reaction time, memory, mood, and performance, as well as alleviation of mental and physical fatigue³⁹. Previous research has reported that college students use guarana powder to increase attention, improve cognitive performance, or stay awake^{26,42}. While no serious health risks are associated with adequate use, caution is advised when combining guarana with other CNS stimulants, as it may cause excessive stimulation⁴³.

Vitamins, essential organic compounds for cell function, growth, and development⁴⁴, are regulated by the Brazilian Health Regulatory Agency (Anvisa) as dietary supplements, not for treating or preventing disease⁴⁵. Multivitamins lack standardized definitions regarding nutrient composition or dosage⁴⁶. Chronic use in cognitively intact adults may modestly improve immediate free recall memory⁴⁷, and supplementation can enhance mental and physical performance by addressing micronutrient deficiencies⁴⁸. Among Brazilian medical students, 41% use vitamin supplements, with 29% citing increased energy and 16% reporting reduced stress and fatigue⁴⁹. While multivitamins are generally safe when consumed at recommended levels⁴⁶, excessive intake of vitamins may potentially lead to adverse health consequences⁴⁹.

Sertraline, a Selective Serotonin Reuptake Inhibitor (SSRI), is prescribed for conditions such as Major Depressive Disorder (MDD), Obsessive-Compulsive Disorder (OCD), and Social Anxiety Disorder (SAD)⁵⁰. While not indicated for cognitive enhancement, it may improve cognitive function in depressed patients⁵¹. College preparatory course students possibly use sertraline not to enhance study performance but to deal with depressive symptoms that prevent them from studying. Although generally safe, sertraline carries risks, including increased suicidal ideation in adolescents and young adults with depression and potential toxicity leading to serotonin syndrome, characterized by symptoms such as muscle rigidity, hyperreflexia, and hyperthermia⁵⁰.

The use of medication to enhance academic performance without medical guidance by the participants highlights a persistent lack of medical assistance. Our findings align with previous research showing that 79% of entrance exam candidates using psychostimulants lacked a medical prescription¹⁸. This practice is also prevalent among medical students⁵², suggesting that many obtain medications irregularly from irregular establishments or through sharing with friends or family members who have prescriptions.

CONCLUSIONS

The findings of this study indicate that college preparatory course students aiming for medical school admission frequently use substances to enhance academic performance. These findings indicate the necessity for targeted interventions to mitigate the risks associated with unsupervised substance use, particularly medication.

Some limitations were encountered in the present study. As it has a cross-sectional design, it does not allow establishing causal relationships. Data were collected through self-reported questionnaires, and information on substance dosages was not obtained. Despite these limitations, the study provides a comprehensive analysis of substance usage patterns among students, offering valuable insights for future research.

Educational and preventive interventions are urgently needed. Educational institutions should develop initiatives to educate students about the risks of unsupervised medication use and promote healthier alternatives. Emphasizing holistic approaches that address medical, social, and psychological factors is essential to fostering healthier and more balanced academic environments. Such efforts can help mitigate the risks associated with substance use and support students in achieving their academic goals.

AUTHOR'S CONTRIBUTION

Tâmara Chagas Mendes: contributed to all phases of the research and prepared the final version of the article. Paulo Tarso Farias Teixeira: planned the research design, collected data and critically reviewed the final version of the article. Rafael Magno Leonhardt: planned the research design, collected data and critically reviewed the final version of the article. Tamires Ayra de Carvalho Ferreira Lima: planned the research design, collected data and critically reviewed the final version of the article. Camila de Lima: supervision of all stages of the research and critical review of the final version of the article

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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DATA AVAILABILITY

Research data is available in the body of the document.

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