

The use of brain stimulants among medicine students: integrative review.

O uso de estimulantes cerebrais entre estudantes de medicina: revisão integrativa

El uso de estimulantes cerebrales entre los estudiantes de medicina: una revisión integradora.

RESUMO

Objetivo: evidenciar o uso de estimulantes cerebrais por estudantes de medicina no Brasil para melhora da performance acadêmica, entendendo as substâncias mais utilizadas, a prevalência de uso, efeitos percebidos e consequências. Metodologia: a pesquisa trata-se de uma revisão integrativa, na qual foram realizadas buscas nas fontes de dados PubMed, SciELO, LILACS e MEDLINE, a partir dos descritores "stimulants", "medical students", "performance" e "psychoactive substances" no período de 2018 a 2023, que resultaram na seleção de 9 artigos que atenderam aos critérios de inclusão e exclusão. Resultados: foi observado consumo abusivo de estimulantes, principalmente de cafeína, bebida energética, metilfenidato e anfetaminas entre o público-alvo, além de maior incidência entre estudantes do quarto ano, que se mudaram da cidade-natal, tabagistas e/ou sedentários. Conclusão: o tema é um problema de saúde pública e carece de pesquisas aprofundadas para propiciar a mobilização das instituições de ensino e órgãos de saúde.

DESCRITORES: Estimulantes cerebrais; Estudantes de medicina; Substâncias psicoativas; Performance.

ABSTRACT

Objective: to highlight the use of brain stimulants by medical students in Brazil to improve academic performance, understanding the most used substances, the prevalence of use, perceived effects and consequences. Methodology: the research is an integrative review, in which searches were carried out in PubMed, SciELO, LILACS and MEDLINE data sources, from the descriptors "stimulants", "medical students", "performance" and "psychoactive substances" from 2018 to 2023, which resulted in the selection of 9 articles that met the inclusion and exclusion criteria. Results: abusive consumption of stimulants was observed, mainly caffeine, energy drink, methylphenidate and amphetamines among the target audience, in addition to a higher incidence among fourth-year students, who moved from their hometown, smokers and/or sedentary. Conclusion: the theme is a public health problem and lacks in-depth research to encourage the mobilization of educational institutions and health agencies.

DESCRIPTORS: Brain stimulants; Medical students; Psychoactive substances; Performance.

RESUMEN

Objetivo: destacar el uso de estimulantes cerebrales por estudiantes de medicina en Brasil para mejorar el rendimiento académico, conociendo las sustancias más utilizadas, la prevalencia de uso, los efectos percibidos y las consecuencias. Metodología: la investigación es una revisión integradora, en la que se realizaron búsquedas en las fuentes de datos PubMed, SciELO, LILACS y MEDLINE, utilizando los descriptores "estimulantes", "estudiantes de medicina", "rendimiento" y "sustancias psicoactivas" de 2018 a 2023, lo que resultó en la selección de 9 artículos que cumplieron con los criterios de inclusión y exclusión. Resultados: se observó un consumo abusivo de estimulantes, principalmente cafeína, bebidas energéticas, metilfenidato y anfetaminas entre el público objetivo, además de una mayor incidencia entre los estudiantes de cuarto año, que se mudaron de su ciudad natal, fumadores y / o sedentarios. Conclusión: El tema es un problema de salud pública y requiere una investigación en profundidad para movilizar a las instituciones educativas y los organismos de salud.

DESCRIPTORES: Estimulantes cerebrales; Estudiantes de medicina; Sustancias psicoactivas; Rendimiento

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INTRODUCTION

The transition from adolescence to adulthood, especially in the Brazilian reality, usually comes from the pursuit of professional training, with the medical course being one of the most sought after and dreamed of by young people in Brazil. The process of entering the university is usually exhausting and when entering, in fact, the academic faces even greater challenges, while developing autonomy, new responsibilities arise in the reality of a student who tends to psychosocial instability. It is worth highlighting the irregular sleep routine, inadequate diet, with high consumption of sugar, salt and super-processed products, leading this group to a precarious mental health and vulnerability to the consumption of psychoactive substances.¹

Medical students have a higher prevalence of stress and mental disorders, especially anxiety, than the general population. Passing the medical university generally causes positive feelings, however, it can be a critical period for these students, since, as already mentioned, they are exposed to several stressors: extensive content to study, lack of time, self-demand to get good grades, insecurity in

dealing with disease situations and facing the dilemma of life and death prematurely. Thus, students are anxious and in a permanent state of wakefulness, which triggers impaired cognitive performance, reduced learning, restlessness, difficulty concentrating and memory failures.²

According to a study carried out with students from a medical university in Minas Gerais, "manifestations and conditioning factors of illness were perceived as feelings of guilt and insecurity, allied to social pressures for a high academic and professional performance" in relation to the mental exhaustion that the medical course brings. The study also stated that "stress, anxiety and burnout are common illnesses".³ It is pertinent to point out that the human brain is still going through the process of myelination during the second decade of life (a common age group for these students), with the frontal cortex - responsible for execution and attention - being the last to develop⁴, therefore, harmful stimuli have the potential to damage nerve cells and lead to changes in the cognitive process, whether in learning and/or memorization.

In this context, brain stimulants are elements that act by raising the state of alertness in the human body, thus improving

mood, cognitive performance, concentration, memory and creativity, in addition to having antidepressant properties. These exogenous substances have effects that mimic the sympathetic system and affect cholinergic, dopaminergic, noradrenergic, and serotonergic neurotransmitter pathways.⁵ It is important to understand that these stimulants range from those that are more culturally accepted, such as caffeine, energy drinks and guarana, to those that are illicit or illegally obtained, such as MDMA (methylenedioxyamphetamine), methylphenidate, modafinil, piracetam and amphetamines.⁶

Of these mentioned substances, amphetamines are the most used group of medications, mainly methylphenidate and dextroamphetamine, however, they present a significant risk of dependence, in addition to other harmful effects such as aggressiveness, agitation, confusion, headache, tremors, mood swings, anorexia and nausea, arrhythmias, overdose and depression.⁷ Studies estimate that 5 to 35% of university students use drugs to improve academic performance, thus, it is clear that these students are included not only in a highly competitive environment, but also that the psychology of this group is more susceptible to accessing tools that

increase their productivity, even if this means bringing risks to their own health.⁸

It is clear, therefore, that brain stimulants are a public health problem among medical students, since they increase the chances of economic, social and cultural costs, whether due to the entire process that involves the recovery of the user, or due to the impact on their training, self-confidence and quality of life. Therefore, having knowledge about its prevalence, motivation and characteristics involved helps in understanding and planning how to deal with this situation. The present study focused on analyzing and understanding the Brazilian scenario and the profile of medical students and the main stimulants used by them during their training.

METHOD

This is a research carried out through an integrative literature review, where a bibliographic search was carried out in the following data sources: Center for Biotechnology Information (PubMed), Scientific Electronic Library Online (SciELO), Latin American and Caribbean Health Sciences Literature (LILACS) and Medical Literature Analysis and Retrieval System Online (MEDLINE). Articles published in the last 5 years, in Portuguese and English, were selected. The descriptors used to locate the studies were: Stimulants, Medical Students, Psychoactive Substances and Performance, in order to understand the use of brain stimulants by Brazilian medical students.

The search strategy was directed towards answering the question: "What is the current Brazilian scenario of medical students regarding the use of brain stimulants?". Thus, aiming to acquire the answer to this question, a search method was developed using group descriptors with at least two keywords. At Scielo, the crossings were: stimulants AND medical students. In PubMed, the crosses were: stimulants AND medical students e psychoactive substances AND medical students AND performance. In LILACS, the crossings were: psychoactive substan-

ce AND medical students. In MEDLINE, intercepts were stimulants AND medical students e psychoactive substances AND medical students.

The selection criteria adopted for the articles found were: being published in English or Portuguese, publication in the last five years, free full text and articles that covered the Brazilian territory. As exclusion criteria, articles that were not published in the last five years, literature review articles and those that were published in a language other than Portuguese or English were analyzed and removed from this work. After applying the strategy used to search for articles, containing the chosen descriptors, the selection was carried out in three stages:

- A) First, the titles that did not fit the criteria of our study or that were not carried out with a focus on Brazil were excluded, after being identified and read in the different electronic data sources.
- B) Secondly, the selected abstracts were read, also excluding those that did not belong to the inclusion criteria of the present study.
- C) After these two steps, thirdly, all selected articles were read in full for a final selection for this review.

With this, a table was created in the Word program, inserting the main data of the selected articles and choosing to consider the following characteristics for the presentation of the results: title, author, year of publication, methodology and main results.

RESULTS

The electronic search using the described search strategies yielded 1827 articles on the SciELO, PubMed, LILACS and MEDLINE platforms. Following the inclusion and exclusion criteria, constant repeated references in more than one data source were subtracted and, after the entire selection process, 9 articles were selected after reading them in full.

In the PubMed data source, 449 articles were found, of which 351 were ex-

cluded by filters, 77 excluded by title, 20 were read by abstract and one was selected for full reading.

In the SciELO electronic platform, 10 articles were found, of which 7 were excluded by title, 3 were read by abstract and 1 selected for full reading. In the LILACS data source, 102 articles were found, of which 86 were excluded by the filters, 4 excluded by the title, 12 were read by the abstract and 6 in full.

In the MEDLINE platform, 1266 articles were found, of which 938 were excluded by filters, 283 excluded by title, 45 were read by abstract and 1 selected for full reading.

The selected articles were categorized and the information was extracted and organized according to the following characteristics: title, author, year of publication, methodology and main results, as shown in the table below.

DISCUSSION

The admission of young people to medical universities entails a major change in environment and habits, with the presence of new responsibilities and challenges that the course presents. Faced with the great pressure required by professional preparation to deal with human life, stress becomes a common factor. With this, the university becomes a period of great vulnerability for the use of these psychoactive substances.⁹ One study analyzed the odds ratio of using psychotropic drugs among students from various higher education courses (Medicine, Physical Education, Pharmacy and Nutrition), which obtained the result that individuals in medical school are 7.943 times more likely to use these substances. In addition, in general, individuals with high income and who are in the last period of the course were more likely to use it.¹⁰

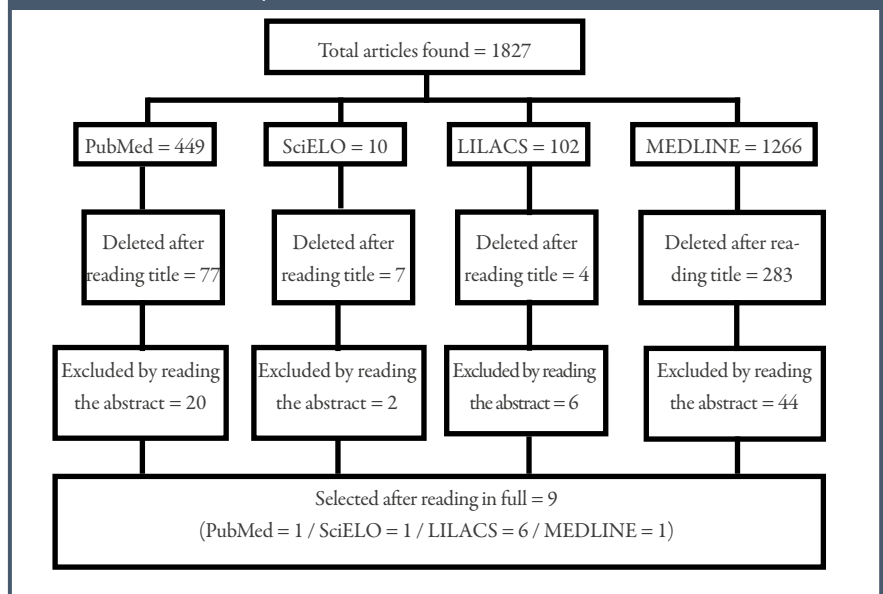
The use of psychostimulants, such as methylphenidate, became a recurrent practice of doping that surpassed sports environments. These brain stimulants are used for treatments of attention deficit hyperactivity disorder (ADHD) and nar-

colepsy. However, the use of these substances by healthy individuals, without attention disorder, can increase cognitive abilities and relax inhibitions of executive functions important for mental performance. Therefore, the indiscriminate use of these substances without a medical prescription by medical students has become a frequent practice, since it increases their learning capacity, performance and concentration. Thus, creating a clandestine trade of these substances on university campuses and becoming a matter of public health concern.¹¹

Thus, psychostimulants can be classified into different classifications, however, in general, there are natural ones (related to plant extraction, such as caffeine) and synthetic ones, which are produced in the laboratory, such as methylphenidate. At first, coffee has the highest consumption prevalence, in addition to other compounds that contain caffeine in the composition, such as energy drinks or caffeine capsules, since they end up having their use more widespread due to easy access and socio-culturally widespread use, although they can cause dependence. Guarana powder goes through a similar process and has guaranine as its principle. Regarding methylphenidate, its importance for treating ADHD has already been mentioned, which made it commercialized worldwide and, due to this widespread need, facilitated its access for other purposes.⁹

Analyzing the main substances used and understanding their mechanisms of action, we observed that methylphenidate acts by increasing noradrenaline (NA) and dopamine (DA) levels in the prefrontal cortex and cortical/subcortical regions. Its effect leads to better levels of attention in ADHD. Modafinil, used for narcolepsy, has actions on NA, glutamate and mainly on AD since it increases its levels in the caudate and nucleus accumbens, in addition to blocking DA transporters. Amphetamines act by blocking the reuptake of NA and DA in the presynaptic neuron and increase their release also in the presynaptic neuron, thus increasing the concentration of the synaptic cleft.⁶

Flowchart 01 – Description of article selection.



Source: Research Data, 2023.

Regarding the prevalence of substances, Muniz et al. reports that 70.0% of students consumed caffeine, followed by 37.78% who consumed energy drinks and 13% of students consumed amphetamines. Regarding the use of methylphenidate, the authors agreed: Mezacasa Júnior et al. says in his research that the most consumed substance was methylphenidate, going from 21% in first year students to 56% in fourth year students. Meanwhile, Haas et al. reports that at the universities of Florianópolis, of the 698 students analyzed, 11.2% used methylphenidate or lisdexamfetamine without a medical prescription - a scenario that denotes a common practice in this group, since among drugs without proper prescription, methylphenidate is mostly chosen. In the Cândido et al. sample, methylphenidate use was six times higher than consumption at any other time.^{7,6,12,11}

With regard to the beginning of consumption, it is necessary to point out that the experimentation of psychostimulants can start even in the period of the entrance exam, as evidenced by Batista et al., but it is during the medical graduation that the use becomes more frequent and worrying, having as motivation the rea-

sons already discussed. This beginning is also more evident, according to Mezacasa Júnior et al., among students who migrated from other states, who were at the end of the clinical cycle and who failed some subject, who took sleeping pills and who had already smoked (of the 64% who stated that they consumed or had consumed psychostimulants, 48.2% reported who smoked or had ever smoked).^{1,6}

Thus, as associated variables, we can say that sedentary lifestyle, smoking and the use of other medications are related to the studied practice.¹² This proves that the association of these stressors, in addition to the factors conditioned by training, further increases the prevalence of the use of these substances by academics. It should be noted that the study by Mezacasa Júnior et al. was produced by observing students from a university in the extreme south of Brazil in the period from 2015 to 2018 and it was seen that the proportion of students who started using some type of stimulant during the medical course doubled from 2015 (15%) to 2018 (30%).⁶ Consumption of more than one psychostimulant agent simultaneously demonstrated an increase in stress among these students.

Revisão Integrativa EN

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The use of brain stimulants among medicine students: integrative review.

Table 1 – Description of selected articles

TITLE	AUTHOR	YEAR	METHOD	RESULTS
Use of psychoactive substances among medical students at a university in the Brazilian semi-arid region. (Uso de substâncias psicoativas entre estudantes de medicina em uma universidade do semiárido brasileiro.)	Batista RSC, Freitas TBC de, Nascimento EGC do, Martins RR, Miranda FAN de, Pessoa Júnior JM..	2022	Cross-sectional, descriptive study	Experimentation begins in the pre-university period (between 16-18 years old), and during medical graduation, use becomes more frequent.
Impact of the use of illicit and licit substances and anxiety disorders on the academic performance of medical students: a pilot study.	Ferreira PM, Alves RJR, Zantut-Wittmann DE.	2022	Cross-sectional study	Of the 67 students analyzed, 17.91% used ecstasy or amphetamines. It was analyzed that the pre-clinical cycle group used more ecstasy and amphetamine than the other groups.
Consumption of psychostimulants by medical students at a university in the extreme south of Brazil (Consumo de psicoestimulantes por estudantes de medicina de uma universidade do extremo sul do Brasil)	Mezacasa Júnior RC, Meneghini KFD, Demenech LM, Morgan HL, Petry AF, Dumith SC.	2021	Observational Study	64% of students have consumed or still consume psychostimulants. 31% started after starting the course, increasing this percentage over time, being 15% in 2015 and 30% in 2018. The most consumed substance was methylphenidate 21% in first year students and 56% in fourth year students.
Evaluation of the consumption of brain stimulants among students of the Medical Course of a University Center in the interior of Minas Gerais (Avaliação do consumo de estimulantes cerebrais entre os acadêmicos do Curso de Medicina de um Centro Universitário no interior de Minas Gerais)	Muniz LR, Almeida KC de.	2021	Cross-sectional study	Of the 116 students who participated in the survey, 90 reported using brain stimulants. Of these, 70% caffeine, 37% energy drinks and 13% amphetamines.
Academic performance and use of psychoactive drugs among healthcare students at a university in southern Brazil: cross-sectional study.	Boclin K de LS, Cecílio FFC, Faê G, Fanti G, Centenaro G, Pellizzari T, et al	2020	Cross-sectional study	Of the analyzed students, 95.8% used medical prescription; 73.2% used it for stress relief. Many students reported having some side effect (59.2%) such as headaches (23.8%)
Consumption of Brain Stimulants by Students in Teaching Institutions in Montes Claros/MG. (Consumo de Estimulantes Cerebrais por Estudantes em Instituições de Ensino de Montes Claros/MG.)	Santana LC, Ramos AN, Azevedo BL de, Neves ILM, Lima MM, Oliveira MVM de.	2020	Cross-sectional study	53.7% used some type of psychostimulant; higher prevalence of ecstasy (1.7%, $p = 0.001$) and methylphenidate (3%, $p < 0.001$) among higher education students..
Prevalence of and factors associated with the use of methylphenidate for cognitive enhancement among university students.	Cândido RCF, Perini E, Pádua CM de, Junqueira DR.	2019	Descriptive cross-sectional study	9.8% of students reported using methylphenidate. Of these, 59% had the objective of cognitive improvement, and 27.3% bought the medication without a medical prescription.

Increase of binucleated cells in the oral mucosa: a study on the use of psychotropics by students of a Brazilian institution.	Oliveira LB de, Parreiras JAR, Sebastião EC de O, Silva GN da.	2019	Cross-sectional study	Medical students are 7,943 times more likely to use psychotropic drugs than those of other degrees. Furthermore, its use was able to increase the number of binucleated cells.
Sociodemographic, psychiatric, and personality correlates of non-prescribed use of amphetamine medications for academic performance among medical students.	Haas GM, Momo AC, Dias TM, Ayodele TA, Schwarzbald ML.	2019	Cross-sectional study	Of the 698 students, 11.2% said they had used these substances without a medical prescription, the motivations being studying longer (84.6%), increasing concentration (46.2%), staying awake (28.2%) and experimenting (15.4%).

Source: Research Data, 2023.

Regarding the gender profile of the aforementioned academics, controversial data were observed between the gender that consumes these substances the most, given the discordant ratio of male and female participants - with much more active participation of the latter in research. Therefore, proportionally, it can be said that the highest consumption is by the male public, however, in recent years, there has been an increase in use by females, which may be a consequence of the current medical and cultural scenario, where women are entering higher education and, in particular, the medical course with more predominance.¹ On the other hand, regarding the proportion of students who have already used methylenedioxymethamphetamine, modafinil, piracetan and amphetamine, Mezacasa Júnior et al. shows that the prevalence was higher for males.⁶

Cândido et al., discuss how self-medication is an important sociocultural factor in this problem, as the practice in the case of students is encouraged by colleagues and friends, just as it happens in reality with other medications that are usually recommended indoors by family members.¹¹ Muniz et al. it also draws attention to the non-prescribed use of medication, as in relation to methylphenidate, of the students who reported using it, 66.67% did so without a medical prescription, while only 33.33% had a medical indication.⁷ On the other hand, when considering illicit substances, a low frequency of consumption was reported, such as cocaine, which may be a reflection of the financial cost, access to places where the

sale takes place and even the sociocultural stigma related to the substance.¹

It is also worth mentioning the effects, in fact, perceived by students after this consumption. According to Santana et al., the order of incidence was by sleep reduction, concentration improvement, well-being, reasoning, fatigue reduction, memory improvement and stress reduction.⁹ It is undeniable that psychostimulant substances produce a rapid positive effect, however, when observing the long term, few students reported a real effect on academic results, therefore, "There may be a motivational effect associated with psychoactive drugs that is more important than the actual effect on individual abilities."⁹

Among the adverse effects, high doses of caffeine (with plasma concentration greater than 50µM - at least five and at most ten cups of coffee) can promote tolerance, with reports of feelings of anguish, nervousness and agitation being common.⁹ In addition, amphetamines can cause damage to several systems: in the gastrointestinal tract it leads to xerostomia, reduced appetite and abdominal pain. In the cardiovascular system, it predisposes to hypertension, tachycardia, arrhythmia and even cardiac arrest. In the endocrine system, there may be a decrease in growth hormone (GH) and changes in the secretion of sex hormones. In the nervous system, headache, insomnia, stress and chemical dependency.⁸

Other effects that should be considered are behavior modifications, in which the student may be involved in assaults and car accidents and present risky sexual

behaviors. On the other hand, also among the perceived consequences, we can mention even the microscopic ones, considering the study by Oliveira et al., which showed an increase in the number of binucleated cells in the oral mucosa - which are commonly related to cancer cells.¹⁰ Furthermore, in the study by Boclin et al., many students reported some side effects (59.2%), such as headaches (23.8%). It is clear, therefore, that the continuous and exacerbated use of psychostimulants brings with it the appearance of psychological, physical, social, financial and academic problems.⁸

In view of the articles included in the research, there was both an increase in studies on this topic, as well as an increase in its use by medical students. This information indicates the social relevance of this theme, as well as highlighting a problem that ranges from licit to non-licit substances and obtaining medication for non-therapeutic purposes among a young public. In addition, these data denounce the model of university education, society's view of what productivity means and become valuable for creating interventions in universities, such as improved curriculum approach and multidisciplinary work to build mental and emotional support for medical students.

CONCLUSION

The integrative review produced verified that the consumption of psychostimulants by medical students in Brazil is a worrying reality, where the incidence of

substance use grows with the years, motivated by the desire to improve academic performance by reducing sleep and tiredness, although these are physiological manifestations of the organism that need to be respected. It can be said, therefore, that the search for productivity among Brazilian medical students often occurs in an irresponsible and unhealthy way, as the consumption of brain stimulants in this group happens in an accentuated and growing way, thus, it is characterized as a public health problem.

Among the limitations of the research, it is worth mentioning that although studies on the subject have increased, there is still a low scientific production on the subject in the last 5 years, therefore, other studies were left out because they did not

meet the time criteria determined for the selection of this review. In addition, the articles were produced covering a few national regions - most of the studies took place in the south (n=2) and southeast (n=5), a way that is still far from understanding the realities of the north region (n=0), northeast (n=1) and midwest (n=0). Furthermore, the methodologies of the works are diverse in relation to the types of substances used, the way to measure them and the consequences require greater detail, especially with regard to chemical dependency and other repercussions on students' lives (financial, social, psychological or physical).

In general, it is a public need to invest in research aimed at verifying the prevalence and incidence of the use of brain

stimulants in medical students across the country, as well as motivating the direction of research in the North, Northeast and Midwest regions, in order to have a deeper psychosocial and geographical vision, in order to establish intervention and care goals according to regional needs. Second, it is necessary to create standardized evaluation methodologies to direct these studies. It is essential to develop public and interventionist policies, with the active participation of universities and educational campaigns aimed at the young population, with an emphasis on the most common psychoactive drugs. Finally, inspection and control over illegal sales of medicines must be reinforced by health surveillance.

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