

We need to talk about the use of methylphenidate by medical students – review of the literature

Precisamos falar sobre uso de Metilfenidato por estudantes de medicina - revisão da literatura

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ABSTRACT

Introduction: Studies methylphenidate (MPH) has been used by medical students to increase their mental activity and improve the performance required during undergraduate school, generating concern regarding the risks to their physical and mental health. This scenario indicates the need for specifically aimed measures in medical schools.

Objective: To review the literature about the use of MPH without medical indication amongst medical students.

Method: A thorough review of the literature published in English, Spanish, and Portuguese, between 2013 and 2019, based on data made available by PUBMED and SCIELO, utilizing keywords in the three above languages, along the four stages of the selection process.

Results and Discussion: Altogether, 224 articles were found, of which 25 were selected after reading, dealing with the use of MPH or 'cognition enhancer' by undergraduate medical students without a doctor's prescription. The research indicated significant variability in the frequency of consumption, related to the investigated pattern of use, use with or without indication, before or after entering University and country where the study was carried out. The most frequent justification for the use without medical indication was to attain improvement in academic performance. A lack of research with a fair appraisal of the cognition, behavioral and psychic risks involved, among them addiction and the approach of the topic in medical schools, was noted.

Conclusion: The high rates of usage of MPH by medical students aiming at cognitive enhancement strengthens the importance of preventative actions in medical schools. The strategies must consider information concerning the risks of use (of MPH) without medical indication; non-pharmacological interventions for performance improvement; sleep hygiene measures organization for adequate study activities; broad discussions about ethical aspects and curricular structure.

Keywords: Medical Students; Methylphenidate; Stimulants; Cognitive Enhancement.

RESUMO

Introdução: Estudos mostram que o metilfenidato (MPH) tem sido utilizado por estudantes de medicina para aumentar sua atividade mental e melhorar o desempenho exigido durante a graduação, gerando preocupações quanto aos riscos à sua saúde física e mental. Esse cenário indica a necessidade de medidas especificamente direcionadas nas escolas médicas.

Objetivo: Revisar a literatura sobre o uso de MPH sem indicação médica entre estudantes de medicina.

Método: Revisão minuciosa da literatura publicada em inglês, espanhol e português, entre 2013 e 2019, com base em dados disponibilizados pelo PUBMED e SCIELO, utilizando palavras-chave nos três idiomas acima, ao longo das quatro etapas do processo de seleção.

Resultados e Discussão: Ao todo, foram encontrados 224 artigos, dos quais 25 foram selecionados após leitura, tratando do uso de MPH ou 'potencializador da cognição' por graduandos de medicina sem prescrição médica. A pesquisa indicou variabilidade significativa na frequência de consumo, relacionada ao padrão de uso investigado, uso com ou sem indicação, antes ou após a entrada na Universidade e país onde o estudo foi realizado. A justificativa mais frequente para o uso sem indicação médica foi a de obter melhora no desempenho acadêmico. Notou-se a carência de pesquisas com uma avaliação adequada dos riscos cognitivos, comportamentais e psíquicos envolvidos, entre eles o risco de adição e a abordagem do tópico nas escolas médicas.

Conclusão: As altas taxas de uso do MPH por estudantes de medicina visando o aprimoramento cognitivo reforça a importância de ações preventivas nas escolas médicas. As estratégias devem considerar informações sobre os riscos do uso (do MPH) sem indicação médica; intervenções não farmacológicas para melhoria do desempenho cognitivo; medidas de higiene do sono; organização para atividades de estudo adequadas; amplas discussões sobre aspectos éticos e estrutura curricular.

Palavras-chave: Estudantes de Medicina; Metilfenidato; Estimulantes; Aprimoramento cognitivo.

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INTRODUCTION

In the last decade, there has been a growing concern in the academic world regarding the continuous use of psychostimulants to improve school performance amongst undergraduate students¹. These substances are characterized by their capacity to stimulate the Central Nervous System (CNS)², enhancing attention and concentration. Among these substances, 'energy beverages' (drinks based on *caffeine*, *guaranine*, *cola*, and *taurine*), medications used for weight loss, and the drugs indicated for the treatment of attention deficit and hyperactivity disorder (ADHD) and narcolepsy stand out^{2,3}.

The medications more frequently utilized to improve cognitive performance are those indicated for the treatment of ADHD, which is characterized by loss of attention, mental organization, and hyperactivity/impulsivity, starting at childhood and being able to persist up to adult life, which can harm an individual's social, academic, and professional life⁴. The ADHD pharmacological treatment includes using Methylphenidate (MPH)⁵, a stimulant drug sold in Brazil under the commercial names Concerta®, Ritalina®, and Ritalina LA®⁶ as first-class medications for therapeutic intervention^{2,5,7,8,9}. This drug promotes an increase in attention and the control of behavioral impulses; however, it has the potential for the development of drug dependence when inadequately used⁶. Therefore, the recommendation for its use should follow strict criteria, after a medical and psychological evaluation taking into account family history, development during childhood, school performance, an analysis of the use of other psychoactive substances, as well as the level of intelligence of the personality¹⁰.

The use of stimulants to enhance mental activity has been described as an option to deal with the demands that undergraduate school requires and to improve academic performance², generating concerns about the risks to the individuals' health and quality of life. Recent investigations carried out at the University of Rhode Island, Brown University, and at the Rhode Island Memorial Hospital studied the consequences of the unprescribed use of *Adderall*® (a mixture of amphetamine salts, also used to treat ADHD) by undergraduate students. The authors verified that the attention capacity improves, albeit to the detriment of the working memory functions, which, in turn, could compromise the performance of daily tasks, solving problems, and social relations as well¹.

Amongst the university courses, a degree in Medical Science is considered one of the most demanding in respect to the performance of its students^{2,11}. Their journeys begin the moment they choose the profession, going through pre-college preparatory courses, competing with others to get into a university, and after that having to keep up the

high performance during the entire graduation¹¹. Most of the students arrive at the University hoping that the level of continued dedication demand will slack down and gets frustrated when they realize that, quite to the contrary, the rhythm of studies will continue at a very high rate of demand¹¹. Besides this, other factors such as sleep and leisure deprivation contribute to stress and low academic performance². Committed to a strenuous routine, the students may resort to means to attain efficiency in the course activities, amongst them the use of brain stimulants such as the MPH².

This subject is essential to all Higher Medical Education institutions and those that render student support. This essay aims to make a literature revision concerning the usage of MPH among medical students without a doctor's prescription, seeking a better understanding of the aspects of using psychostimulants and promoting preventive actions to offer medical students better learning conditions and quality of life.

METHOD

A comprehensive revision was carried out in international and Brazilian national literature, focusing on articles published in the last seven years (January 2013 through December 2019). In addition, the authors included articles written in English, Spanish and Portuguese, about the usage of MPH without medical indication by medicine students based on data made available by Pubmed/Medline and Scielo, using the following as keywords or key expressions in these three languages, respectively:

Medical Students; Methylphenidate; Stimulants and Cognitive Enhancement.

Estudiantes de Medicina; Metilfenidato; Estimulantes; Mejora Cognitiva.

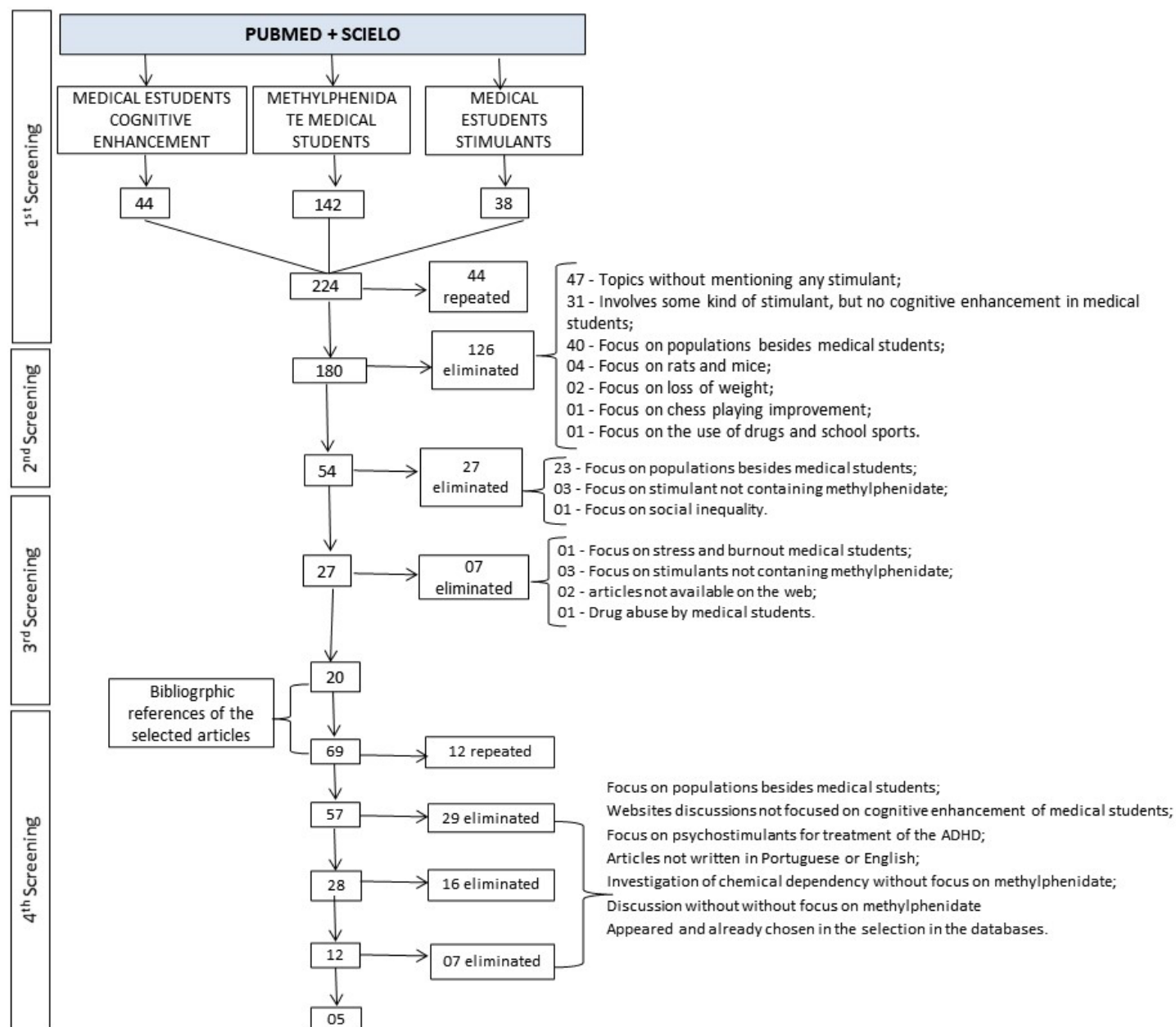
Estudantes de Medicina; Metilfenidato; Estimulantes; Aprimoramento Cognitivo.

To this effect, a selective structure was established, comprising four stages, which included articles focusing on the scope of the research, follows: title of the article, analysis of the abstracts, dynamic reading of the articles, and complementary search in the bibliographic references of the selected ones, which met the same appropriate criteria concerning the topic, abstracts, and dynamic reading.

RESULTS

In total, 224 articles were found, of which 09 were from the Scielo database, and 215 from Pubmed. The repeated articles or the ones that did not address MPH use by medical students without clinical orientation were excluded, as shown in Figure 1.

Figure 1. Flowchart of the stages, exclusions and partial result.



Source: Pubmed e Scielo.

The publications concerning cognitive intensifiers that included the use of MPH were maintained, resulting in 20 articles that were revised and had their bibliographical references assessed. In this process, 69 articles were submitted to the forementioned screening method, plus another five articles to be analyzed. Thus, in total, 25 articles were selected for this review (Table 1) and the highlights of the review are presented in Chart 1.

DISCUSSION

The study indicated significant variability in the frequency of consumption, related to the pattern of use investigated, use with or without indication, before or after entering University

and country where the study was performed. Among the assessed articles, the students from Latin American countries were the ones who showed a higher prevalence of MPH use. A Puerto Rican survey showed the highest prevalence (47.4 %) ¹², followed by 45% of the students interviewed in a Paraguayan school, of which 33% used the drug without adequate clinical indication ¹³. Then comes a total of 34.2% of the students from a medical school in the Rio Grande do Sul, Brazil, of which 23% used it without adequate indication ¹⁴. The other two studies carried out in Brazil ^{2,7} indicated higher rates of use when compared to other countries such as the USA, with 18% ¹⁵, Israel ⁸ and Africa with 17% ¹⁶, North of Iran with 11% ¹⁷ and a study in Pakistan with 9% ¹⁸.

Table 1. Description of the selected articles.

Author / Year	Objective	Type of study	Main findings
A-Morgan HL, Petry AF, Licks PAK, Ballester AO, Teixeira KN, Dumith SC. 2017.	To investigate the use of brain stimulants (type and reasons) by medical students in the South of Brazil	Cross-sectional study (n=200)	57.5% of consumption in life (20% of the use of methylphenidate), 52.3% of the current use (5.5% of current use of methylphenidate and of these, 64% started using it in college). More than 80% had the goal to enhance concentration and increase the number of hours awake. Reduction of use during the course.
Fond G, Gavaret M, Vidal C, Brunel L, Riveline JP, Franchi JAM, et al. 2016.	Persistence and characteristics of the use of psychostimulants by medical students and postgraduate students in France	Cross-sectional study (n=1681)	6.7% used nonmedical stimulants during their lifetime. 57.7% of methylphenidate consumers seek to enhance their academic performance and concentration/attention.
Carneiro SG, Prado AST, Moura HC, Strapasson JF, Rabelo NF, Ribeiro TT, et al. 2013	Persistence of use without MPH prescription by medical students in Volta Redonda RJ-Brazil	Cross-sectional study (n=160)	Improve the capacity of concentration and attention, memory, and the number of hours awake. However, 10.8% of students claim to increase the dose to maintain the same effect.
Cohen YG, Segev RW, Shlafman N, Novack V, Ifergane G. 2015.	To evaluate the medical and nonmedical use of MPH among medical students in Israel	Cross-sectional study (n=229)	9.6% were previously diagnosed with attention deficit disorder. In addition, 17% reported lifelong use of MPH, while 13.5% reported using MPH during the preceding 12 months.
Eslami AA, Jalilian F, Ataee M, Mirzaei-Alavijeh M, Mahboubi M, Afsar A, et al. 2014.	To determine the factors related to inadequate use of Ritalin among medical students in Iran	Cross-sectional study (n=241)	6.6% of inadequate use of MPH in life, most of them seeking improvement in their academic performance. Prevalent use of tobacco and alcohol. Attitude, subjective norms, and prototype variables were responsible for 29% of the variation in intention and 25% of the disposition of this misuse of MPH
Acosta DL, Fair CN, Gonzalez CM, Iglesias M, Maldonado N, Schenkman N, et al. 2019	Persistency of medical and nonmedical use of stimulant medications by undergraduate medical students from Puerto Rico	Cross-sectional study (n=152)	Persistency of use of 47,4%. 60.3% used it to study for school examinations or to deal with the workload. 24.3% having their prescription, and 15.8% received the stimulant drugs from a friend
Franco Netto ROR, Franco Netto JAR, Silva Junior NZ, Silva SM, Vaz LHS, Agüero MAF, et al. 2018.	Indiscriminate use of methylphenidate and possible side effects in medical students in Paraguay	Cross-sectional study (n=100)	33% used methylphenidate without clinical indication. 76% used it to enhance concentration capacity, and 41% felt tired after using it. Higher consumption in the first two years.
Silveira RR, Lejderman B, Ferreira PEMS, Rocha GMPR. 2014.	To evaluate the prevalence of MPH use among medical students, to discriminate MPH use, and to correlate with alcohol intake.	Cross-sectional study (n=152)	23.02% used MPH once in life (majority of women). Its use occurred before exams; they started using it in college encouraged by colleagues. A greater use by 6 th year students and nonmedical use of MPH correlated with alcohol abuse
Emanuel RM, Frellsen SL, Kashima KJ, Sanguino SM, Sierles FS, Lazarus CJ. 2013.	To evaluate the use and attitude of stimulant medication by medical students in Chicago-USA	Cross-sectional study (n=1115)	18% of use during life. 57% started using it during College. 63% made illicit use of the drug, having received it from a friend, colleague, relative, or someone they know.
Retief M, Verster C. 2016	Determine the prevalence and correlates of nonmedical use of stimulants as well as subjective opinion on peer numbers using these drugs (South Africa)	Cross-sectional study (n=251)	17% used psychostimulants, but only 2% had diagnosis of ADHD. Higher risk behavior for the use of illicit substances in users of psychostimulants. Most students believe that only a few colleagues use stimulants.
Fallah G, Moudi S, Hamidia A, Bijani A. 2018.	To determine the persistence of the use of stimulants by medical students and residents in the North of Iran	Cross-sectional study (n=444)	11% use stimulants, of which 6.5% use Ritalin. 51% of Ritalin users began with a 5mg dose, and the majority used it to improve focus and concentration.
Javed N, Ahmed F, Saeed S, Amir R, Khan H, Iqbal SP. 2019	Prevalence of non-therapeutic use of MPH and reasons to use (Pakistan)	Cross-sectional study (n=400)	9% used MPH at least once in their lifetime, as most users seek to improve their attention capacity. The main side effects mentioned were lethargy, soreness, and anxiety.

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Table 1. (Continuation) Description of the selected articles.

Author / Year	Objective	Type of study	Main findings
Finger G, da Silva ER, Falavigna A. 2013.	Review the use of methylphenidate in healthy medical students	Literature review (9 articles)	Use in the previous year; the prevalence ranged from 3% to 16%. Current literature does not show sufficient evidence to support MPH use in order to improve cognition. There is no evidence that it enhances the capacity for memorization or associative learning. The drug appears to increase waking hours.
Abbasi-Ghahramanloo A, Fotouhi A, Zeraati H, Rahimi-Movaghar A. 2015.	The persistence of inadequate use of substances and its determinants by medical students in Iran	Cross-sectional study (n=1992)	2,7% used MPH in the previous year to improve academic performance.
Silveira VI, Oliveira RJF, Caixeta MR, Andrade BBP, Siqueira RGL, Santos GB. 2015.	To determine the frequency of psychostimulant use among medical students from a school from the South of Minas Gerais	Cross-sectional study (n=116)	Persistence of 57% of stimulants use (majority women). 95.45% nonmedical use and 87.87% claim that the drugs are effective to extend study periods.
Wasserman JA, Fitzgerald JE, Sunny MA, Cole M, Suminski RR, Dougherty JJ. 2014.	To analyze the nonmedical use of stimulants, in addition to variables linked with academic stress, social media connections, and use of other substances among osteopathmedical students in the Midwest USA	Analytical study (n=380)	Osteopath medical students in the United States showed more frequent use of non-prescribed psychostimulants than the general population.
Roncero C, Egido A, Rodriguez-Cintas L, Perez-Pazos J, Collazos F, Casas M. 2013.	International literature review between 1988 and 2013 about the legal and illegal substances	Literature review (18 articles about stimulants, totaling 13.142 students)	Use rate of 7,7%. Stimulant use is related with moments of academic stress.
Kudlow PA, Naylor KT, Xie B, McIntyre RS. 2013	To evaluate the real and hypothetical use of cognitive enhancers by students in Canada	Cross-sectional study (n=326)	15% with off-label use of one or more pharmaceutical stimulants as a cognitive enhancer.
Micoulaud-Franchi J-A, MacGregor A, Fond G. 2014	Persistence and the reasons to use illegal neuroenhancers in France	Cross-sectional study (n=206 medical students pharmacy students)	Non-clinical use of stimulant medications showing a rate of 5,8%. Most students used to improve academic performance and keep awake.
De Brun S, Wouters E, Ponnet K, Van Hal G. 2019	To answer the questions: Does competition put students under higher stress, increasing the possibility of misuse? Do the levels and interrelations between competition, stress, and misuse vary among students with different post-graduation course aspirations?	Analytical study (n=3.159)	A 2019 Belgium study researched what would be behind the need for cognitive improvement. The perception of the medical school as a competitive environment and high level of stress.
Bidwal MK, Ip EJ, Shah BM, Serino MJ. 2014	To compare the features of pharmacy, medical students, and medical assistants regarding the persistence of drugs, alcohol, and tobacco use and identify risk factors linked to prescribed stimulants. California	Cross-sectional study (n=730)	The use of psychostimulants was higher by doctors' supervisors and medical students than in the pharmacy course. Those three mentioned groups had a two-fold higher stress level than the general population
Jain R, Chang C, Koto M, Geldenhuys A, Nichol R, Joubert G. 2017.	To investigate the persistence of MPH misuse and the knowledge regarding this drug	Cross-sectional study (n=541)	Persistence of use by 9.9%, the majority use it to improve academic performance, and it is used the most by third-year students.
Chandramouleeswaran S, Edwin NC, Rajaleelan W. 2016.	To discuss the prescription of agents that improve cognition in healthy adults	Opinion article	Questions the risks and benefits of the use of cognitive enhancers in healthy adults and their prescription.

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Table 1. (Continuation) Description of the selected articles.

Author / Year	Objective	Type of study	Main findings
Beyer C, Staunton C, Moodley K. 2014.	Presents a potential harm to society and the individual as the long-term side effect profile of this medication is unknown	Debate	The effects of MPH as a significant cognitive enhancer are more subjective than practical, and the existing studies are insufficient to directly answer this medication long-term side effect profile. Finally, the authors discussed ethics in the prescription and use by future doctors.
Cohen JL, Ma E, Rogers AJ. 2017.	The well-being of students in medical schools	Opinion article	Use of psychostimulants among medical students to improve their academic performance. Criticizes medical schools for not evaluating, intervene or question themselves about the nonmedical use of such drugs.

Source: Pubmed e Scielo.

Chart 1. Highlights of the review on the use of psychostimulants by medical students.

Topic	Description
Epidemiological data	<p>Significant variability in use rates (3% to 47%), depending on the location of the study and methodological differences in data collection (use throughout life or after entering University; prescribed or self-recommended use; frequent use or experimentation).</p> <p>Indications of an average rate of use in life are around 10%.</p> <p>Conflicting data regarding gender distribution: some studies point to greater use by men, and others have found no differences.</p> <p>Data are inconclusive regarding the course period most associated with the use.</p> <p>Most studies suggest a preponderance of use after entering University.</p>
Motivations for use	<p>Unlike medical students' usual consumption pattern of other psychoactive substances (recreational use and in social contexts), psychostimulants, particularly MPH, are mostly related to the search for increased waking time and improved concentration, attention, memory, and academic performance.</p>
Use of other substances	<p>Some studies indicate higher consumption rates among students who use other icit and illicit substances - particularly alcohol - however, there are little data on the risks of interaction and abuse or dependence rates.</p>
Risks related to use	<p>Few studies address the topic, but they mainly point out increased anxiety and problems with sleep. There is no confirmation of benefits in cognitive functions, only increased waking time.</p>
The role of the medical school	<p>Articles point to concern about how university disciplines present the substances to the students, as there are indications of greater use after its mention in the initial years of the course.</p> <p>Other studies indicate the need to discuss the topic with students, mainly because they describe behavior facilitated by peers.</p> <p>Additionally, they highlight the importance of addressing the risks of use, self-prescription, and the ethical aspects involved.</p> <p>Few articles discuss, although they point out, the need for studies on issues related to medical education, content, forms of teaching/learning, competitiveness, and mental health of future doctors.</p>

Source: Pubmed e Scielo.

The most recent study in Brazil, published in 2016, showed consumption (at least once in the lifetime) of 20%² of the students, and another study carried out in Rio de Janeiro⁷ in 2013 indicated a rate of 23.7% of use during the lifetime of those students that participated in the study. At a literature review carried out in 2013, it was described, this same group of students, a percentage of use of 3 to 16%¹⁹, while 14.5%¹⁹ admitted they had already used MPH to improve academic performance.

Seven studies were carried out on the difference in use between the genders, without significant differences.

Five, however, indicated a higher rate of consumption of psychostimulants (including MPH) by the male gender^{3,9,15,17,20}, while one of these specified the use of MPH⁹. Only one article described a higher prevalence of use by the female gender²¹.

Some studies suggest that the majority of the medical students that use MPH started using it after entering the University. A study carried out in the USA says that 57% of the interviewed students who had already used MPH declared having started using it during college¹⁵ and a study carried out in Brazil pointed to the fact that 64% of the students with

a background of use claimed they started using this substance during the medical course². In a North American study performed with students of Osteopathic Medicine, the authors found that the frequency of students that admitted the use of psychostimulants without medical indication was higher than the diagnosis rate in the population²².

In a study carried in a University in the Brazilian state of Minas Gerais, half of the students who used psychostimulants did it before the exams²¹. Another study in Puerto Rico found a rate of 60.3%¹². These findings emphasize that the stimulants seem to be considered a facilitator for “good” results in the exams²¹. Other studies also pointed out that the motivation leading to the use of MPH without a medical indication aimed at better academic performance²³, increasing waking hours, improving concentration, attention capacities, and extended memory^{2,3,7,8,9,12,13,14,15,17,18,21,24,25}. In addition, research in Iran revealed the role of social groups in the indication of brain stimulants¹⁷, also considered a motivator for consumption without medical indication.

A Belgium study of 2019, set to investigate what would be “behind” the need of the students seeking cognitive enhancement, questioned 3,159 students that used non-therapeutic stimulant medications²⁶. The authors pointed out that the clearer the perception that the medical school is a competitive environment, the more significant the levels of stress and the higher the probability for inadequate stimulant use. The research reveals that, contrary to expectations, the association of competition with stress was significantly stronger in those students who wanted to become general practitioners, with the consequent use of stimulants, compared to those aiming to have a medical specialization²⁴. In another study, medical supervisors and medical students reported greater use of psychostimulants, without medical indication, than the Pharmacy course students. These three groups showed stress rates roughly two times higher than the adult population in general²⁷.

A study carried out in the state of Rio Grande do Sul, Brazil, determined that 14.3%¹⁴ of the users of stimulants were associated with alcohol consumption, and 5.7% admitted using MPH in parties as well¹⁴. These findings suggest that the most frequent use was not related to social activities or parties, such as the other psychoactive substances, but was probably associated with academic performance improvement. This research also realized that MPH users who used it together with alcohol, with or without a medical prescription, showed alcohol consumption patterns that were considered a health risk¹⁴. The MPH, when associated with alcohol, produces a euphoric effect decreases the sensation of inebriation or drunkenness¹⁴. However, this combination produces a toxic metabolite, and its effect on the organism remain little known¹⁴.

The medical schools in South Africa adopted the posture of not providing information about the indications and effects of MPH in the first five semesters of the course²⁸. They based this decision on research carried out in 2017, in which the higher percentage of consumption was reported by students attending the third year of medical school (18.5%), raising the hypothesis that the knowledge about the pharmacological effects of the substance can contribute to its demand and misuse²⁸.

Brazilian and Paraguayan studies found a higher rate of psychostimulant consumption (including caffeine, methylphenidate, modafinil, piracetam, energy drinks, and amphetamines) by the students attending the first years of medical school. In the state of Rio Grande do Sul, the rates were decreasing according to the year of the course: from 69.2% in the 1st year, to 61.5% in the 2nd, 40.8% in the 3rd year, and 34.8% in the 4th year² moreover, in the state of Minas Gerais the rates went from 65.78% in the 1st year, to 64.10% in the 2nd and 41.02% in the 3rd year²¹; furthermore, in *Universidad Internacional Tres Fronteras*, in Paraguay, the rates were 22% in the first year, 32% in the second, 18% in the third and 14% in the fourth and fifth years¹³, differently from those observed in the American²⁸ and Puerto Rican¹² studies, which showed similar rates among all years.

One aspect that deserves special attention is the obtaining of a controlled medication without an appropriate prescription. MPH is sold only under medical prescription in Brazil and other countries. In Brazil, the prescription necessarily requires the yellow prescription pad for controlled drugs (A3). In addition, the packaging has a black strip across the box, which indicates that it can only be sold with a medical prescription, and it carries information concerning the risk of chemical and psychological dependence according to specifications 344 of SVS/MS Ordinance of May, 1998²⁹. Despite these measures, a recent study showed that 24.3% of the MPH user students obtained it through a ‘self-written prescription,’ and 15% obtained it from a friend¹².

This fact flashes a red alert on the risks of self-medication and the importance of medical assessment for the consumption of prescribed medications by undergraduate medical students. An Iranian study pointed to a rate of 4.9% related to the misuse of medicaments requiring a medical prescription (in this study, opioids, tranquilizers, and MPH were taken into consideration)²⁰. Considering that all of them are medications that offer risks of dependence, it is relevant to question whether the easy access to these drugs can contribute to this self-medication behavior and the trivialization of the use by future doctors.

Despite the known potential dependence properties of the substance, the only cross-sectional study carried out in the state of Rio de Janeiro, Brazil, showed a prevalence of 10.8%⁷ of students that claimed they had to increase the dose to attain the

same effect, suggesting a possible development of tolerance, one of the diagnostic criteria for dependence⁵. Although the included articles have not explored MPH dependence in detail, suggestions were there for broader research on this topic¹⁴. Some references deal with the dependence on this medication as something more theoretical than practical³; however, the increase in consumption by the young people seeking cognitive enhancement deserves attention and care, for its use without therapeutic indication can raise the potential of dependence. According to Dafny⁵, sensitization can increase the experienced effects when compared to those experienced at the first use of the same dose, which can be considered an additional warning signal for the need to evaluate groups regarding the chemical dependence.

An US article published in 2013 measured the consumption pattern of stimulants, with a predominance of amphetamine salts and MPH¹⁵. Among the users, an average frequency of drug use ranged from 10 to 12 occasions during a 30 day period, which consisted in most cases in oral administration (92%), with a smaller percentage (18%) of inhaled administration, associated or not with oral administration¹³. In 2018, an Iranian study demonstrated that most interviewed individuals consumed these substances through an oral route (79.6%). However, 6.1% said they consumed it by an intravenous route and 2% by the inhaled route¹⁷. Thus, although the selected studies indicate the use of MPH primarily by oral administration, it is essential to follow a possible increase in the other means of administration of these substances, keeping in mind that the use of intravenous or intranasal drugs implies more severe damage and potential risks such as of overdose.

Addressing the possible consequences of MPH use, Beyer³⁰ points to the need for more comprehensive studies that demonstrate whether the cognitive improvement justifies the risk of eventual harm to the body. Moreover, a study with undergraduate medical students disclosed the presence of side effects, among them, body pain, headache, tachycardia, anxiety¹⁸, cardiac arrhythmias and glaucoma³⁰ in African undergraduate students, and in Paraguayan undergraduate students, tachycardia, decreased appetite and tremors¹³.

The therapeutic effects of MPH on those suffering from ADHD appeal to the students without such diagnosis^{2,10}. Nevertheless, using the substance as an intensifier to attain success in exams³¹ can harm the cognitive functions, such as the capacity to solve problems¹, in addition the risk of acquiring a chemical dependence^{5,6,19}. These consequences can, in turn, worsen academic performance, making what seemed an apparent advantage a new problem to be dealt with³¹.

Besides this, an Indian study addressed some ethical questions concerning the prescription of cognitive stimulants

to individuals who do not need them, creating an even more severe behavioral problem when they are self-prescribed by future doctors^{30,32}. Furthermore, this study proposes a reflection about the competition for higher grades among medical students and the use of medications to boost this performance, since the stimulant does not create skills, but rather intensifies a condition that already exists in a person, which can be improved through different strategies, not of a pharmacological nature and exempt from acute and chronic risks³¹.

National^{33,34} and international^{35,36} studies have pointed out that the required workload and the predominantly transmitting pedagogy, combined with impacts on lifestyle, social relationships, and poor sleep quality, have been associated with emotional exhaustion, dehumanization, and feelings of dissatisfaction and inefficiency among medical students. The students report factors related to a decrease in their quality of life, including competition, unprepared teachers, excess of activities, medical school schedules that demand exclusive dedication, contact with pain, death, and suffering, and harsh social realities, as well as frustrations with the program and insecurity regarding their professional future. The scarcity of time for studying, leisure activities, relationships, and rest can influence the use of substances, including psychostimulants. These data indicate the necessity of national quantitative and qualitative studies to discuss these difficulties in our universities and subsidize ways of approaching them adapted to our scenario.

CONCLUSION

An analysis of the articles reveals that MPH misuse consumption rates among medical students is a matter of concern. The undergraduate medical school students that use the substance without medical indication, generally speaking, resort to MPH to enhance academic performance, both in the study and when facing exams. Few studies have evaluated the cognitive, behavioral, and psychological risks, including the dependence associated with such consumption patterns. Finally, some studies addressed the ethical aspects related to the context of use, besides the trivialization of self-prescribed medicines.

Considering this scenario, we highlight the importance of prevention actions inside medical schools, by providing information concerning the risks of MPH consumption without clinical indication, educational programs that can help to deal with the University routine, behavioral strategies aimed to improve cognitive performance, with emphasis on measures covering sleep hygiene, study organization, mnemonic activities and the valorization of measures that improve quality of life, such as physical and recreational activities. Such initiatives can stimulate the self-confidence

of innate capabilities and contribute to maintain the future doctors' physical and mental health.

AUTHORS' CONTRIBUTION

Natália Aparecida Amaral ontributed with the study design, research, data analysis and the writing of the manuscript; Eliza Maria Tamashiro contributed with the writing of the manuscript and data analysis; Eloisa Helena Rubello Valler Celeri, Amilton dos Santos Júnior and Paulo Dalgalarondo were responsible for the overall review and final approval of the manuscript and Renata Cruz Soares de Azevedo was the advisor, study supervisor and contributed with the study performance, data analysis, drafting and final approval of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

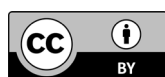
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