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Prevalence of Psychostimulant Drug Use Among Medical Students and Specialty Residents in Chilean Universities

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Prevalencia del consumo de fármacos psicoestimulantes entre estudiantes de medicina y médicos residentes de especialidad en universidades chilenas

ABSTRACT

Psychostimulants are used to enhance cognitive functions such as attention and alertness, particularly in contexts of high academic demand. ***Aim:*** *This study aims to assess the prevalence of psychostimulant use among medical students and residents in Chile, identifying associated factors such as academic stress, level of training, and contextual elements.* ***Methods:*** *A cross-sectional study was conducted through a survey administered to 314 participants, the majority of whom were female (72.3%), with 38.2% being 6th-7th year medical students and residents.* ***Results:*** *The results revealed that among responders, 17.8% reported using methylphenidate (MPH), 13% lisdexamfetamine (LDX/AMPH), and 11.4% modafinil, with a low proportion consuming them under medical prescription. A significant association was found between high levels of academic stress and the use of modafinil (p=0.023). Additionally, a significant association between academic progression and LDX/AMPH use was found (p=0.0077).* ***Conclusions:*** *The use of psychostimulants among medical students raises ethical and public health concerns, considering the risks of dependency, adverse effects, and academic inequalities. The consumption of psychostimulants is high among medical students and residents in Chile, particularly in advanced stages of training. It highlights the need for ethical and educational interventions in the academic environment.*

Keywords: *Central Nervous System Stimulants; Medical Students; Methylphenidate; Modafinil; Prevalence.*

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RESUMEN

Los psicoestimulantes se utilizan para mejorar funciones cognitivas como la atención y el estado de alerta, especialmente en contextos de alta exigencia académica. ***Objetivo:*** *Evaluar la prevalencia del consumo de psicoestimulantes entre estudiantes de medicina y médicos residentes en Chile, identificando factores asociados como el estrés académico, el nivel de formación y elementos contextuales.* ***Métodos:*** *Se realizó un estudio transversal mediante una encuesta aplicada a 314 participantes, en su mayoría mujeres (72,3%), siendo el 38,2% estudiantes de medicina de 6°-7° año y residentes.* ***Resultados:*** *Entre los encuestados, el 17,8% reportó consumo de metilfenidato (MPH), el 13% de lisdexanfetamina (LDX/AMPH) y el 11,4% de modafinilo, con una baja proporción de uso bajo prescripción médica. Se observó una asociación significativa entre altos niveles de estrés académico y el uso de modafinilo (p=0,023). Además, se encontró una asociación significativa entre la etapa de la carrera y el uso de LDX/AMPH (p=0,0077).* ***Conclusiones:*** *El consumo de psicoestimulantes entre estudiantes de medicina plantea preocupaciones éticas y de salud pública, considerando los riesgos de dependencia, efectos adversos y desigualdades académicas. El uso de estos fármacos es elevado entre estudiantes y residentes en etapas avanzadas de formación, lo que subraya la necesidad de intervenciones éticas y educativas en el entorno académico.*

Palabras clave: *Estimulantes del Sistema Nervioso Central; Estudiantes de Medicina; Metilfenidato; Modafinilo; Prevalencia.*

Psychostimulants are a heterogeneous group of chemical substances that act on the central nervous system and regulate superior cerebral functions, modifying behavior[1]. The primary characteristic of these drugs is their ability to enhance attention, alertness, and cognitive functions. This category of drugs is diverse and includes compounds ranging from caffeine up to highly addictive drugs such as cocaine and amphetamines, among others. According to the "Décimo Cuarto Estudio Nacional de Drogas en Población General" of Chile in 2020[2], the highest prevalence of marijuana, cocaine and energy drinks consumption is found in the age group of 19 to 25 years, which coincides with the typical age range for higher education students.

It is globally recognized[3,4] that university students, when facing a high academic workload, often use psychostimulant drugs to enhance cognitive performance. This is based on the belief that these substances improve aspects such as alertness, memory, attention maintenance, and vigilance for extended periods, resulting in optimal academic outcomes[5]. However, according to the evidence, the efficacy in this regard is still questionable and involves a series of potential adverse effects[5,6,7]. Thus, while some benefits have been demonstrated when used in small doses and in moderation, it has been observed that their excessive use could be detrimental, for example, by increasing fatigue levels[8], and even leading to dependency or significant cardiovascular side effects[3,9].

It is also noteworthy that the consumption of potentially addictive drugs during mid or late adolescence (i.e. 15-25 years old), has been related with a greater vulnerability to drug use disorders in adulthood[10].

As the number of individuals, particularly university students, using substances to enhance cognitive performance continues to rise, the high levels of stress and the demanding nature of medical education, faced both at the beginning and throughout their studies, make the use of these drugs particularly prevalent among medical students[11].

Psychostimulants are the most used group of pharmacological cognitive enhancers (PCEs)[12], with methylphenidate (MPH) and amphetamine-based compounds (e.g. amphetamine -AMPH- or lisdexamfetamine -LDX-) standing out. While these substances are FDA-approved for the treatment of attention-deficit/hyperactivity disorder (ADHD), they are classified as Schedule II controlled substances by the U.S. Drug Enforcement Administration due to their high potential for dependency[13].

On the other hand, modafinil is a non-amphetamine stimulant primarily approved for the treatment of narcolepsy and other sleep disorders, such as sleep apnea and shift work sleep disorder. Its main function is to promote wakefulness and reduce excessive daytime sleepiness[14]. In healthy individuals, modafinil can extend wakefulness for up to 12 hours, making it advantageous in high-demand situations or under tight deadlines[15,16]. Unlike other stimulants, such as amphetamines or MPH, modafinil is classified by the U.S. Drug Enforcement Administration as a Schedule IV substance, reflecting its lower potential for abuse and dependence compared to other controlled substances. Nonetheless, a prescription is still required for its acquisition. Despite this regulation, these medications have gained popularity among many students seeking to enhance academic performance. However, this practice lacks solid evidence of efficacy and is frequently undertaken without medical indication[17].

In a related context, in 2021 in Chile, the "second study on drug use in higher education" analyzed the consumption of alcohol, marijuana, tranquilizers, pain relievers, cocaine, ecstasy, and crack cocaine[18]. However, the study did not address the use of amphetamine-based psychotropic drugs, methylphenidate, or modafinil. This gap underscores the need to document the prevalence of these substances among medical students in Chile.

In addition, it is of interest to investigate whether consumption patterns observed in other parts of the world[19,20,21,22] are replicated in medical students in our country. Furthermore, it would be valuable to explore the prevalence of psychostimulant drug use among physicians currently undergoing specialization (residents), as there is limited research on this population. Thus, consumption in this group may be facilitated by greater economic independence, easier access to medical prescriptions, as well as being in a competitive environment that demands increased academic rigor and new occupational responsibilities[23].

Therefore, the aim of this study was to investigate the prevalence of psychotropic drug use among medical students and specialty residents in various universities in Chile, with an emphasis on psychostimulants with medical use. A secondary aim was to assess whether the use of psychotropic drugs is associated with factors such as years of study progress, stress levels, gender, and other variables.

Methods

Study design

This study employed a descriptive, cross-sectional observational approach utilizing a survey as its measurement instrument. The survey (kindly provided by Dr. M.F. Martins, Dr. S. Vanoni and Dr. V.P. Carlini, Universidad Nacional de Córdoba, Argentina), previously validated by an expert committee at the University of Córdoba, was adapted to the local context[19]. This survey was selected as it was built and applied considering a population with a similar cultural and regional background to that included in the present study.

Consisting of 16 questions, the survey evaluates epidemiological and academic variables specifically related to the field of Medicine, alongside aspects of psychoactive substance use.

Regarding the academic variables considered, the following were assessed: "year of the program", "whether the participant is up to date with the program", "perception of academic performance", "self-assessed level of difficulty of the program", "self-perceived level of stress related to studies", and "average hours of sleep the night before an exam".

The questionnaire was built in Google Forms, and the corresponding link was shared with medical students and residents from various universities in Chile. Dissemination was facilitated through their respective faculty and student organizations, including the International Federation of Medical Students' Associations (IFMSA) and the Scientific Academy of Medical Students (ACEM), using platforms such as Gmail, Instagram, Whatsapp, etc.

Study population

The inclusion criteria for study participation encompassed regular Medicine students from the first to the seventh year and medical specialty students (residents) from any Chilean university. Medical students on temporary leave at the time of survey completion were excluded.

To estimate an appropriate sample size for the study universe, data from the 2022 Chilean universities admission process[24] were utilized to determine the number of available positions for medical students in each university. This total was multiplied by the 7-year duration of the program to estimate the overall number of medical students in Chile. The number of specialty residents granted from 2018 to 2021[25] was averaged across those years and multiplied by 3.5 (average duration of specialties in Chile) to estimate the total number of specialty students in Chile. The sum of both values resulted in a universe of 17,349 students. The sample size (n) for the study was calculated with a 95% confidence interval and a 5.5% margin of error using the Sample Size Calculator SurveyMonkey, resulting in n=312.

Measures

Psychotropic drug use served as the independent variable, and associations with other study variables, both academic and epidemiological, were explored.

The obtained data ensured complete anonymity and confidentiality, as participants were not required to provide their names or email addresses. Furthermore, all participants provided their informed consent before completing the survey. This research was approved by the University of Santiago de Chile Institutional Ethics Committee (N°543/2022).

Statistical analysis

Statistical analysis was performed with the frequency of occurrence in absolute values and participants were considered consumers of a given drug, if they reported using it "a few times a month", "a few times a week," or "every day". Responses of "rarely" or "never," were categorized as non-consumption. Descriptive statistics characterize the data, presenting the frequency of occurrence in absolute values, percentages, and measures of central tendency. In order to analyze the association between the different variables (Table 1) and psychostimulant consumption, a Multivariate Logistic Regression Analysis was performed for each drug.

The statistical analysis was done in GraphPad Prism v10.6 (GraphPad Software, San Diego, CA).

Table 1. Sociodemographic and academic characteristics of the participants.

Analyzed variables	**Results % (n)**
Sex	Female: 72.3% (221) Male: 27.1% (85) Prefer not to say: 0.6% (2)
Work	14.3% (45)
Sports	53.5% (168)
Arts activities	18.8% (59)
Other extracurricular activities	27.7% (87)
Without extra activities	22.3% (70)
Year of the career	1st: 3.8% (12) 2nd: 7% (22) 3rd: 15% (47) 4th: 16.9% (53) 5th: 19.1% (60) 6th: 18.2% (57) 7th: 12.7% (40) Residents: 7.3% (23)
Academic difficulties	In the correct year of career: 74.8% (235) Self-perception of academic performance: Satisfied: 28% (59) Somewhat satisfied: 53.2% (167) Unsatisfied: 18.8% (59) Self-assessed level of difficulty of the program: Very difficult: 12.1% (38) Difficult: 62.7% (197) Intermediate: 25.2% (79) Easy: 0% (0) Self-perceived level of stress related to studies: High stress: 55.7% (175) Moderate stress: 42% (132) Low stress: 2.2% (7) Average hours of sleep the night before an exam Pre-exam sleep < 4 hours: 32.8% (103) Pre-exam sleep 4-7 hours: 58.6% (184) Pre-exam sleep > 7 hours: 8.6% (27)

Results

A total of 314 participants completed the survey between November 2021 and March 2022. The majority were females (72,3%), and 38.2% were either interns or residents. Socio-demographic and academic variables are shown in Table 1.

Participants were considered consumers of a given drug, if they reported using it "a few times a month", "a few times a week," or "every day". Responses of "rarely" or "never," were categorized as non-consumption. Among those surveyed, 98.4% reported consuming at least one of the psychotropic substances evaluated. The consumption rate was 94.2% for coffee, tea, or mate and 51.9% for energy drinks. Reported rates of use of MPH, marihuana, LDX/AMPH (for the sake of clarity, data of consumption of LDX and AMPH were grouped, since ultimately both preparations involve the same active compound), or modafinil were 17.8%, 15.2%, 13%, and 11.4%, respectively. The frequencies of consumption, i.e. "every day," "a few times a week," "a few times a month," "rarely," and "never" for each psychoactive substance are highlighted in Table 2.

In line with the study objectives, the use of MPH, modafinil, and LDX/AMPH was analyzed in relation to several variables. Most users of MPH (58.9%; n = 33) and LDX/AMPH (58.5%; n = 24) reported consuming these substances under medical prescription (Figure 1). Consistently, the multivariate logistic regression analysis indicated a significant association between the use of these psychostimulants and medical prescription (MPH: OR = 5.46; 95% CI: 2.62–11.75; $p < 0.0001$; LDX/AMPH: OR = 5.05; 95% CI: 2.10–12.66; $p = 0.0003$). In contrast, only 27.8% (n = 10) of modafinil users reported using this drug under medical prescription (Figure 1).

Table 2. Rates of use for the different psychotropic substances

Psychotropic	everyday % (n)	a few times a week % (n)	a few times a month % (n)	Rarely % (n)	Never % (n)
Coffee, tea, mate	58.3 (183)	24.8 (78)	11.1 (35)	4.5 (14)	1.3 (4)
Energy drinks	5.1 (16)	23.6 (74)	23.2 (73)	19.7 (62)	28.3 (89)
Methylphenidate	7.6 (24)	4.8 (15)	5.4 (17)	8.3 (26)	73.9 (232)
Marijuana	1.6 (5)	6.1 (19)	7.6 (24)	23.2 (73)	61.5 (193)
Lisdexamfetamine/ amphetamine[a]	6.1 (19)	3.5 (11)	3.5 (11)	2.9 (9)	84.1 (264)
Modafinil	3.2 (10)	2.9 (9)	5.4 (17)	11.1 (35)	77.4 (243)
Cocaine	0 (0)	0 (0)	0 (0)	0.6 (2)	99.4 (312)
Tussi[b]	0 (0)	0 (0)	0 (0)	2.5 (8)	97.5 (306)
Ketamine	0 (0)	0 (0)	0.3 (1)	0.3 (1)	99.4 (312)

[a]data for lisdexamfetamine and amphetamine were grouped. [b]the most common street name in Chile for 4-bromo-2,5-dimethoxyphenethylamine or 2C-B.

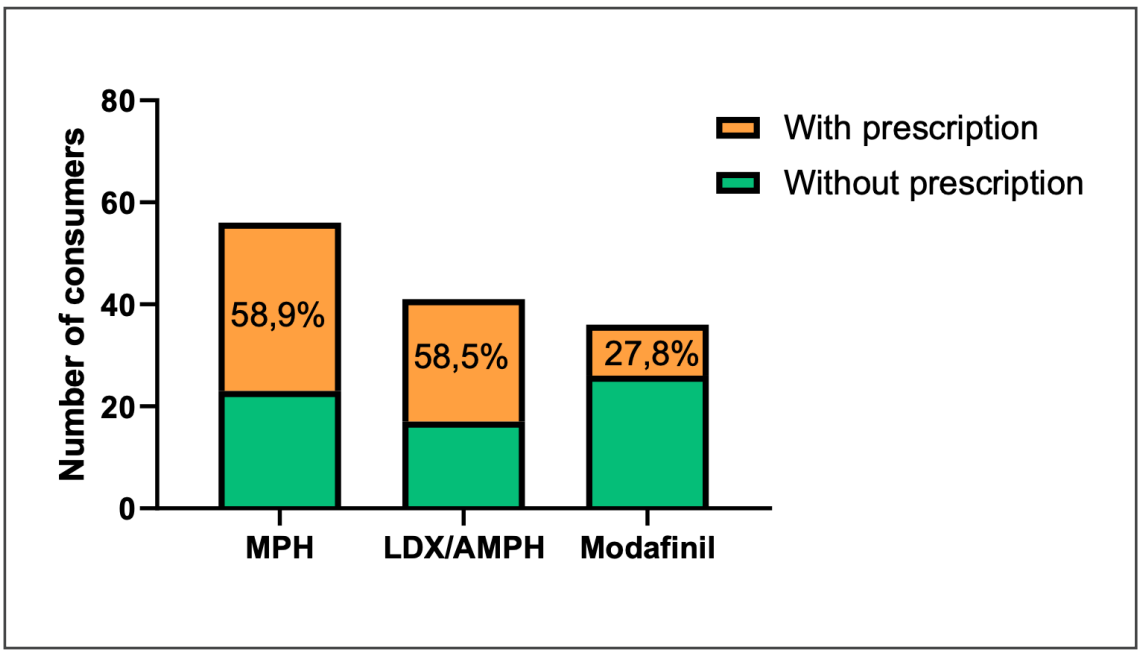

Figure 1: *Number of consumers of methylphenidate (MPH), lisdexamfetamine/amphetamine (LDX/AMPH) and modafinil with (orange) and without (green) medical prescription. The percentage of consumers with medical prescriptions is included within each bar.*

A significant negative association was observed between MPH use and participation in extracurricular activities (OR = 0.42; 95% CI: 0.18–0.98; p = 0.044), suggesting that engagement in activities beyond formal academic training may act as a protective factor (Table 3).

Regarding the year of study, a significant association was found with LDX/AMPH use (OR = 2.31; 95% CI: 1.27–4.55; p = 0.0077), indicating that consumption increased with academic progression (Table 3).

In addition, modafinil use was significantly associated with self-perceived stress levels (OR = 2.64; 95% CI: 1.14–6.78; p = 0.023), suggesting that higher stress levels were linked to greater likelihood of use (Table 3).

Finally, no significant association was observed between the use of any of these psychostimulants and gender (Table 3).

Table 3. Multivariate Logistic Regression Analysis evaluating the association between the different variables and methylphenidate (MPH), lisdexamfetamine/amphetamine (LDX/AMPH) or modafinil consumption.

	Modafinil			MPH			LDX/AMPH		
Variable	**OR**	**IC95%**	**p**	**OR**	**IC95%**	**p**	**OR**	**IC95%**	**p**
Gender	1.321	0.545–3.067	0.528	1.099	0.477–2.447	0.82	1.192	0.454–2.995	0.135
Academic progression	0.841	0.495–1.437	0.522	1.042	0.654–1.673	0.864	2.305	1.266–4.553	0.0077*
Medical prescription	0.927	0.366–2.192	0.867	5.461	2.615–11.75	0.0001*	5.047	2.104–12.66	0.0003*
Extracurricular activities	2.101	0.739–7.590	0.173	0.421	0.183–0.976	0.0439*	0.846	0.307–2.544	0.096
Self-perceived stress levels	2.636	1.135–6.777	0.023*	1.533	0.721–3.406	0.271	1.338	0.560–3.405	0.416

*p<0.05; OR: odd ratio; IC: interval of confidence.

Discussion

The aim of this study was to determine the prevalence of psychostimulants drug use among medical students and specialty residents in Chilean universities.

The survey results indicated no significant association between psychotropic drug use and gender. Similarly, García de Oliveira and colleagues[26] described two independent cross-sectional studies conducted five years apart to assess drug use among medical students in São Paulo. Their findings revealed that amphetamine use was initially more prevalent among women. However, after five years, amphetamine use among men increased to nearly the same level as in women, a result that slightly differs from other studies. Moreover, among men, amphetamine use replaced cocaine as one of the most consumed substances[26]. In addition, a study conducted on medical students and residents in France found no significant differences between men and women in the use of caffeine pills/energy drinks, or prescription psychostimulants. This suggests that men and women are equally likely to use psychostimulants to enhance academic performance, attention, concentration, or wakefulness[23]. Consistent with these findings, other researchers have also reported no significant gender differences in the use of MPH or amphetamines[27,28,29]. In contrast, other studies have observed significant gender differences in psychotropic drug use, with higher consumption of modafinil and MPH among men as compared to women[3,19,30,31]. It is important to note that, in our study, the majority of respondents were women (72.3%), which limits the conclusions that can be drawn regarding gender differences and represents one of the study's limitations.

When examining the possible relationship

between academic year and substance use, a statistically significant association was found between the use of LDX/AMPH and academic progression. This relationship could be influenced by factors such as increased academic difficulty, heightened stress levels, and the greater capacity acquired at the final stages of training.

In accordance with this idea, an analysis of the relationship between academic stress levels and the use of these psychotropic drugs revealed a statistically significant association between high levels of academic stress and increased consumption of modafinil.

Despite the common assumption that first-year students facing new academic pressures would exhibit a higher prevalence of psychotropic drug use, other authors have also reported findings similar to our results. Moreover, several studies have demonstrated a significant association between age and psychotropic drug use[32]. A study conducted among medical students at the National University of Córdoba (using the same instrument employed here) indicated a clear upward trend in the use of modafinil and/or MPH as students advanced in their medical training[19]. Similarly, research by Acosta and colleagues[28] showed a significant difference in the use of amphetamine-based drugs and MPH across different age groups. Specifically, the highest consumption was observed among individuals aged 27 to 30 years, compared to those aged 23 to 26, despite a greater number of responses from the latter group.

In line with these findings, a study conducted at two universities in the metropolitan area of Florianopolis found that the non-prescribed use of MPH and amphetamines for academic performance was significantly associated with older age, cannabis use in the previous month, higher scores on the Alcohol Use Disorders Identification Test - Consumption (AUDIT-C), lower scores on the Big Five Inventory (BFI) conscientiousness domain, and positive screening on the Adult ADHD Self-Report Scale (ASRS)[33].

A study conducted at a large osteopathic medical school in the Midwestern United States surveyed 380 students. The proportion of students reporting non-medical use of prescription stimulants to aid their studies was significantly higher than the national estimated rate of ADHD diagnosis in comparable populations[34]. Furthermore, other studies have indicated that most students using psychotropic drugs do so for cognitive enhancement rather than for medical purposes[35,36]. In our study, a high percentage of psychostimulant users also reported consumption without a medical prescription (particularly modafinil). In addition, the percentage of students using MPH, modafinil or LDX/AMPH with a medical prescription was also much higher than the global prevalence rate of ADHD in adults, which has been estimated to be 1.4–3.4%[37]. Therefore, it would be important to investigate whether high-demand, high-stress careers contribute to an increased ADHD diagnosis rate, or if high prescription rates are driven by other factors.

Positive perceptions of non-medical stimulant use and the use of other substances have been reported to be strongly associated with non-medical stimulant use[34]. Furthermore, results from the same study also indicated that stress and competitiveness were not associated with the use of psychostimulants[34]. In contrast, our results indicate that consumption of modafinil was positively correlated with the level of self-perceived stress. Consistent with our findings, Acosta et al. reported that as self-assessed stress levels increase from low to high, the prevalence of psychotropic drug use also rises[28]. A number of other investigations have also found significant associations between stress level and stimulants use in medical and other college students[3,38,39].

Regarding medical residents, a study by Rubin-Kahana et al., (2020)[40] on the prevalence of non-medical drug use for cognitive enhancement among Israeli residents revealed that 28.1% of survey participants reported past drug use, with 73.67% using drugs without a related medical diagnosis. Nearly half (47.1%) of users obtained the substances through a prescription, despite lacking a medical condition. The initiation of drug use primarily occurred during residency (54.3%). Positive factors influencing non-medical drug use included self-reported undiagnosed ADHD, fear of failing exams, the belief that over 30% of peers

use cognitive-enhancing drugs, and a diagnosis of a learning disability. In contrast, self-identification as a competitive individual and being a parent were negatively associated with drug use[40].

Among advanced students and residents, the increased use of non-prescription psychotropic drugs may be related to growing academic pressures, coupled with greater knowledge of these drugs' availability, their effects, and easier access to them. These factors likely contribute to a greater use of psychostimulants in the belief they enable longer study hours, improved concentration, and sustained wakefulness. However, it is essential to consider that stimulant medications are associated with common side effects (e.g., insomnia), as well as less common but more severe effects (e.g., arrhythmias) and their potential for dependency[6,41].

To better understand the relationship between popular stimulants and cognitive enhancement, it is critical to consider the Yerkes-Dodson law, which describes the relationship between arousal levels and performance. This law suggests that the effects of stimulants follow a dose-dependent continuum: low doses may achieve optimal psychoactivation, enhancing cognition, while exceeding the effective dose leads to cognitive deficits, psychomotor agitation, and addiction. Numerous studies have repeatedly confirmed this theory. Additionally, modafinil warrants specific attention as a distinct stimulant with a unique neurochemical profile and behavioral effects, differentiating it from others[12].

An important limitation of this study is that the survey was distributed via social media and email on a voluntary basis, which introduces likely self-selection bias and may compromise sample representativeness. Respondents who choose to participate in digital calls may differ from the wider population of students (for example, greater interest in the topic, prior experience with stimulants, or different reporting attitudes), potentially leading to over- or under-representation of users. Furthermore, as the study relies on self-reports of substance use, there is a risk of under-reporting due to social desirability or stigma; comparative studies using biological measures (urine, hair) indicate that self-reports often detect less use than objective tests, particularly for infrequent use or for more stigmatized substances[42]. These limitations may affect the external validity of the findings and suggest cautious interpretation of prevalence estimates and associations; future studies should consider probability-based sampling, biological verification, or statistical adjustments to mitigate selection bias.

Concluding Remarks

Our data indicate that, as observed in other studies, medical students in Chile consume prescription psychostimulants at higher rates than general healthy population[42]. Moreover, this consumption does not appear to be occasional but rather follows a relatively stable pattern. Remarkably, the highest consumption rates were reported among students who have extensive contact with patients (6th-7th year students and residents). While psychostimulants can offer potential benefits such as enhanced mental alertness, memory, and wakefulness, these compounds can also influence behavior and may induce side effects such as euphoria and anxiety. Thus, a major concern arises regarding how the doctor-patient relationship could be affected when a physician is under the effects of these substances.

In agreement with previous reports[44,45], high levels of stress, mostly related with academic demands, were found to be correlated with higher rates of psychostimulants use, with many users (40-70%) consuming these drugs in the absence of a medical condition. Although debatable[46,47], the use of these drugs to cope with rigorous academic or professional obligations might be viewed as a form of "intellectual doping", potentially leading to inequality in academic settings.

Despite these considerations, as the use of medications to enhance cognitive performance continues to rise, especially among college students, both health and ethical concerns must be addressed, particularly at university institutions.

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