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Substance Use among Medical Students: A Literature Review 1988-2013

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The use of legal and illegal substances by medical students is a phenomenon that is only partially known. The aim of this paper was to review the literature published internationally in the last 25 years about the use of legal and illegal substances by medical students. A systematic search was made of MEDLINE and LILACS. One hundred and six manuscripts were evaluated, which included a population of 88,413 medical students. We validated 74,001 questionnaires, which represented 83.7% of responses. The methodology and the rigor of its application are not the same in all the publications. There are many regional variations, most studies being made in America and Europe. With the exception of alcohol in some areas of the Western world, medical students use substances less than university students in general and the general population. The substances used are mainly alcohol (24%), tobacco (17.2%), and cannabis (11.8%). The use of hypnotic and sedative drugs also is common (9.9%). The rate of use of stimulants is 7.7% and of cocaine, 2.1%; opiate use being very low (0.4%). In some parts of Latin America, up to 14.1% use inhalants. Students in the last years of school have a higher rate of substance use. The use of substances, except for hypnotics and sedatives, is more common among men than women. The use of substances by medical students is a phenomenon that should be evaluated systematically due to its prevalence and potential impact.

Keywords: Medical students, Substance abuse, Addiction, Alcohol, Tobacco, Sedatives

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Consumo de drogas entre los estudiantes de medicina: Una revisión de la literatura 1988-2013

El consumo de drogas legales e ilegales entre los estudiantes de medicina es un fenómeno parcialmente conocido. El objetivo de este trabajo es revisar la literatura internacional publicada, en los últimos 25 años, sobre el consumo de drogas legales e ilegales entre los estudiantes de medicina. Se realizó una búsqueda sistemática en MEDLINE y LILACS. Se evaluaron 106 manuscritos, que incluían 88.413 estudiantes de medicina. Se validaron 74.001 cuestionarios que representan el 83,7% de respuestas. La metodología y rigurosidad no son homogéneas en todas las publicaciones. Existen muchas variaciones regionales, siendo América y Europa las zonas en las que se han realizado más trabajos. Con la excepción del alcohol, en algunas zonas de occidente, los estudiantes de medicina consumen menos que los estudiantes universitarios en general y que la población general coetánea. Los consumos son principalmente de alcohol (24%), tabaco (17,2%) y cannabis (11,8%). También el consumo de fármacos hipnosedantes es frecuente (9,9%). El uso de estimulantes es del 7,7%, de cocaína es del 2,1%, siendo el de opiáceos muy reducido (0,4%). En algunas zonas de Latinoamérica hasta el 14,1% consumen inhalantes. Los estudiantes de los últimos años de carrera consumen más. El consumo de drogas es superior en los varones respecto a las mujeres, exceptuando los hipnosedantes. El consumo en estudiantes de medicina es un fenómeno que, por su prevalencia y posibles repercusiones, debe ser sistemáticamente evaluado.

Palabras clave: Estudiantes de medicina, Consumo de drogas, Adicción, Alcohol, Tabaco, Sedantes

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INTRODUCTION

The overall increase of drug use in recent decades has been documented in numerous reports.¹ At present there is concern about combined substance abuse, the emergence of new psychoactive substances, and the expansion of the market for amphetamines and tranquilizers.² In the European report on drugs, a decrease in the demand and availability of heroin, cocaine and ecstasy, and an increase in the use of stimulants (amphetamine and methamphetamine) have been documented. Cannabis use shows signs of decreasing in some countries, but it is generally still important.³ The rates of alcohol and tobacco use are stabilized in a large proportion of users, but there is increased recreational use in countries that previously had low rates of alcohol and tobacco use.³

The onset of substance abuse usually occurs in adolescence and early adulthood.^{2,3} Medical students are in this age range and will soon become part of the health care system as doctors. Physicians are a key element in the treatment of problems associated with substance abuse, which is why medical schools should train medical students to understand the risk inherent in the use of addictive substances because, in the future, they will have to prevent, diagnose, and treat substance abuse by their patients.⁴ The study of substance abuse by medical students is also important because the perception and detection of patients with substance abuse problems may be influenced by physicians' experience with substance abuse.⁵ Therefore, medical students should know the most prevalent types of substance abuse, the risk factors associated with substance abuse or dependence among medical students, and whether or not there are geographical or other differences in specific types of substance abuse. However, despite the relevance of this issue, there are no up-to-date reviews on substance abuse among medical students, or on the existence of geographic differences in substance abuse.

The aim of this paper is to review the literature published in the last 25 years on the epidemiology of the use of legal and illegal drugs among medical students and to describe the prevalence of substance abuse by both geographical area and the substance used.

MATERIAL AND METHODS

A systematic search was made of the MEDLINE and LILACS databases. A similar search strategy was used in both databases. The MeSH Subject Headings used covered illegal substances and alcohol, as well as tobacco. Finally, the following strategy was used to search MEDLINE, based on *MeSH* and *Major Topics*, in addition to filters for date, the existence of an abstract, and the English and Spanish languages:

((((((((((((((("Substance-Related Disorders/prevention and control"[Mesh] OR "Substance-Related Disorders/statistics and numerical data"[Mesh])) OR "Street Drugs/statistics and numerical data"[Mesh] OR "Designer Drugs/statistics and numerical data"[Mesh] OR ("Tobacco Use Disorder"[Mesh] OR "Smoking"[Mesh] OR "Tobacco Use Cessation"[Mesh])) AND ("Students, Medical/organization and administration"[Majr] OR "Students, Medical/psychology"[Majr] OR "Students, Medical/standards"[Majr] OR "Students, Medical/statistics and numerical data"[Majr] OR "Students, Medical/trends"[Majr])) AND (hasabstract[text] AND ("1988/01/01"[PDat] : "2013/12/31"[PDat]) AND (English[lang] OR Spanish[lang]))) NOT "training"[Title] AND (hasabstract[text] AND ("1988/01/01"[PDat] : "2013/12/31"[PDat]) AND (English[lang] OR Spanish[lang]))) NOT "cancer" AND (hasabstract[text] AND ("1988/01/01"[PDat] : "2013/12/31"[PDat]) AND (English[lang] OR Spanish[lang]))) NOT "teaching"[Title/Abstract] AND (hasabstract[text] AND ("1988/01/01"[PDat] : "2013/12/31"[PDat]) AND (English[lang] OR Spanish[lang])))).

This search yielded 120 articles that were reviewed by reading the abstracts. Seventeen were eliminated as inappropriate for the purposes of the study. Finally, a total of 103 articles were included.

The search in LILACS was based on locators and descriptor categories:(I02.851.686.602 OR M01.848.769.602) AND (C25 OR F03.900 OR SP4.011.783). Basically: Substance-related disorders and medical students. English, Spanish, and Portuguese. The articles retrieved in MEDLINE (254) were filtered out, leaving 29 manuscripts that were included in the study.

In addition, we reviewed 22 more articles retrieved using Related citations in PubMed and LILACS. A total of 154 articles were reviewed (37 LILACS, 117 MEDLINE). Forty-eight articles were excluded for not providing specific data on medical students and/or drug use. Finally, we included 106 articles,⁶⁻¹¹ calculating the prevalence of substance use.

After selecting the literature, the following parameters were extracted: country, year of publication, type of questionnaire and percentage of responses obtained, smoking, and use of alcohol, cannabis and derivatives, opiates (heroin), hypnotics, cocaine, amphetamine stimulants and derivatives, hallucinogens, inhalants, and other. The data were grouped as homogeneously as possible. Observations from the discussion section of articles deemed to be interesting or novel were extracted and the methodology used by the authors was scored from 1 to 3 to estimate the quality of the publications.

The articles were grouped by geographic and cultural regions: North America (US and Canada), Latin America (Caribbean, Central, and South America), Europe, Eastern Islamic (countries of mainly Islamic religious orientation),

Eastern non-Islamic (countries of other faiths and cultures, including China and Japan), and Oceania (Australia and New Zealand) in order to facilitate and standardize the results.

High-risk drinkers were defined by questionnaires and scores, such as CAGE= \geq 2 and/or AUDIT= \geq 8, and/or consumption of 21 and 14 standard drinks per week for men and women, respectively. Harmful drinking was defined as consuming more than 28 standard drinks/week for men and more than 17 standard drinks/week for women.

RESULTS

One hundred and six articles were evaluated, which included 88,413 medical students. We validated 74,001 questionnaires, representing 83.7% of the responses. The distribution by geographical and cultural areas and their numerical representation in the sample are shown in Table 1.

Prevalence data on tobacco and/or alcohol use was provided in 94 articles. In these articles, 68,791 medical students who used tobacco and 28,046 medical students who consumed alcohol were surveyed. Moreover, the use of illegal drugs by 45,772 medical students is described in 52 articles. One article was dedicated exclusively to cocaine use¹⁸ and another to amphetamine use³⁹ (Table 2).

Tobacco: 72 articles contained data on tobacco use (38 about tobacco use alone and 34 about tobacco and other substance use) by 68,791 medical students. The rate of tobacco use was 17.23%, with a male:female ratio of 2:1.

Alcohol: 43 articles contained data on alcohol use (9 alcohol use alone) by 28,046 medical students. The proportion of medical students with harmful or risky alcohol

use was 24% according to the results of the CAGE and/or AUDIT questionnaires and/or standard drinks consumed. The proportion of medical students that had consumed alcohol in the last week was 75%, especially among the European and Latin American populations.

Cannabis: 23 articles contained data on cannabis use reported in 17,887 medical students. In the last month, 11.84% reported having used cannabis, with a male:female ratio of 2:1. The lowest level of alcohol use was in Nigeria (0.01%) and the highest was in the US and Croatia (29.4% and 31.9%, respectively).

Opiates (and heroin): 11 articles contained data on opiate use in 4,975 medical students. Opiate use was practically nil (0.4%), except in an article on 146 medical students from Iran,⁸⁷ where 6% used opiates and 2% used heroin.

Sedatives: 16 articles documented sedative use in a total of 14,538 medical students. In the last month, the proportion of medical students who had consumed sedatives was 9.91%, although the prevalence was as high as 25% in some studies.^{25,28,61} The male:female ratio was 1:2.

Cocaine: 20 articles contained data on cocaine use in 6568 medical students. In the last month, 2.12% reported cocaine use, with a male:female ratio of 5:1. The lowest rate of consumption was reported in Cuba (1.5%) and Brazil (1.73%), and the highest was reported in the US (3.86%).

Stimulants: 18 articles contained data on the use of stimulants in 13,142 medical students. Its use is linked to moments of more intense academic demands (such as exams). The rate of students using stimulants was 7.7%. This rate increased to 13.24% if coffee, energy drinks, or khat

Table 1	Distribution of articles and population by geographic and cultural areas							
	Articles/5-Year period						N	%QR
	1988 1992	1993 1997	1998 2002	2003 2007	2008 2013	Total		
North America	6	1	0	3	3	13	12464	78.5
Latin America	0	5	3	7	18	33	28193	82.7
Europe	2	4	5	5	8	24	14154	78.7
Africa	1	0	0	0	3	4	2182	93
Eastern Islamic	1	3	0	6	6	16	10371	87
Eastern Non-Islamic	2	0	1	1	11	15	20297	87
Oceania	0	1	0	0	0	1	752	79
Total	12	14	9	22	49	106	88413	83.7

N: sample population of medical students in different academic years
 %QR: percentage of validated self-administered questionnaire responses

Table 2		Use of substances of abuse by medical students (MS) (%) and gender ratio of use							
	Tobacco	Alcohol	Cannabis	Cocaine	Opiates	Sedatives	Stimulants	Hallucinogens	Inhalants
N articles	72 (38 mono-thematic)	43 (9 mono-thematic)	23	20	11	16	18	11	11
N Population of MS	68791	28046	17887	6568	4975	14538	13142	8341	10005
% Users <i>(current smokers)</i>	17.23	24 *	11.84**	2.12**	0.4	9.91**	7.7	2.85	14.32***
M:F gender ratio	2:1	1:0.8	2:1	5:1	-	1:2	1.4:1	1.4:1	2:1

N: articles and MS population questioned, by substance abuse. *Risky/harmful use (CAGE= \geq 2; AUDIT= \geq 8; standard drinks/week= \geq 21 for men and 14 for women). **Last month. ***Very localized substance use

(Yemen, Ethiopia)^{77,78} was added to the stimulants consumed in exam situations. The male:female ratio was 1.4:1.

Hallucinogens: 11 articles contained data on the use of hallucinogens in 8,341 medical students at some point in their lives. The rate of hallucinogen use by medical students was 2.85%, with a male:female ratio of 1.4:1.

Inhalants: The use of inhalants was examined in 11 articles (9 from Brazil and 2 from Europe) covering 10,005 medical students. The phenomenon is a very localized but common, since 14.32% of medical students have used inhalants (air fresheners in Latin American culture), the male:female ratio of users being 2:1.

Substance use by geographical and cultural areas

Tobacco and alcohol use among medical students is shown by geographical and cultural areas in Table 3. The proportion of smokers ("current smokers") was 17.23% of medical students, but the differences between geographical areas ranged from 3% in Oceania to 21% in Latin America. In Africa and the Eastern Islamic region there are only data from the related countries. The use of illegal drugs is shown Table 4. No data are available for the Eastern Non-Islamic region and Oceania, and few studies from Africa and the Eastern Islamic region.

DISCUSSION

Unlike other reviews of substance use among college students in general,¹¹²⁻¹¹⁴ this review focused on medical students. Only one similar article was detected, which was published in Brazil in 1997.¹¹⁵ The 106 manuscripts from which the results were extracted are sufficiently representative for the purposes of this review. The geographical areas of Africa and Oceania are not well

represented. Despite conducting an exhaustive search for additional literature, no more publications from these regions were found. An article from New Guinea⁶ was classified as from the Eastern Non-Islamic region due to the cultural differences between New Guinea and Australia and New Zealand. Only 13 articles were from the US, where much was published on this topic between 1960 and 1980, but interest declined in the late twentieth century; the opposite process was observed in South America. Seventy-one articles (67%) were published in the last 10 years, which provides a more updated view of substance abuse among medical students, especially in Latin America, Europe and the Eastern region, whether Islamic or non-Islamic.

Another finding of this review is that the articles have been published, with few exceptions, in journals with a low impact factor or limited distribution. Most of the studies are descriptive cross-sectional studies and it is sometimes difficult to standardize the results. This could be attributed to various factors: In first place, there are many local and cross-sectional studies, and only 33 (31%) multicenter studies and 8 (7.5%) longitudinal studies. Another relevant factor may be cultural because the diversity of priorities regarding population health and the social realities of different countries may diminish the interest and possibilities for publication in international journals. Finally, there are methodological issues; the process for obtaining the data is not always well described and, although the results are usually obtained using internationally accepted and validated self-administered questionnaires, in practice modified questionnaires are applied.^{36,44,53,68,75} This also explains why comparisons are difficult, and why the implications for each geographical area are not always applicable to different countries. The results could be standardized if questionnaires that are accepted and validated for this population are used, objectives are clarified, and the methodology is described in detail.

Table 3		Tobacco and alcohol use according to geographic distribution and culture			
		Tabaco		Alcohol	
North America	%	7.55%	Risk	12.3%	
			Last month	87.6%	
	N	9377		3975	
Latin America	%	21.27%	Risk	13.7%	
			Last month	73.3%	
	N	16864	N	12809	
Europe	%	18.6%	Risk	23.8%	
			Last month	61% <i>*dangerous level: for 10.21%*</i>	
	N	11667		6036	
Africa	%	17.7%	Ethiopia		Nigeria
			Risk	4.5%	7%
			Last month	9.3%	84%
	N	1597	820	775	
Eastern Islamic	%	16.17%	Turkey		Iran
			Risk	14.2%	9%
			Last month	-	-
	N	9577	620	146	
Eastern Non-Islamic	%	12.82%	Risk	7.13%	
			Last month	-	
	N	18957		2865	
Oceania	%	2.9%	No data		
	N	752			

N: population of medical students (MS) questioned about tobacco and alcohol

The most studied substances are tobacco and alcohol, which are the substances most used and with the greatest implications for public health problems in many of the regions described. The results are very reliable for two reasons: the number of medical students included and the use of the concepts "current smoker" and "hazardous and harmful alcohol consumption" as search variables. The tobacco data given are related to smoking cigarettes, not other types of smoking, such as water pipes, cigars, or pipes, due to their low incidence in the overall results.

Cannabis, sedatives, and stimulants are the next most common substances in the order of substances preferred by medical students. Cannabis was used by 1% to 6% on a weekly/daily basis,^{7,8,115,117} by 11.8% in the last month,^{20,21,43,116} and 50% had tried it sometime.^{7,61,117} Sedatives and stimulants (about 10% and 8%, respectively) are not used regularly; use of these substances is associated with times of increased stress, such as examinations and demands with

broader implications, as their medical studies progress.^{20,33,48,61} Sedatives are the only substances used more by women than by men.^{37,42,47}

The detection of a high rate of inhalant use (14.3%) among medical students is explained by the inhalant use in Latin America, especially in Brazil.^{25,34,37} In other areas, the variability or inaccuracy of questionnaires regarding these substances, or easy access to other substances may not be detected.

In general, gender differences in substance use are consistent with the results obtained in studies of the general and university populations.^{2,3,112-114}

Geographic areas and substance use

Tobacco: In North America, 7.5% of medical students are "current smokers," a clearly lower prevalence than that of the

Table 4		Percentage use of substances of abuse by geographic distribution						
		North America	Latin America	Europe	Africa	Eastern Islamic	Eastern Non-Islamic	Oceania
Cannabis	%	16.5%	9.55%	20%	0.01%	9%	-	-
	N	5095	9196	2722	728	146	-	-
Cocaine	%	3.86%	1.88%	1%	0%	-	-	-
	N	1865	2038	1937	728	-	-	-
Opiates	%	1.1%	0.17%	1%	0	8% (2%heroin)	-	-
	N	300	1864	1937	728	146	-	-
Sedatives	%	3.56%	9.6%	17.6%	5%	-	-	-
	N	4957	4190	4663	728 (Nigeria)	-	-	-
Stimulants	%	7.15%	9.57%*	4.5%	1.15%	8.7%	-	-
	N	1727	6923	2722	1460	310	-	-
Halluciongens	%	0.6%	3.68%	8% (LSD+mushrooms)	0	-	-	-
	N	300	4591	2722	728	-	-	-
Inhalants	%	-	14.11%	5.5%	-	-	-	-
	N	-	7283	2722	-	-	-	-

N: number of the population of medical students (MS) questioned about the substance abuse
 * with coffee and stimulating drinks: 14.3%

general university population, which is around 25%.¹¹⁸⁻¹²¹ However, the prevalence at present is probably lower than 7.5%, as half of the articles were published between 1988 and 1992 and the U.S. National Survey on Drug Use and Health (NSDUH)¹²² stated that tobacco use among the general university population decreased by 10% (from 32% to 22%) between 2002 and 2012, so it can be assumed that tobacco use also decreased among medical students.

In Latin America (21%), Europe (19%), and Africa (18%), the prevalence is very similar and the data are consistent. However, within Europe there are clear differences in prevalence, being 15% in Finland¹²⁴ and 28% to 30% in countries like Spain, Germany, Italy, and Poland.^{52,70,75,125} The difference in prevalence detected in studies may lie in the definition of "current smoker," which for Latorre et al. means "smoking at least one cigarette a day in the last 30 days."⁷⁵ The definition used in this study was "adults who have smoked 100 cigarettes in their lifetime and now smoke cigarettes every day (daily) or some days (not daily)."¹²³

In the Eastern region, medical students smoke less: the prevalence in the Eastern non-Islamic region is 13% (26% men/2.4% women) and in the Eastern Islamic region it is 16% (17.4% men/2% women). Gender differences (9:1) are marked (except in Turkey⁸⁴ and Japan:¹⁰⁷ 27% men vs. 10% women, and 18.1% men vs. 5.1% women, respectively). In

these societies, smoking is not very socially acceptable among women, being influenced by cultural, lifestyle, and probably religious aspects.

There were few studies from Oceania and in 1993,¹²⁶ 1997,¹¹¹ and 2003¹²⁷ the prevalence was similar to that of the US: 3% to 5% daily smokers and 7% occasional weekend smokers.

Independently of the geographical area, in various studies increased cigarette use is observed clearly as age increases and students advances through their courses,^{33,52,77,82,99-101,127} the key year being the third year.¹²⁸ In addition, it is confirmed that smoking was positively associated with increased concurrent use of alcohol and cannabis,^{40,50,63} especially in Latin American and European regions, and smoking is favored by family use.^{49,57,83,122}

The studies reveal less tobacco use than in the university population and the general population of the same age.^{40,77} The reasons given for this phenomenon are a better understanding of tobacco-related diseases and, sometimes, brief smoking cessation training.^{49,75,103}

Alcohol: There are two clearly differentiated groups:

1. In America and Europe (including Turkey), between 13% and 24% of medical students have high risk drinking.

The importance of alcohol in these areas is clear, since 84% of the articles on alcohol use come from these areas, the data being homogeneous and consistent. Europe stands out with 23.8% of medical students with alcohol use at risk and reaches harmful levels in almost half of them, although there are large differences between countries. In the United Kingdom, Pickard et al. documented 52.6% of men and 50.6% of women medical students with weekly alcohol use in excess of the respective 16 and 14 standard drinks/week recommended⁶⁰; other excessive weekly alcohol use rates reported are 25.5% by Ashton¹²⁹ and 21.8% by Collier et al.⁵³ In Germany, risky alcohol use among men is 30% (9% harmful); among medical students, 36.5% of men and 30.4% of women drink more than recommended.⁷¹ In the general university population, Webb et al. in a study in the UK reported alcohol use in excess of 14 standard drinks/week (women) and 21 standard drinks/week (men), respectively, in 46% of women and 61% of men in the university population (15% with harmful use).¹¹⁷ In Spain, Zaldivar et al. reported harmful alcohol use in 25% using the CAGE and AUDIT questionnaires.¹³⁰

In the US and Canada, 20% of college students are considered "heavy drinkers."¹¹⁴ In Mexico, 11.1% (17% of men and 6.2% of women) of young people entering the university had an AUDIT score of 8 or more, although it is known that alcohol use increases with age and the university courses completed.¹³²

2. In Africa and the Eastern region, risky alcohol use ranged from 4.5% in Ethiopia to 9% in Iran. The articles included in this review were from a few countries and the study population was small, all of which could explain the variability of the data. Of the 36 articles from these areas, data on alcohol use were found in only 8 articles. This may reflect the low specific weight of these areas in medical and scientific publications in general, or the lack of interest in this area of research. For example, only 4 articles from Africa have been published in the last 25 years and, finally, alcohol use is not a priority problem in these areas due to its low prevalence and incidence. This would explain why we evaluated alcohol use in fewer than 800 students from the Eastern region of Islamic influence.

The data obtained allow us to affirm that there are no significant differences in alcohol use between the general population of university students and medical students specifically. However, there are differences with the non-student population of the same age, since students had a two-fold higher rate of risky alcohol use and three-fold higher rate of harmful alcohol use.^{113,133} This phenomenon was known and increased alcohol use and harmful alcohol use had been noted in the last three decades of the twentieth century,⁶⁶ and, more recently, the severity of this problem

and the risk of many students to suffering harmful effects of alcohol use.¹¹³ It has been thought that the figures for alcohol use probably are underestimated. Finally, it should be noted that the data are very consistent, affirming in several studies that male medical students drink more often, more intensely, and in larger amounts than female medical students.^{58,66,71,88,134}

Differentiation of these blocks of more and less alcohol use also raises the possibility of differentiating alcohol use in relation to ethnicity or perhaps gender. These ethnic differences are still maintained in multiracial studies. When ethnic groups in the US are ranked by the rate of alcohol use, the highest rate is found in whites, followed by progressively lower rates among Hispanics, African Americans, and Asians.¹³⁵ On the other hand, Van Etten et al. (2001) argue that the determinant factor of alcohol use, more than gender, is the opportunity to use alcohol.¹³⁶ The study of ethnic and gender differences should continue in view of the implications for prevention and detection in the future.

The data in this review regarding other substances are more difficult to interpret and compare because the questionnaires are diverse, memories of use are unreliable, and the abuse substances vary in the type of use and dose. Even the classification of some of the substances used is subject to interpretation. Therefore, the data can be inconsistent and the validity of the results reported differs between substances. Although reliable conclusions can be reached about the use of a certain substance in specific geographical areas, their usefulness is only partial because, as previously suggested,^{113,114,131,133,135} they cannot be generalized.

Cannabis: Cannabis is the most commonly used illegal substance. The data do not refer to occasional use, but to periodic monthly or weekly use. There are numerous observations and the figures are congruent, so the data can be considered reliable for Europe (20%), North America (16.5%), and Latin America (10%), although there is less cannabis use in the Central American^{28,33,50} and Caribbean countries than in Brazil or Colombia.^{29,21,47,48} Cannabis use among medical students in Europe does not differ much from the use by the general population, where about 14% of young people aged 15 to 24 years have used cannabis in the last year, a figure that increases to over 20% when students aged 15 to 16 years are evaluated.³ In the US, the rate of cannabis use by medical students is lower than in either the general or university population. Regular use ("current use") of cannabis is 23.5% in men and 16.1% in women in the university population, and slightly lower in the general population of the same age (18.7%), figures that have shown a slight upward trend over the last decade.¹²² One possible explanation for this phenomenon could be the different ethnic, economic, and cultural composition of medical students in the US compared to the general population and general university population.

No studies from Oceania were retrieved on the use of cannabis by medical students, which is surprising because the recent prevalence of cannabis use in the population aged 20 to 29 years is 26% (32% men and 19% women).^{137,138} Therefore, it can be hypothesized that the rate of cannabis use among the university population is high, but it has been reported that local researchers are not interested in studies of this type,¹³⁹ which would explain the lack of such studies.

Regarding cannabis use by gender, for every two male cannabis users there is one female cannabis user, although the difference is smaller in Brazil⁴² and much greater in Cuba.⁵¹

Opiates: There are few observations, but the results seem to be very consistent. Opiate use is lower among medical students than in the general population of similar age.² Estimates of the frequency of problem opiate use in populations in Europe, US, and Australia place it in the range of 0.4% to 0.6%.

Opiate use by Iranian medical students (8%) merits special mention. This is consistent with the extensive use of opiates in Iran: 73.3% of the general population has tried opium, 39.45% has tried heroin, and 21.9% has tried syrup of poppy; in the last month 13% of the population has used opiates.¹⁴⁰ In this context, 21.1% of high school students and 18.5% of nursing students use or have used opiates.¹⁴¹ Despite this, the use by medical students is even smaller since 23% of university students have used opiates at some time and the proportion of regular users is 6.2% for opium, 0.6% for morphine, and 0.8% for heroin.¹⁴²

Sedatives: Medical students use sedatives in stressful situations, increasing use as their studies progress.^{20,33} The figures for sedative use vary, being high in Europe and low in North America. However, for purposes of comparison we should clarify the meaning of "sedative" (hypnotics, benzodiazepines, barbiturates, and other) and the types of use (prescription, occasional, or regular). In Latin America, the proportion of medical students who use sedatives (9.6%) is consistent across studies. Likewise, the male:female ratio 1:2 is consistent with international reports indicating greater use among women in the general population.^{2,122} Benzodiazepine use by medical students is important, especially in Western societies where these substances are used heavily,^{2,3} because benzodiazepine use by future physicians could affect the detection of addiction and related problems in the general population.⁵

Cocaine: The data on cocaine use for North America, Latin America, and Europe are not abundant, but they are consistent and uniform in a variety of articles and also concur with the cocaine use of university students in general and students of the health sciences in particular. The percentages refer to specific or occasional cocaine use, not to daily cocaine use and, except in the US, there are no signs

that these rates are of concern among researchers. Countries with notable rates of cocaine use are the US with 4%, compared to a similar age group with a rate of 2.6% in the last decade¹³⁷ and, at the opposite pole, Africa with a rate of 0%.

Stimulants: There are geographical differences in the rates for stimulant use. Medical students from the American continent have the highest rates of stimulant use, almost doubling the rate of use by European medical students. American medical students seem to use stimulants especially in times of increased demand and, as is the case with sedatives, the use of stimulants increases as students progress in their studies.^{42,48} In studies conducted in Colombia, 16.5% of medical students used amphetamines once or twice a week,⁴⁸ this group having the highest rate of amphetamine use among all other students, which are already a population with a high rate of use.³⁹ These studies indicate occasional use of stimulants at certain times in the academic year, which seems to be a specific phenomenon since stimulant use among high school students in Latin America is less than 5%.¹⁴³ In the US, the university population has less amphetamine use than the non-university population of the same age, with a rate of 11.9% throughout life (vs. 18.6%), 11% in the last year of study (vs. 17.5%), and 0.1% of daily use (vs. 0.3%). It should be considered that substances of the amphetamine family, such as Ritalin® (methylphenidate), sometimes are categorized with the amphetamine-type stimulants and other times are differentiated. Nonetheless, amphetamine use is relevant as 5.7% of students have used amphetamines in the last year.^{145,146}

As has been noted, in Europe stimulants are used less often by both young people and students. The European weighted mean rate of stimulant use is 5.5% over a lifetime and 1.2% in the last year.³

Data on medical students from Oceania was not available, but stimulant use by both the secondary school population (5%) and young people aged 20 to 29 years old (10%) were equivalent to the figures for the Latin American population.¹⁴⁷

As amphetamine use is occasional and appears to be associated with academic events,^{42,48,143} the prevalence of amphetamine use detected, especially recent use, may depend on when it is evaluated. Consequently, studies should be carried out at different times in the school year.

Hallucinogens: Few studies (11) exist in which the use of hallucinogenic substances has been investigated and it is possible that the classic pattern of hallucinogen use has changed. In addition, there appears to be great variability in relation to the geographical areas studied: hallucinogens are very rarely used by medical students in the US; there are no data from the Eastern regions or Australia, and the mean

rate of hallucinogen use in Latin America is 3.68%, the reported prevalence being similar in different articles.^{8,36,37,42,47,48} On the other hand, the prevalence of 8% reported in Europe must be interpreted with caution because it is determined by the work of Webb et al.,⁵⁸ including experimentation with hallucinogens throughout the life of LSD and hallucinogenic mushrooms.⁵⁸ In addition, it has been noted in recent reports^{3,143} that hallucinogen use among the general population is marginal and has been decreasing for more than 10 years.¹⁴⁵ In this sense, hallucinogen use among the Spanish university population last year was 3%, negligible in the last month, and nonexistent in the last week.¹⁴⁶

Inhalants: Eleven articles describe inhalant use among medical students, nine of them from Brazil and two from Europe (Croatia and UK). The rate of inhalant use in Brazil (14.11%) is consistent, but in Europe (5.5%) the rate must be interpreted with caution due to the small number of studies. In the other geographical areas, inhalant use is not mentioned in the articles on medical students.

The finding of major inhalant use among medical students in Latin America is consistent with the extensive use of these substances among the general population. In some countries of this or nearby geographical areas, inhalant use increases until students enter the university: in Trinidad-Tobago, Jamaica, and Guyana more than 10% of the population aged 17 years used inhalants last year, whereas in Brazil it was more than 18% last year and 13% in the last month. In Mexico, Brazil, Trinidad-Tobago, Jamaica, Haiti, and Guyana, inhalant use last month exceeded cannabis use (sometimes by a ratio of 1:3).¹⁴⁷ Western countries were at the opposite pole, with much less inhalant use, as reflected in the report of the European Monitoring Centre for Drugs and Drug Addiction,³ which does not consider inhalants. The report of the United States' SAMHSA (Substance Abuse and Mental Health Services Administration) discusses inhalant use very briefly, noting that 62% of first-time use is by people younger than 18 years, and in the US the highest rates of inhalant use are at age 14 and then rapidly decrease.¹²² The high prevalence described is thus found in countries where inhalant use is more problematic. In this sense, inhalant use as described is specific to Latin America and cannot be generalized to medical students in other countries.

CONCLUSIONS

This paper has certain limitations because results from different countries were added up in order to compare studies. Although we tried to group countries by geographic areas and cultural proximity, the groups generated may not be shared by other researchers. Furthermore, as there are no studies of substance abuse by medical students in some geographic areas, or the available studies are about very specific types of substance abuse, their validity should be

considered and the results should be interpreted with caution. In order to compare the results of medical students, large general population studies have been used and data have been compared to the most relevant studies of university students in general. However, although more than one article has been used to make comparisons, because of the breadth of the concept of "university population" and the methodologies used in different studies, the results are not always easy to interpret. Moreover, the description of the methodology in some articles is either incomplete or can be improved; modified questionnaires are used in conditions that differ from the validated conditions, and the diagnostic criteria are not always the same. This may explain why the articles have been published in local or small-circulation journals, and the difficulties for comparing studies. Finally, it should be noted that extensive data from Latin America have been included in this review, which may be due to the inclusion of the LILACS database in the literature search.

Despite this, due to the exhaustive search conducted and the wide range of articles addressing the topic finally selected, especially from America and Europe, we believe that medical students use substances other than alcohol less frequently than university students overall and the general population of the same age. The exact reasons for this difference in the rate of use are not known, but it could conceivably be that medical students have a better understanding of the consequences of substance use or less access to them.

Although there are geographical differences in alcohol use, the substances used by medical students are mainly alcohol, tobacco, and cannabis, although the use of hypnotic drugs is also frequent. There is less use of cocaine and stimulants, and opiate use is uncommon. Due to the wide disparity in the prevalence of hallucinogen use described and the methodology used in its study, the findings on hallucinogen use should be interpreted with caution. The use of tobacco, alcohol, and cannabis can be explained by the high rates of use of these substances among the general and university populations. However, the use of stimulants and sedatives appears to be more specific to this population and is associated with periods of high academic demands. Specific studies of these substances of abuse should be conducted.

The number of published papers has increased in recent years, mostly from Europe, Latin America, and the Eastern non-Islamic region. The substances best studied are tobacco and alcohol. It should be noted that there are local variations, even within the same geographic area, and articles have not been published in every country. In some areas, such as Oceania and Africa, there have not been studies, particularly regarding illegal drugs. In addition, there are patterns of substance use specific to regions, such as opiate use in Iran or inhalant use in parts of Latin America.

The use of substances by medical students is a phenomenon that should be evaluated systematically due to its prevalence and potential impact. There are two particularly relevant factors, academic year and gender: medical students have higher substance use rates in the last years of school, and men have higher substance use rates than women, except for the use of hypnotics.

CONFLICTS OF INTEREST

There are no conflicts of interest for this study.

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