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Research

Cognitive enhancers: Consumption of psychostimulants in medicine

Potenciadores cognitivos: Uso de psico-estimulantes en el ámbito de la medicina

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Abstract

Psychostimulants are drugs that can be used to improve cognitive performance by students and health care professionals. This trend might establish a public health issue. The purpose of this study is to describe the prevalence of psychostimulant use in medical students and resident doctors, and to identify consumption related risk factors. The study was conducted through a self-administered, anonymous online survey. 355 respondents were included, 27% (n = 96) were resident doctors, 70.4% (n = 250) students and 2.5% (n = 9) specialists. 17.4% (n = 62) opted for psychostimulant drugs of which modafinil was the most chosen. The most desired effect was to improve wakefulness 83.6% (n = 51). The average age for consumers was 27.31±3.08 (p = 0.033). The multivariate analysis revealed that the predictive variables with highest risk of consumption were: having read the package insert (OR = 5.2; p = 0.0001), previous use of benzodiazepines (OR = 3.75; p = 0.045) and having considered ethical its use (OR=1.03; p = 0.0001). According to literature, the prevalent use of psychostimulants by doctors under training in our population might be higher than other countries. This study is an important source of information for health authorities as it highlights unrestricted access and inappropriate use of psychostimulants.

Keywords: Psychostimulants; drugs; pharmacoepidemiology; modafinil; medical students

Resumen

Los psicoestimulantes son fármacos que pueden ser utilizados para mejorar el rendimiento cognitivo por los médicos en formación. Esta tendencia representaría un problema de salud pública del cual existe escasa información disponible. Describir la prevalencia del uso de psicoestimulantes en alumnos de medicina y médicos residentes e identificar factores de riesgo asociados al consumo. Encuesta online anónima y autoadministrada. Se analizaron 355 encuestas, 27% (n = 96) fueron médicos residentes, 70.4% (n = 250) estudiantes y 2.5% (n = 9) médicos especialistas. El 17.2% (n = 62) recurrió a drogas psicoestimulantes, de las cuales la más elegida fue el modafinilo (n = 39). El objetivo más buscado fue mejorar la vigilia 83.6% (n = 51). La edad media para los consumidores fue 27.31 ± 3.08 (p = 0.033). En el análisis multivariado se observó que las variables predictoras de mayor riesgo de consumo fueron: haber leído el prospecto (OR = 5.2; p = 0,0001), haber consumido benzodiacepinas previamente (OR = 3.75; p = 0.045) y haber considerado ético su uso (OR = 1.03; p = 0.0001). La prevalencia de uso de psicoestimulantes por médicos en formación en nuestra población podría ser mayor a la de otros países. El presente trabajo representa una importante fuente de información para las autoridades sanitarias dado que destaca el libre acceso y el uso inapropiado de psicoestimulantes.

Palabras clave: Psicoestimulantes; fármacos: farmacoepidemiología; modafinilo; estudiantes de medicina

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Introduction

Pharmaceutical industry have developed drugs with the potential to improve cognitive performance. These drugs are called cognitive stimulants, neurostimulants o nootropics (Froestl, Muhs & Pfeifer, 2014; 2014b; 2014c).

In the last years the use of these drugs has been described in healthy subjects, who use them as "smart drugs", searching to improve their performance. This phenomenon comes hand in hand with a serious ethical debate, so that this practice is known as "brain-doping" comparing it to sports doping (Cakic, 2009).

Numerous studies have been made in Europe and the US, finding a prevalence that varies between 1.9% to 20% (Zaami et al. 2020; Franke, Bagusat, Rust, Engel & Lieb, 2014; Eickenhorst, Vitzthum, Klapp, Groneberg & Mache, 2012; Moore, Burgard, Larson & Ferm, 2014; Wolff, Brand, Baumgarten, Lösel & Ziegler, 2014; Dietz et al., 2013; Maher, 2008; Franke et al., 2011; Mache, Eickenhorst, Vitzthum, Klapp & Groneberg, 2012; Mazzoglio et al., 2011; Barón et al., 22011).

Consumption found was diverse, from daily use substances (such as caffeine), phytopharmaceuticals, illicit drugs (such as cocaine), over the counter drugs and even psychotropic drugs and psychostimulants. The psychoactive drugs that are most used by students are modafinil, methylphenidate, amphetamine and antidementia drugs such as donepezil, being the first three the more frequent (Zaami et al. 2020; Franke et al., 2014; Eickenhorst et al., 2012; Moore et al., 2014; Wolff et al., 2014; Dietz et al., 2013; Maher, 2008; Franke et al., 2011; Mache et al., 2012; Mazzoglio et al., 2011; Barón et al., 22011).

In Latin America, there are only two publications about it: one of them evaluated the prevalence and the associated factors to the use of amphetamines in medical school students from Colombia, meanwhile the other study described the use of psychoactive drugs in anatomy students from Universidad de Buenos Aires in Argentina (Mazzoglio et al., 2011; Barón et al., 2011).

Studies that have included resident physicians focused on emergency services or on call duty. Modafinil was observed to have a prevalence of use of 2.4%, 3.1 to 11% were general stimulants and 38 to 46% of sedatives in general (McBeth et al., 2009; Handel, Raja & Lindsell, 2006; Fallah, Moudi, Hamidia & Bijani, 2018; Shy, Portelli & Nelson, 2011).

The goal of this study was to describe the prevalence of use of psychostimulants in medicine students and residence physicians and to identify the risk factors associated with the consumption of these medications.

Material and Methods

Cross study made between May and July 2018. An anonymous online poll was conducted to students from medical school and residents of medicine.

The online platform, Google Forms was used. It was distributed by email through Sociedad Neurológica Argentina's, Segunda Cátedra de Farmacología's, la Sociedad Argentina de Terapia intensiva's mailing lists and through closed Facebook groups for residents and students from different medicine classes.

Medicine students from any year were included as were residents of any speciality (basic or post basic no matter the year) and physicians (studying a new residency).

The questionnaire was divided into two parts, in the first one the questions were about the demographic characteristics of the pollers, and the second part included questions about knowledge and consumption.

In the poll, "nootropic drug" was described as those capable of improving cognitive capacities. A list of substances were introduced for the pollers to select those they thought would adjust to that definition. It was inquired about the knowledge and closeness to those substances. Next, they were asked about the consumption of substances with the goal of improving their cognitive performance, introducing a list of options and a free row in case of not finding the substance. Finally, those who said to have consumed substances to improve their cognitive performance were ask about the way and the frequency of the use and whether they reached the hoped effect or if they suffered adverse reactions.

Open questions, multiple options and 0 to 100 scales were used.

IBM SPSS Statistics (version 23.0) was used for descriptive and comparative statistics. Groups were defined according to the consumption of psychostimulants drugs of interest (amphetamines, methylphenidate and modafinil). Parametric and nonparametric statistics were used and, then, a multivariate analysis using the significant variables in the univariate to perform a binary logistic regression. A significance level of 0.05 was considered.

Participation in this poll was voluntary and anonymous, informed consent was implicit the moment the poll was completed and sent. The survey was approved by both Sociedad Neurológica Argentina and University of Buenos Aires medical school.

Results

355 surveys were analyzed, 70.4% ($n = 250$) were medicine students, 27% resident physicians and 2.5% ($n = 9$) physicians, with an mean age of 26.03 ± 3.95 years old (Table 1).

Table 1.
Demographic characteristics.

	Total ($n = 355$)	C-Psy ($n = 62$)	NC-Psy ($n = 293$)	*p*	C- Moda ($n = 39$)	NC-Moda ($n = 216$)	p
Gender							
Femenine % (n)	68.73% (244)	13.11% (32)	86.89% (212)	0.001	9.43% (23)	90.57% (221)	NS
Masculine % (n)	31.27% (111)	27.03% (30)	72.97% (81)	0.001	14.41% (16)	85.58% (95)	NS
Age (mean . SD)	26.03 (3.95)	26.44 (3.21)	25.94 (4.08)	NS	27.30 (3.08)	25.87 (4.02)	0.033
Nacionality% (n)							
Argentina	90.4% (321)	17.76% (57)	82.24% (264)	NS	10.9% (35)	89.09% (286)	NS
Brasil	2.3% (8)	37.5% (3)	62.5% (5)	NS	25% (2)	75% (6)	NS
Chile	1.4% (5)	40% (2)	60% (3)	NS	40% (2)	60% (3)	NS
Colombia	3.7% (13)	0.00	100% (13)	NS	0	100% (13)	NS
Other	2.25% (8)	0	100% (8)	NS	0	100% (8)	NS
Residents % (n)	27% (96)	11.46% (11)	88.54% (85)	0.027	8.3% (8)	91.7% (88)	0.004

	Total (n = 355)	C-Psy (n = 62)	NC-Psy (n = 293)	p	C- Moda (n = 39)	NC-Moda (n = 216)	p
Specialty							
Anesthesiology	2.5% (9)	33.33% (3)	66.67% (6)	0.047	22.2% (2)	77.8% (9)	0.02
Surgery	1.7% (6)	16.67% (1)	83.33 (5)		16.67% (1)	83.33% (5)	
Clinical medicine	1.4% (5)	0	100 (5)		0	100% (5)	
Ginecology	1.4% (5)	20% (1)	80 (4)		20% (1)	80% (4)	
Neurology	2.8% (10)	40% (4)	60 (6)		40% (4)	60% (6)	
Pediatrics	10.1% (36)	2.78% (1)	97.22 (35)		0	100% (37)	
Intensive care	2% (7)	28.57% (2)	71.43 (5)		28.57% (2)	71.43 (5)	
Traumatology	0.3% (1)	100% (1)	0.00		100 (1)	0.00	
Other	4.5% (16)	6.25% (1)	93.75 (15)		6.25 (1)	93.75% (15)	
Year of residency							
1st year	10.4% (37)	8.11% (3)	91.89% (34)	NS	2.7% (1)	97.3% (36)	0.042
2nd year	3.7% (13)	7.69% (1)	92.31(12)		7.69% (1)	92.31% (12)	
3rd year	2.8% (10)	20% (2)	80% (8)		20% (2)	80% (8)	
4th year	6.2% (22)	18.18% (4)	81.82% (18)		18.18% (4)	81.82% (18)	
5th year	1.1% (4)	50% (2)	50% (2)		50% (2)	50% (2)	
Post-basic	1.7% (6)	33.33% (2)	66.67% (4)		33.33% (2)	66.67% (4)	
Medicine students % (n)	70.4% (250)	18.8% (47)	81.2% (203)	0.027	10.8% (27)	89.2% (233)	0.004
Year							
1st year	6.8% (24)	20.83% (5)	79.67% (19)	NS	4.2% (1)	95.8% (23)	0.042
2nd year	3.9% (14)	14.29% (2)	85.71% (12)		7.1% (1)	92.9% (13)	
3rd year	7% (25)	8% (2)	92% (23)		4% (1)	96% (24)	
4th year	7.9% (28)	3.57% (1)	96.43% (27)		0	100% (28)	
5th year	21.1% (75)	20% (15)	80% (60)		13.3% (10)	86.7% (65)	
6th year	15.5% (55)	23.64% (13)	76.36% (42)		16.4% (9)	83.6% (46)	
Internship	11.8% (42)	23.81% (10)	76.19% (32)		14.3% (6)	85.7% (36)	
Specialist doctor % (n)	2.5% (9)	44.44% (4)	55.56% (5)	0.027	44.44% (4)	55.56% (5)	0.004
Works % (n)	53.2% (189)	15.87% (30)	84.13% (159)	NS	9% (17)	91% (172)	NS
Work time hours/day[*]	7.86 (3.22)	7.60 (4.01)	7.91(3.03)	NS	8.64 (4.40)	7.76 (3.06)	NS
Sleep hours/day[**]	6.29 (1.03)	6.25 (1.10)	6.30(1.02)	NS	6.30 (1.07)	6.29 (1.02)	NS

Reference: C-Psy: Psychostimulants Consumers; NC-Psy: Non Consumers of Psychostimulants; C-Moda: Modafinile Consumers; NC-Moda: Non-Consumers of Modafinile.
NS: Non significative. SD: Standard Deviation. [*] Amount of work hours in a day (mean, SD)
[**] Amount of sleep hours in a day (mean, SD).

17.2% (n = 62) resorted to psychostimulants (amphetamines, methylphenidate and modafinil) to improve their cognitive performance. The most chosen was modafinil (n = 39). 54.4% (n = 156) of the people surveyed that had consumed a nootropic before said they've done prior to an exam, while 45.6% (n = 131) did it while taking classes. 53% (n = 189) referred to have consumed an illicit substance.

On a scale from 0 to 100, people surveyed would use a psychostimulant again to improve their performance (mean of 71.45 ± 34.08). Less than half of the people surveyed had any knowledge about the mechanism of action (mean 35.80 ± 28.70) and the possible adverse reactions (mean 34.95±29.57). About half consumers considered their ethical use (mean of 51.88 ± 31.45) (Figure 1).

Figure 1. Factors associated with consumption. Mean values of response on a 0 – 100 scale.
Reference: Reference: C-Psy: Psychostimulants consumers; NC-Psy: Non-consumers of psychostimulants; C-Moda: Modafinile consumers; NC-Moda: Non-consumers of Modafinile; ADR: adverse drug reactions.

Specialized physicians were the ones who presented a higher prevalence of use with a percentage of 44.44% (n = 4); secondly, with 18.8% (n = 47) were medicine students; and, lastly, residents with a percentage of 11.5% (n = 11). Among specialties, neurologists (40%, n = 4) and anesthesiologists (33.3%, n = 3) are the ones with a higher rate of consumption ($p < 0.05$) (Table 1). Men were more likely to consume psychostimulants than women ($p = 0.001$).

The most wanted goal was to improve awakeness 83.6% (n = 51). More than half said they got what they wanted and they would use it again to get it (mean 71.15 ± 26.46 y 68.15 ± 34.63 respectively) (Figure 2). 57.1% (n = 32) reported that they suffered severe reactions.

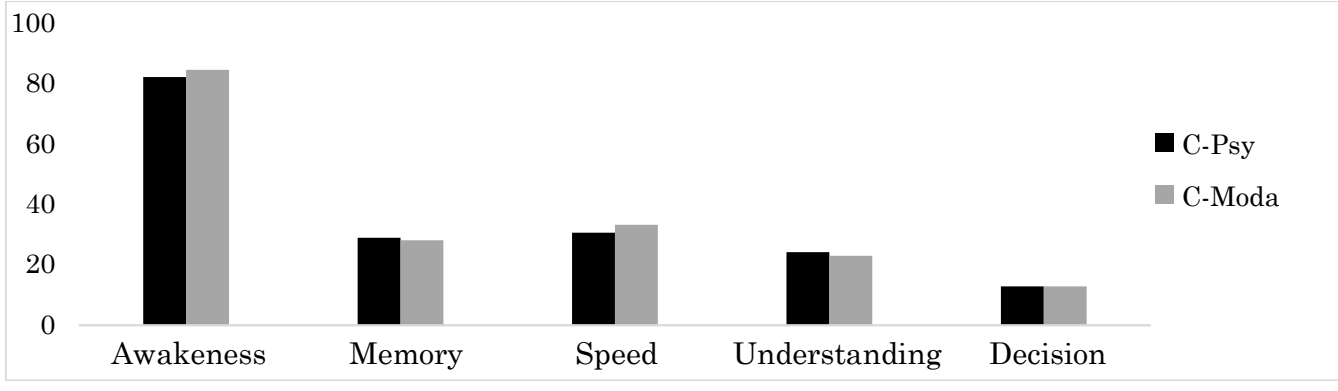

Figure 2. Wanted goals for consumption of Psychostimulants and Modafinile.
Mean values of response on a 0 - 100 scale.
Reference: C-Psy: Psychostimulants consumers; C-Moda: Modafinil consumers.

The variables that predict a risk in the consumption of psychostimulants were to have read the leaflet of a psychostimulant (OR = 5.2; p = 0.0001), to have previously consumed benzodiazepine as a recreational drug (OR = 3.75; p = 0.045) and to consider the ethical use of psychostimulants (OR = 1.03; p = 0.0001) (Table 2).

TABLE 2.
Multivariate analysis. Binomial logistic regression evaluating predictors for Psychostimulant consumption.

	B	SE	Sig.	OR	OR 95% CI	
					Inferior	Superior
Whether they read the leaflet	1.651	0.472	0.000	5.212	2.066	13.147
Feminine gender	–1.015	0.423	0.017	0.362	0.158	0.831
Whether they knew the PSI by media	–1.662	0.544	0.002	0.190	0.065	0.551
Whether they knew the ADR	0.017	0.009	0.051	1.017	1.000	1.035
Whether they considered consumption ethical	0.031	0.007	0.000	1.032	1.017	1.047
Whether they consumed marijuana	0.992	0.522	0.057	2.696	0.970	7.493
Whether they consumed BDZ	1.321	0.658	0.045	3.748	1.032	13.618
Whether they wanted to improve awakeness	1.213	0.624	0.052	3.364	0.991	11.421
Constant	–5.854	0.995	0.000	0.003		

Reference: ADR: adverse drug reactions; BDZ: benzodiacepines; PSI: psychostimulants SE: Standard error. Sig.: Significancy. OR: Odds Ratio. CI: Confidence interval.

Discussion and Conclusions

In our population, the prevalence of use of psychostimulants by physicians in training is higher than in other countries and similar to the one found in a previous paper made in our country where a higher consumption of modafinil was found (Mazzoglio et al, 2011).

Between the predicting consumption factor the knowledge of drugs, the previous use of illegal drugs, to consider the consumption of nootropics ethical and the wish to improve awakeness have all been of importance.

Lastly, the posture taken by the surveys over the ethical dilemma that the use of nootropics and "brain-doping" is interesting. There was a difference between the consumers and the non-consumers, being the first for and against the latter. Finally, the analysis of the surveyed population as a whole reveals an indifferent posture.

Amongst the limitations of the study, the poll might have underestimated the consumption by absence of a second blind method, but that allowed for a higher amount of information. On the other hand, the way of diffusion makes it impossible to determine the response rate.

Amongst the study' strengths it is remarkable the number of analyzed polls, larger to studies made previously in Latin America. Also, it included a larger population that included every physician in training.

The use of psychostimulants to improve cognitive performance can be cataloged as an *off-label* use. Studies had been made resulting in mild to moderate improvements in different task, mostly in sleep-deprivation situations (Zaami et al., 2020; Vademecum Nacional de Medicamentos-VNM, s.f.).

As it is an *off-label* use, most of the consumers do not have a medical prescription, and get them from the internet or from people that have a prescription for a medical condition (Zaami et al., 2020).

A population study reported a high rate of prescriptions of non-recommended drugs. In this paper a similar situation arises related to the lack of education about a rational use of medicine. Also another study reported that false information and *off-label* promotion are common in neurological drugs advertising (Rojas, Demey & Arizaga, 2013; Sánchez et al., 2021).

This paper will be a source of information for authorities and eventual regulatory modifications. It is possible that the condition of "sale under archived prescription" when it comes to these psychotropic drugs is not enough.

It is through medical education that prescriptive and auto consumption conduct can be modified.

Conflicts of Interest

Authors reports no conflicts of interest to report in relation to this study.

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