

Opinion and prevalence of use of central nervous system stimulants in open population: results of an electronic survey

Paulina Flores-Medina¹ and Paul Carrillo-Mora^{2*}

¹Faculty of Medicine, Universidad Autónoma de Sinaloa, Culiacán, Sinaloa; ²Subdivisión de Investigación en Neurociencias Clínicas, Instituto Nacional de Rehabilitación Luis Guillermo Ibarra Ibarra, Mexico City, Mexico

Abstract

Objective: The objective of the study was to know the opinion and prevalence of use of central nervous system stimulant drugs (SDs) in healthy people in open population. **Methods:** An electronic survey was designed with 11 questions to know the frequency of use of SD, and also questions to explore previous knowledge, opinion about the risks associated with its use and about its regulation, etc. The survey was spread by electronic social networks to persons over 18 years old of any gender. Descriptive analysis and a Chi-square test were done to find associations between variables. **Results:** A total of 526 surveys were conducted, 271 male participants (51.5%) and 249 female (47.3%). The median of age was 22 years old (range 18-83 years). Median scholarship was 12 years (range 6-20 years). About 49.6% were students. About 75% had prior knowledge about stimulants, 13.6% reported prior use, 26% opined these drugs could be dangerous, and 88% opined that they should be regularized. Finally, ages between 18 and 30 years old and scholarship above high school were associated with the use of SD. **Conclusion:** There was a frequency of 13.6% of SD use. Most of the respondents are worried about its safety and are in favor of their regularization. Being young with high scholarship was associated with SD use.

Keywords: Central nervous system stimulants. Survey. Prevalence. Cognition. Healthy people.

Opinión y prevalencia de uso de estimulantes del sistema nervioso central en población abierta. Resultados de una encuesta electrónica

Resumen

Objetivo: Conocer la opinión y frecuencia de uso de fármacos estimulantes del sistema nervioso central (FE) en población abierta. **Métodos:** Se diseño una encuesta anónima electrónica con 11 preguntas para conocer la frecuencia de uso de FE, su conocimiento previo, su opinión sobre los riesgos asociados con su consumo y opinión sobre su regulación, etc. La encuesta se difundió por redes sociales a > 18 años de ambos sexos. Se realizó análisis descriptivo y prueba de Chi cuadrada para buscar asociaciones entre las variables. **Resultados:** Se realizaron 526 encuestas, 271 participantes hombres (51.5%) y 249 mujeres (47.3%). La mediana de edad de 22 años (rango 18-83 años). La mediana de escolaridad fue 12 años (rango 6-20 años). 49.6% fueron estudiantes. Un 75% tenían conocimiento previo de los estimulantes, un 13.6% reportó uso previo; un 26% opinó que pueden ser peligrosos; un 88% opinó que deben ser controlados. La edad entre 18-30 años y la escolaridad superior a bachillerato se asoció con uso de FE. **Conclusiones:** Existió una frecuencia del 13.6% de uso de FE.

Correspondence:

*Paul Carrillo-Mora

E-mail: neuropolaco@yahoo.com.mx

2604-6180 / © 2022 Academia Mexicana de Neurología A.C. Published by Permanyer. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Date of reception: 06-01-2022

Date of acceptance: 21-02-2022

DOI: 10.24875/RMN.220000031

Available online: 06-05-2022

Rev Mex Neuroci. 2022;23(5):171-176

www.rev mexneurociencia.com

La mayoría tiene dudas sobre su seguridad y está a favor de que sean controlados. Ser joven con alta escolaridad se asoció al uso de FE.

Palabras clave: Estimulantes del SNC. Encuesta. Prevalencia. Cognición. Sanos.

Introduction

The idea of using any substance to enhance alertness or cognitive performance in healthy people is very attractive. Since decades ago, people have been using distinct drugs with this purpose, however, recently, their use in teenagers and young adults has gained a lot of popularity¹. Central nervous system stimulant drugs (SDs) are all neuroactive substances that increase certain brain neurotransmitters, in particular catecholamines (noradrenaline, dopamine, and adrenaline), although, they can increase other neurotransmitters too like serotonin, histamine, and glutamate^{1,2}. Stimulants are a diverse group of substances that include from natural molecules like caffeine, to a synthetic drug such as methylphenidate, modafinil or amphetamine, and its derivatives³.

There are a lot of publications about possible positive effects with the use of SD in alertness or cognitive functions in healthy people, however, to the date, there is no consensus about its utility as the positive observed effects continue being marginal or inconsistent between studies⁴. In spite of the lack of evidence on positive effects, its use has increased in the last years in healthy young individuals, particularly in college students^{5,6}.

In addition to the lack of evidence on its positive effects on cognition, there is a certain concern about the safety and risk of addiction to SD with repeated or chronic use⁷. Furthermore, there is an increasing controversy on the bioethical aspects related to the undiscriminated use of SD on healthy individuals, as is still in discussion if its use should be regularized by health authorities or if it should be considered a form of fraud or brain doping that must be prohibited in educational institutions and other areas⁸.

There are a great number of studies that explore the frequency of use of SD and risk factors related in healthy individuals, however, comparatively, there are few studies that have explored the public opinion on its use and regulation^{9,10}. On this matter, one study that conducted three surveys in 1400 individuals about their opinion on SD use showed that its acceptance is greater when it is reflected in other person, and also acceptance depended on the context of the use by each study¹¹. Another study performed only in medicine

students regarding the use of methylphenidate showed that more than 70% had the perception that methylphenidate could increase their cognitive performance, however, 66% of them were worried with the legality of its use and more than 90% thought that it could be dangerous for their health¹². On the other hand, a study conducted by specialists of different medical-biological and social areas showed that depending on the profession, there is great variability on the opinion about the legality of its use¹³.

Finally, although there are some studies about the frequency of use of SD in Latin America, to the best of our knowledge, there are no prior studies about the general opinion of the use of SD in this population, therefore, the objective of the present study was to get to know the opinion and frequency of the use of SD in a sample of open population in Mexico.

Method

Survey

A clinical transversal descriptive and analytic study was developed. Furthermore, an anonymous survey in an electronic format was developed, in first instance, the survey was applied in pilot group of 50 persons to evaluate the performance and reliability of each question and its adequate understanding by participants; after applying the necessary adjustments, the final version of the survey included 11 multiple-choice questions: six dichotomic answer questions (yes/no) and five with four possible responses, in addition to demographic information and other variables of the participants (sex, age, scholarship, religion, birthplace, chronic diseases, etc.). Questions explored if participants had prior knowledge on SD, if they have used any substances to enhance alertness (like caffeine or tobacco) or to enhance the cognitive functions, as well as their opinion on their safety, if these drugs should be regulated by health authorities, if they are in favor of further research, and finally, a hypothetical scenario was presented on the use of SD: where an individual uses a SD during a job examination and apparently this gives him an advantage over the other applicants obtaining at the end the job in dispute. In this context, the

Table 1. Summary of Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

CHERRIE (Checklist Items)	Description
1. Design of survey	Target population: open population, adults over 18 years of age, of both sexes. Convenience sample.
2. Institutional Review Board	Research project was approved by the bioethics committee of the National Institute of Rehabilitation LGII, with registration number 54/17. The survey was conducted completely anonymous and no confidential information of the participants was managed; the informed consent for inclusion was requested in electronic format. Digital information was encrypted to guarantee confidentiality and to prevent unauthorized access.
3. Development and pre-test	Survey was developed by clinical neuroscience research experts and in first instance was applied in pilot group of 50 participants to evaluate the performance and reliability of each question.
4. Recruitment process and description of the sample having access to the questionnaire	Link for the survey (Google Forms) was sent electronically and the invitation was spread by social media in person-to-person manner, to any person who accepted to answer the survey completely, the inclusion criteria were people over 18 years old, of any gender and any residence place.
5. Survey administration	Invitation was made by social networks (WhatsApp or Facebook), participation was completely voluntary; there was no randomization in the questions; the final version included 11 multiple-choice questions: six dichotomous answer questions (yes/no) and five with four possible responses, in addition to demographic information and other variables of the participants (sex, age, scholarship, religion, birthplace, chronic diseases, etc.). Survey was applied between August 3 and November 5 of 2021.
6. Response rates	The electronic format of the survey could only be answered once, and no question could be left unanswered. No estimate of the percentage of participation was made.
7. Preventing multiple entries from the same individual	The survey was linked to a valid email address and could only be answered once per email address.
8. Analysis	Only fully answered surveys were analyzed; there was no limit of time to complete the survey and no weighting was done within the questions of the questionnaire.

participant was asked if he/she considers the situation fair or unfair and why he/she thinks the individual in the scenario got the job. These two questions have the purpose to discover their opinion on the situation from the ethical perspective.

Participants

The application of the survey had place from August 3 to November 5 of 2021. The link for the survey was sent electronically and the invitation was spread by social media to any person who accepted to answer the survey completely, the inclusion criteria were as follows: people over 18 years old, of any gender and residence place. The only exclusion criteria considered were uncompleted or repeated registered surveys. As the survey was conducted completely anonymous and no confidential information of the participants was managed, the authorization for inclusion in study was requested electronically only.

A more detailed description of the method used in the development and application of the survey is

presented in [table 1](#), following the recommendations of the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)¹⁴.

Statistical analysis

The data were concentrated in a database, and in first term, descriptive statistic was used with mean, median and range to present the general characteristics of the population; in second term, a Fisher's exact test and/or a Chi-square test were used to evaluate the association between the prior use of SD and the participants demographic variables. For the analysis, the GraphPad Prism software version 6.0 was used. $p < 0.05$ was considered statistically significant.

Results

There were a total of 526 opinion surveys completed. Two hundred and seventy-one participants were male (51.5%) and 249 females (47.3%), the rest did not specify (6 = 1.1%). The average age of all participants was

29 years old (\pm 14 years). The age groups distribution was as follows: 18-20 years old: 187 (35.5%); 21-30 years old: 192 (26.5%); 31-40 years old: 46 (8.7%); 41-50 years old: 46 (8.7%); and 51-85 years old: 55 (10.4%). The average scholarship in total sample was 12.7 years (\pm 2.29 years), the distribution by school grade was as follows: elementary and middle school concluded: 47 (8.9%); high school concluded: 306 (58.1%); university concluded: 151 (28.7%); and masters or PhD: 22 (4.1%). On religion, the most frequent one was catholic in 289 participants (54.9%), other religion: 63 (11.9%), and none in 174 (33%). About place of residence, the majority was from Sinaloa ($n = 264$, 50.1%), 126 from Mexico City or Estado de Mexico (23.5%), and other federal entities 135 (26.6%). About their occupation: 261 were students (49.6%), workers from health areas: 41 (7.7%), other jobs: 169 (32.1%), and unemployed: 55 (10.4%). On chronic diseases, 470 (89.3%) did not suffer any chronic disease and 56 (10.6%) did.

About the prior knowledge on SD, 75.6% of participants answered yes and 24.3% answered no. On the prior use of SDs, 72 (13.6%) participants responded yes, 37 of them were male and 35 were female, from the 72 participants that answered yes, only 37 (51.3%) of them used a drug that actually possesses stimulant properties (examples: methylphenidate, Adderall, modafinil, atomoxetine, armodafinil, nicotine, and caffeine), and 38.8% mentioned used other types of drugs or substances that are not considered stimulants (examples: multivitamins, antidepressants, melatonin, and anxiolytics). On the other hand, 79% of participants ($n = 416$) confirmed their use of any substance (caffeine, tobacco, energy drinks, etc.) to maintain or enhance their alertness. Of them 30% ($n = 125$) consume it daily, 20.4% ($n = 85$) use it from 1 to 3 times/week and 49.5% ($n = 206$) consume it sporadically, 63.3% ($n = 333$) said "I don't know" and 10.2% ($n = 54$) don't answered. In the question, where participants were asked if they considered that SD should be controlled by health authorities: 463 (88%) answered positively. Finally, in the hypothetical scenario, 153 (29%) considered the scenario as "fair;" 76 (14.4%) mentioned that the situation was "unfair" and 227 (63.8%) gave other responses. On the same hypothetical scenario, 54 (10.2%) participants attribute the success of person in hypothetical scenario to the use of SD and 63.8% ($n = 336$) attribute it to other causes different from the SD.

When performing the analysis of association of variables, three variables associated significantly with prior SD use, the age group between 18 and 30 years old ($p = 0.0376$), scholarship above high school ($p = 0.0493$),

and practicing a religion different from catholic or have no religion ($p = 0.0041$).

Discussion

The use of SD for different purposes has been popularized in the past few years, particularly in young and healthy individuals, however, it is difficult to establish exact reliable prevalence as there are many variables that influence the results of the studies².

In this sense, one of the aspects that limit the veracity of surveys is that the use of SD can be seen as something forbidden, dishonest, or unethical, therefore, many people usually do not tell the truth about it¹⁵. For this reason, results very important to know the opinion and attitudes of the general population toward SD use in healthy subjects. To the best of our knowledge, this is the first opinion survey on this theme conducted in our country.

In the present survey, one of the aspects to highlight about the studied population characteristics is that the majority of participants were young with an average age of 39 years old which could be due to different factors, being the most probable the easy access to electronic social media, which was the way by the survey was spread in all the age groups¹⁶. In relation to the youth of the population, we also found a very small percentage of participants with chronic diseases (10.6%). In addition, other aspect to highlight is that the education level of the included sample was high with an average of 12.7 years, which is higher than general average scholarship reported in Mexico, being it the highest in Mexico city with 12 years, and the lower in Chiapas with 8 years¹⁷. This could be due to the same reason that was previously indicated and also the fact that the great majority of our individuals were students or have a job.

About the participants responses, there was a high prevalence of previous knowledge about SD (75.6%), which could be due to the high scholarship and age of the participants, which is precisely the population where these drugs are the most popular^{1,2}. On the other hand, in spite of the high frequency of knowledge about SD, the frequency of prior use of SD for cognition was only 13.6%, however, it is difficult to contrast this number with other studies as there is a great variability in the reported prevalence, which range from 1% to 20%¹⁸. The reasons for this variability are diverse, from the way, the surveys are conducted (anonymous, electronically, personally, etc.), the type of population studied (university students, professionals, open population,

etc.), the definition of SD used, if it refers to current or previous use, if it includes the medical prescription of SD, etc.³. Other important factor to consider is that not every participant has the same concept of what is considered a SD, as the 72 participants that confirmed prior use of them, only 37 (44%) were actually using a drug that is considered a stimulant, which means that more than half of the participants attribute stimulant properties to other substances being the most common the vitamin supplements; this is highly related with the extended myth that vitamins have positive effects in alertness, energy, vitality, or even enhance the appetite¹⁹. In contrast, results interesting that 79% of individuals reported using any substance to increase or maintain alertness, being caffeine the most popular. This highlights the fact that the knowledge of "stimulant" concept is ambiguous in general population, as many people consume coffee or nicotine (both considered stimulants) as part of their daily life without pretending necessarily a specific stimulant effect²⁰. About the opinion on the safety of SD, most participants said that they could result dangerous (most think that only in excess), this opinion coincide well with previous studies that point a latent concern in users and non-users on security and risk of addiction to these drugs²¹. However, some recent clinic studies have only showed adverse effects with the moderate use of these drugs²². On the other hand, most participants (88%) confirmed to believe necessary the control and regulation of SD by health authorities, this could be due to the possible risks and ethical dilemmas that have been related to its use²¹. In practice, the majority of these drugs are sold only with medical prescription, there are some of them without this regulation like modafinil in Mexico. In spite of these concerns on the use of SD, the great majority of participants (89%), they were in favor of promote the research to develop SD more effective and safer; on this matter, we did not find other prior survey that explored the same issue, but it is possible that because the majority of the participants are young students, they are more in favor of further research son these drugs. About the ethical-hypothetical scenario presented, it is interesting that 30% considered the situation fair, however, almost 64% considered that the benefits were not related with the use of the drug. This suggests that apparently not all participants are convinced that SDs have significant effects increasing the cognitive performance in real life²³. Finally, the association analysis showed that the age group between 18 and 30 years old, a scholarship above high school, and the practice of a religion different to Catholicism or non-practicing

any religion were related factors with the prior use of SD. This profile of young high school or university students is the same profile that is related with the use of SD in the most previous studies, whereby it matches well with the reported in international literature^{2,18}. About religion, other authors have observed similar results, where the religious environment tends to associate to less use of stimulant substances, even more if they are illegal drugs²⁴. In another similar study carried out in a rural population, it was observed that religiosity was related to a lower propensity to consume illicit drugs such as cocaine and methamphetamine²⁵.

To finalize, it is very important to highlight the identified limitations and biases in the present study, being the most important the electronic distribution of the survey in social media that can sometimes be reached only by a small part of the open population (mostly young people), whereby this study cannot be totally representative of the opinion in the general population, as it was discussed before this could influence both the frequency of use and the opinions on SD; thus, in the future, it will be necessary to develop more extensive similar surveys including population above 50 years old, with more diverse levels of education and socio-economic status to be able to have a more general vision on the use and opinion about SD in healthy subjects.

Conclusion

In the present electronic anonymous survey, whose majority of participants were young adults, mainly students, a prevalence of the use of SD was 13.6%, with a frequency of 80% of the use of stimulants for alertness. Majority of participants have doubts on the safety of the stimulants, are in favor of their regulation by health authorities, but are in favor of continuing with further research on this type of drugs. Finally, the use of stimulants was associated with the age between 18 and 30 years old, a scholarship over high school and the absence of religious beliefs.

Acknowledgments

None.

Funding

The authors declare that there was no source of funding for the realization of this investigation because it was conducted by researchers own financing.

Conflicts of interest

All the authors declare that they have no conflicts of interest with this research or with the publication of its results.

Ethical disclosures

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Likewise, the authors declare that all the participants in this research gave their electronic consent for the present research and for the publication of their results anonymously.

References

1. Carrillo-Mora P, Lugo-Rodríguez Y, Franyutti-Prado KF, Rodríguez-Barragán MA, Cervera-Delgadillo NG. Stimulant drugs to promote the awake state and cognitive performance: they really work?. *Rev Mex Neurosci.* 2022 (In press).
2. Esposito M, Coccimano G, Ministri F, Rosi GL, Nunno ND, Messina G, et al. Smart drugs and neuroenhancement: what do we know? *Front Biosci (Landmark Ed).* 2021;26:347-59.
3. Daubner J, Arshaad MI, Henseler C, Hescheler J, Ehninger D, Broich K, et al. Pharmacological neuroenhancement: current aspects of categorization, epidemiology, pharmacology, drug development, ethics, and future perspectives. *Neural Plast.* 2021;2021:8823383.
4. Repantis D, Bovy L, Ohla K, Kühn S, Dresler M. Cognitive enhancement effects of stimulants: a randomized controlled trial testing methylphenidate, modafinil, and caffeine. *Psychopharmacology (Berl).* 2021;238:441-51.
5. Martins SS, Ghandour LA. Nonmedical use of prescription drugs in adolescents and young adults: not just a Western phenomenon. *World Psychiatry.* 2017;16:102-4.
6. Sharif S, Guirgis A, Fergus S, Schifano F. The use and impact of cognitive enhancers among university students: a systematic review. *Brain Sci.* 2021;11:355.
7. Kapur A. Is methylphenidate beneficial and safe in pharmacological cognitive enhancement? *CNS Drugs.* 2020;34:1045-62.
8. Tapia-Moreno, M.A. Cognition-enhancing drugs: bioethical implications in the light of current scientific evidence. *Bioeth Update.* 2018;4:140-53.
9. Cândido RCF, Perini E, Pádua CM, Junqueira DR. Prevalence of and factors associated with the use of methylphenidate for cognitive enhancement among university students. *Einstein (Sao Paulo).* 2019;18:eAO4745.
10. McDermott H, Lane H, Alonso M. Working smart: the use of 'cognitive enhancers' by UK university students. *J Furth High Educ.* 2021;45:270-83.
11. Conrad EC, Humphries S, Chatterjee A. Attitudes toward cognitive enhancement: the role of metaphor and context. *AJOB Neurosci.* 2019;10:35-47.
12. Erasmus N, Kotzé C. Medical students' attitudes towards pharmacological cognitive enhancement with methylphenidate. *Acad Psychiatry.* 2020;44:721-6.
13. Ram SS, Russell B, Kirkpatrick C, Stewart K, Scahill S, Henning M, et al. Professionals' attitudes towards the use of cognitive enhancers in academic settings. *PLoS One.* 2020;15:e0241968.
14. Eysenbach G. Improving the quality of web surveys: the checklist for reporting results of internet E-surveys (CHERRIES). *J Med Internet Res.* 2004;6:e34.
15. Ram S, Hussainy S, Henning M, Stewart K, Jensen M, Russell B. Attitudes toward cognitive enhancer use among New Zealand tertiary students. *Subst Use Misuse.* 2017;52:1387-92.
16. Cope DG. Using electronic surveys in nursing research. *Oncol Nurs Forum.* 2014;41:681-2.
17. INEGI. Censo de Población y Vivienda. Mexico: INEGI; 2020.
18. Franke AG, Bagusat C, Rust S, Engel A, Lieb K. Substances used and prevalence rates of pharmacological cognitive enhancement among healthy subjects. *Eur Arch Psychiatry Clin Neurosci.* 2014;264:83-90.
19. Moreno-Rodríguez VP, Sánchez-Cabrero R, Abad-Mancheño A, Juanes-García A, Martínez-López F. Food and nutrition myths among future secondary school teachers: a problem of trust in inadequate sources of information. *Soc Sci.* 2021;10:325.
20. Samoggia A, Riedel B. Consumers' perceptions of coffee health benefits and motives for coffee consumption and purchasing. *Nutrients.* 2019;11:653.
21. Schelle KJ, Faulmüller N, Caviola L, Hewstone M. Attitudes toward pharmacological cognitive enhancement-a review. *Front Syst Neurosci.* 2014;8:53.
22. Repantis D, Bovy L, Ohla K, Kühn S, Dresler M. Cognitive enhancement effects of stimulants: a randomized controlled trial testing methylphenidate, modafinil, and caffeine. *Psychopharmacology (Berl).* 2021;238:441-51.
23. Maslen H, Faulmüller N, Savulescu J. Pharmacological cognitive enhancement-how neuroscientific research could advance ethical debate. *Front Syst Neurosci.* 2014;8:107.
24. Debnam K, Milam AJ, Furr-Holden CD, Bradshaw C. The role of stress and spirituality in adolescent substance use. *Subst Use Misuse.* 2016;51:733-41.
25. Cuccia MA, Han X, Curran GM, Booth BM. Associations between religiosity, perceived social support, and stimulant use in an untreated rural sample in the U.S.A. *Subst Use Misuse.* 2016;51:823-34.