



Psychoactive substance use among students: A cross-sectional analysis

Justine Perino^{1,2,3}  | Marie Tournier^{2,4} | Clément Mathieu² |
Louis Letinier^{2,3} | Alexandre Peyré^{1,3} | Garance Perret⁵ | Edwige Pereira⁵ |
Annie Fourier-Réglat^{2,3} | Clothilde Pollet⁵ | Mélina Fatseas^{3,6} |
Christophe Tzourio^{3,5} | Amélie Daveluy^{1,2,3} 

¹Department of Medical Pharmacology, Centre d'addictovigilance de Bordeaux, Bordeaux, France

²Univ. Bordeaux, INSERM U1219, Bordeaux Population Health Research Center, Bordeaux, France

³CHU de Bordeaux, Bordeaux, France

⁴Hospital Charles Perrens, Bordeaux, France

⁵Univ. Bordeaux, Inserm, Bordeaux Population Health Research Center, Team HEALTHY, Bordeaux, France

⁶University of Bordeaux, Institut de Neurosciences Cognitives et Intégratives d'Aquitaine (INCIA), Bordeaux, France

Correspondence

Justine Perino, Centre de pharmacovigilance, Centre d'addictovigilance, Service de pharmacologie médicale, CHU de Bordeaux, Bât. 1A zone nord, 33076 Bordeaux cedex, France.

Email: perino.justine@gmail.com; justine.perino@u-bordeaux.fr

Funding information

French National Research Agency, Grant/Award Number: ANR-10-COHO-05; Health Determinants in Societies, Grant/Award Number: ANR-10-IDEX-03-02

Abstract

Little is known about psychoactive substance use in students, apart from tobacco, alcohol, and cannabis. This study investigated the prevalence of substance use and overlap between various psychoactive substances in students. This cross-sectional study was conducted in 10 066 students included in the i-Share cohort between January 1, 2015, and December 31, 2017. The baseline questionnaire was the key source of information. Psychoactive substances of interest (PSI) were cannabis, cocaine, amphetamines, nitrous oxide, poppers, and MDMA. Their patterns of use were categorized as lifetime, past year, and current use. The use of other psychoactive substances including alcohol and tobacco was described in PSI users and non-users. Most participants were female (75%), and their average age was 21 years. Lifetime use of at least one PSI was reported by 65.5% of participants. Cannabis was the most frequently used substance both over lifetime (57% of students) and past year (35%), followed by poppers and nitrous oxide (28% and 26% of students over lifetime, respectively). Among polydrug users ($n = 1242$), 65% used only nitrous oxide and poppers, showing a strong link between these two substances. Regular alcohol use, binge drinking, and current tobacco use were higher in PSI users than in non-users. Substance use was higher than previously found in both French and European studies in young people. Nitrous oxide use was particularly high. Regular alcohol use, binge drinking, and tobacco use could be used as markers to identify students at risk of PSI use to be targeted by prevention programs.

KEYWORDS

alcohol-related disorders, substance-related disorders, tobacco-related disorders

1 | INTRODUCTION

The attendance at students' parties and/or festivals [1] and academic stress may lead students to indulge in risky behaviors, including psychoactive substance use [2]. Harm associated with psychoactive substance use

depends partly on the substance [3], so studying the types of psychoactive substances used by students, as well as their amount and patterns of use, remains an important public health challenge. This cross-sectional study investigated the prevalence of psychoactive substances use and co-reported use in a large student population.

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2022 The Authors. *Fundamental & Clinical Pharmacology* published by John Wiley & Sons Ltd on behalf of Société Française de Pharmacologie et de Thérapeutique.

2 | MATERIALS AND METHODS

2.1 | Study design and population

This cross-sectional study was carried on in participants in the Internet-Based Students Health Research Enterprise cohort (i-Share, www.i-share.fr), for which participation is on a voluntary basis. The i-Share study was approved by the *Commission Nationale de l'Informatique et des Libertés* (CNIL) [DR-2013-019] [4–6]. The anonymous baseline survey was the key source of information. All students aged at least 18 years old and registered in the i-Share cohort between January 1, 2015, and December 31, 2017, were included.

2.2 | Measures

Psychoactive substances of interest (PSI) were defined as amphetamines, cannabis, cocaine, MDMA, nitrous oxide, or poppers. PSI use was defined as at least one exposure to PSI over lifetime. For each PSI, lifetime use, past-year use, and current use were collected. Because the inclusion questionnaire was not framed according to the definitions commonly admitted for use

frequency [7] and data on use were heterogeneous between the different psychoactive substances, current use was defined differently according to the substance consumed (Figure 1). Poly-drug use was defined as the current use of at least two PSI.

Some variables assessed alcohol use: (i) frequency of alcohol consumption (from “every day” to “several times a year”): occasional use was defined as one intake a week or less and regular use as two intakes a week or more; (ii) alcohol use disorders were approximated using six out of 10 questions in the Alcohol Use Disorder Test (AUDIT) [8]; (iii) binge-drinking was defined as the consumption of at least six units on one occasion. Current and past use of tobacco were reported and high tobacco consumption was defined as more than 10 cigarettes a day. In this study, tobacco or alcohol use was defined as current use with a frequency of at least once a month.

2.3 | Statistical analyses

Variables were described as means with standard deviation for quantitative and as numbers and proportions for qualitative ones. Comparisons were performed

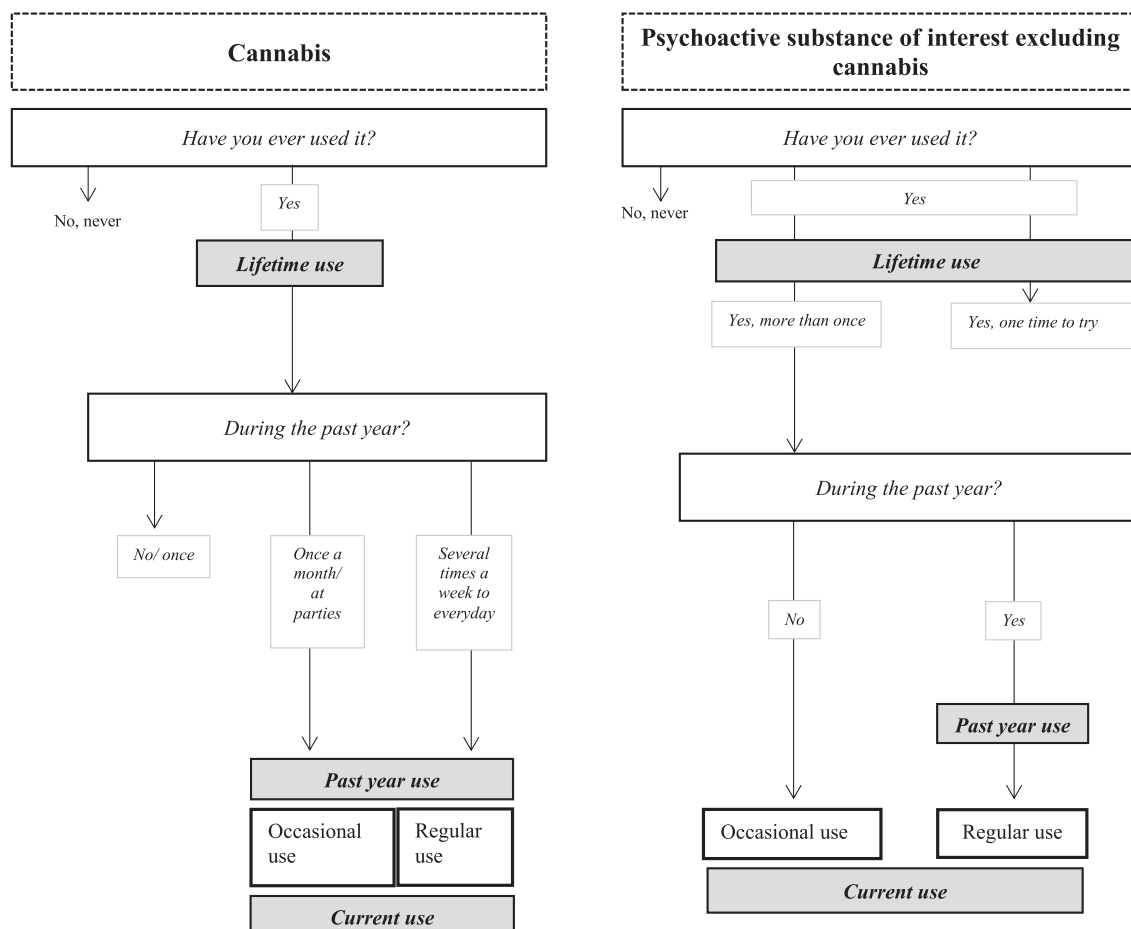


FIGURE 1 Classification of psychoactive substances of interest (PSI) use patterns

using chi-square tests and expressed with p -value ($\alpha = 0.05$). Prevalence was described by using percentages and 95% confidence intervals (95% CIs) and calculated after calibration on the margin on gender and age. These results were obtained by weighting with the ranking ratio method using the APOGEE database [9]. Analyses were performed using SAS Guide® version 3.7 and the chord circle (supporting information) was performed with R®.

3 | RESULTS

The total sample comprised 11 046 students. Among them, 10 066 students answered the questions on their use of PSI and were included in the study (Figure 2). The average age of the participants was 21 (SD 2.69) years and 75% were females. They had mostly obtained a scientific high school diploma (63%) and were from privileged families (55%) while 47% of non-responders were from less privileged families (supporting information).

According to the definitions of substance use, 16.7% of students reported neither PSI nor alcohol or tobacco use, while 73.7% were alcohol users and 30.6% were tobacco smokers. More than half of students (65.5%) had consumed one or several PSI at least once over lifetime (Table 1). Cannabis ranked first

TABLE 1 Psychoactive substances use profile weighted on sex and age ($n = 10\,066$)

	%
Non-psychoactive substances user	16.68
Psychoactive substances of interest (PSI) user	65.05
Tobacco and/or alcohol only user	18.27
Alcohol	
Use	73.71
Binge drinking	81.96
Tobacco	
Past use	27.61
Current use	30.61
>10 cigarettes a day	7.34

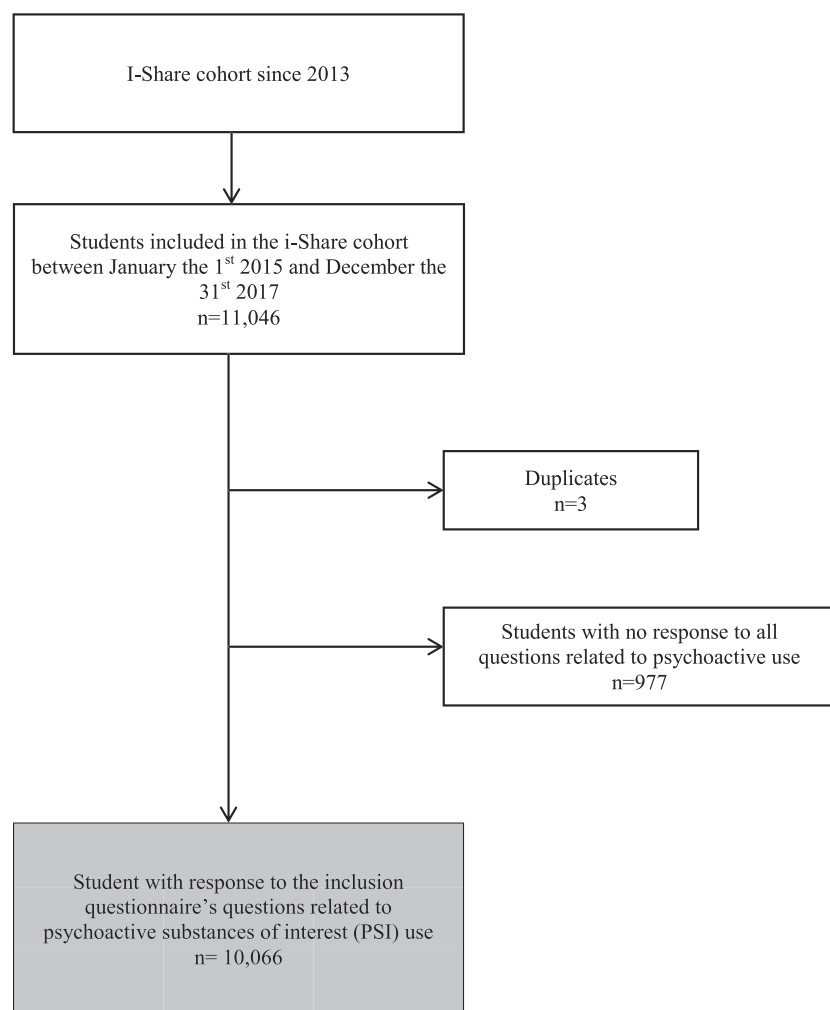


FIGURE 2 Flowchart of the study

with 57% of use over lifetime and 35% in the past year, before poppers and nitrous oxide with lifetime use of 28% and 26% and past year use of 14% and 12%, respectively. MDMA, cocaine, and amphetamine were consumed less frequently; the highest rate was found for MDMA with 12% of lifetime use and 5% over the past year (Figure 3).

The use of alcohol was more often reported by PSI users than by non-PSI users, with higher rates of regular alcohol use and binge drinking (Table 2): 85% and 90% in PSI users versus 46% and 64% in non-PSI users, respectively. Among non-PSI users, lower rate of binge drinking was found among alcohol/tobacco users in comparison to others. Current tobacco use was far higher in PSI users than in non-PSI users with 44% versus 5% (Figure 4). Co-reported use of various PSIs was assessed in current PSI users (Table 3; supporting information): nitrous oxide and cannabis were mostly used alone (51% and 34% respectively), whereas cocaine, amphetamines, and MDMA were mainly associated with another PSI. Among the 1242 poly-drug users, 65% consumed nitrous oxide and poppers, whereas 17% of poly-drug users used MDMA and cocaine.

4 | DISCUSSION

Extremely high rates of psychoactive substances use found in students raise questions about the health risks associated, particularly with cannabis, which is associated with an increased risk of psychiatric [10–12] and cardiovascular conditions [13,14], and nitrous oxide, which is used at a younger age and associated with neurological disorders [15,16]. The frequency of MDMA and cocaine use was not negligible (respectively 7% and 4% of lifetime use), which is consistent with an increase in cocaine consumption due to its high availability nationwide and an increase in the number of deaths and overdoses with cocaine [17]. The association of stimulants such as cocaine and MDMA can be particularly dangerous as it may trigger serotonin syndrome [18] and cardiovascular disorders [19,20], especially arrhythmia. Nitrous oxide, which was the second PSI most frequently consumed by students over the past year, rarely receives specific attention in national and European studies [21–24], as it is often grouped together with other inhaled substances. In a survey conducted in 2017 among young people in the French general population, poppers were found to be the

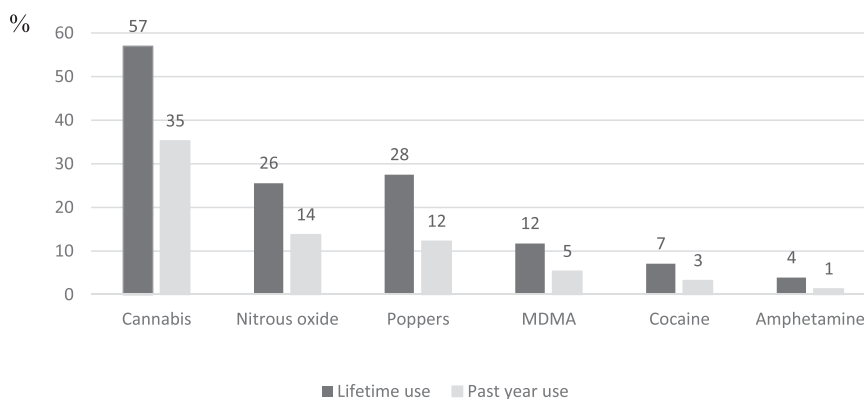


FIGURE 3 Prevalence of psychoactive substances of interest (PSI) use in the study sample over life and the past year with ponderation on sex and age ($n = 10\,066$)

TABLE 2 Comparison of alcohol and tobacco use between PSI user and non-users

	N (%) (n Non PSI users = 3723)	N (%) (n PSI users = 6199)	p
Alcohol use			<0.001
No	704 (19)	138 (2)	
Occasional	1294 (35)	794 (13)	
Regular	1725 (46)	5267 (85)	
Binge drinking			<0.001
Yes	2396 (64)	5575 (90)	
AUDIT score			<0.001
Mésusage de l'alcool	48 (1)	858 (14)	
Alcoolodépendance	1 (0)	99 (2)	
Tobacco use			<0.001
No	2958 (79)	1304 (21)	
Former tobacco user	576 (15)	2164 (35)	
Tabagisme actif	189 (5)	2731 (44)	

second psychoactive substance most often used after cannabis, with 8.8% of lifetime exposure, while “inhaled products” represented only 3.1% [21]. The strong association found in this study between nitrous oxide and poppers use in poly-users reinforces the hypothesis

that nitrous oxide consumption may be largely underestimated in national and European studies.

The over-representation of the use of PSI among tobacco users, regular alcohol users, and binge drinkers suggest that alcohol and tobacco use might be

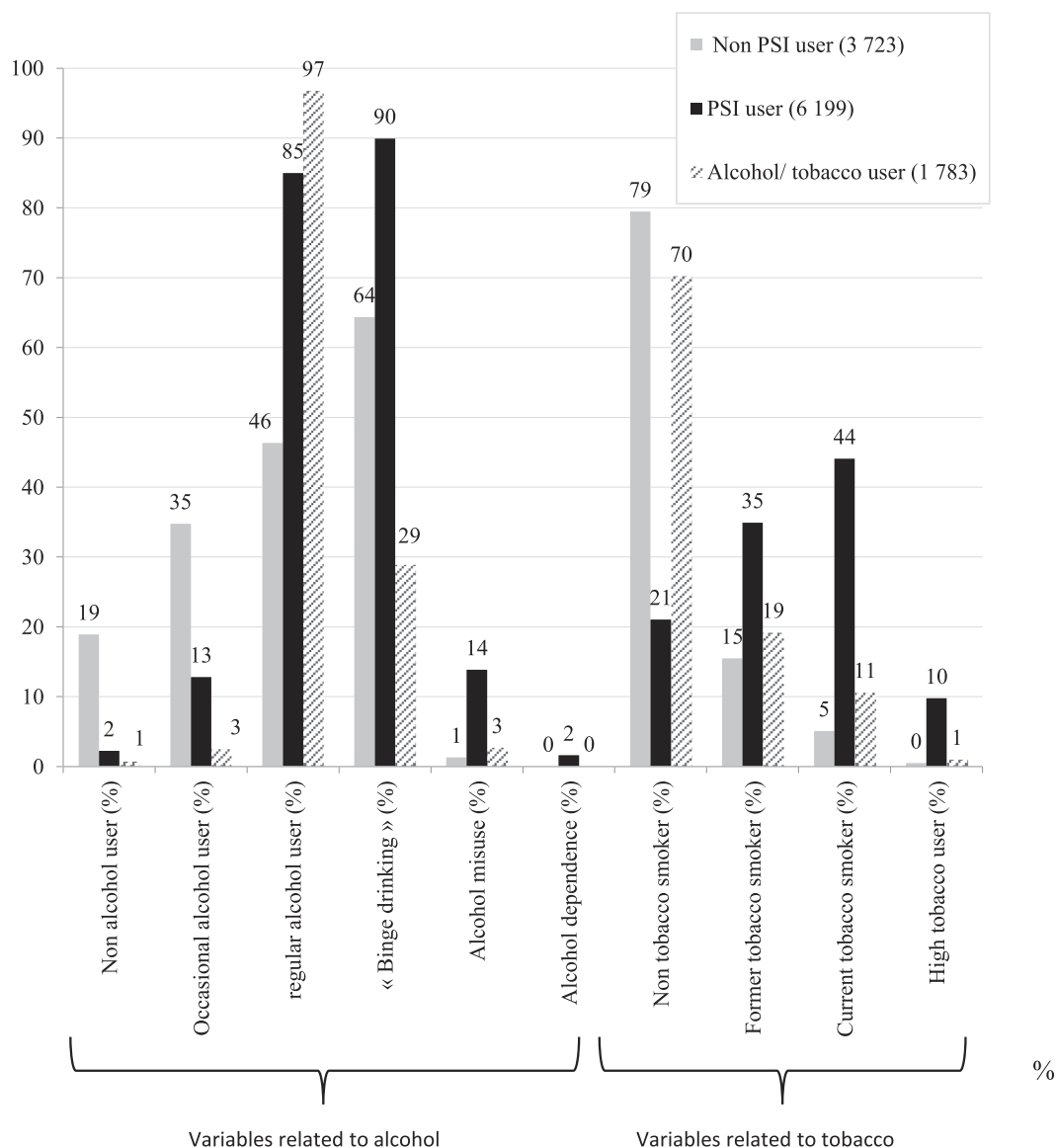


FIGURE 4 Alcohol and tobacco use patterns in non-PSI users, only alcohol/tobacco users and PSI users (in percentages)

TABLE 3 Co-reported substances by couples among current PSI users ($n = 1242$)

	Cocaine, n (%)	MDMA, n (%)	Cannabis, n (%)	Nitrous oxide, n (%)	Poppers, n (%)	Amphetamines, n (%)
Cocaine, n (%)	21 ^a (1.69)					
MDMA, n (%)	217 (17.47)	57 ^a (4.59)				
Cannabis, n (%)	134 (10.79)	253 (20.37)	425 ^a (34.22)			
Nitrous oxide, n (%)	147 (11.84)	251 (20.21)	294 (23.67)	629 ^a (50.64)		
Poppers, n (%)	83 (6.68)	161 (12.96)	236 (19.00)	802 (64.57)	310 ^a (24.96)	
Amphetamines, n (%)	94 (7.57)	118 (9.50)	83 (6.68)	78 (6.28)	55 (4.43)	3 ^a (0.24)

^aCurrent use of only one PSI.

interesting markers to target students at risk of other psychoactive substances use. However, the rates of binge drinking were also high in PSI non-users which does not allow this parameter to be used as a specific indicator.

This is the largest study in Europe conducted on the use of psychoactive substances among students. Geographical data were often missing and could not be included in the analysis. Information and participation biases cannot be excluded, and some variables were underestimated (alcohol use disorders) or might be imprecise due to the i-Share questionnaire. This exposed to an underestimation, which would have little impact on the conclusions.

5 | CONCLUSIONS

This study points to a wide use of psychoactive substances in students and draws attention to gaps in monitoring of nitrous oxide. It also reveals that regular alcohol use and tobacco use could serve as markers to identify students at risk for others psychoactive substance use to be targeted by prevention programs.

ACKNOWLEDGMENTS

The authors are grateful to the participants of the i-Share project, for their commitment and cooperation and to the entire i-Share staff for their contribution and assistance. The authors thanks French National Research Agency and the Health Determinants in Societies for fundings. The authors thank Ray Cooke and Cameron Herman for their assistance in reviewing the manuscript.

CONFLICT OF INTERESTS

The authors have no conflict of interests to declare.

AUTHOR CONTRIBUTION

Dr Justine Perino, Dr Amélie Daveluy, Dr Annie Fourier-Réglat, and Prof Marie Tournier conceptualized and designed the study and reviewed and revised the manuscript. Dr Justine Perino drafted the initial manuscript. Dr Justine Perino, Dr Louis Letinier, Dr Clothilde Pollet, Mrs Edwige Peirera, Mr Clément Mathieu, and Mrs Garance Perret designed the data collection instruments, collected data, carried out the initial analyses, and reviewed and revised the manuscript. Prof Christophe Tzourio coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content. Alexandre Peyré and Prof Mélina Fatseas reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

FUNDING/SUPPORT

This study is ancillary to the i-Share research project which has received funding from the French national Research Agency via the programme “Investissement d’Avenir”, reference ANR-10-COHO-05. This study was supported by a grant from the Excellence Cluster “Health Determinants in Societies” HEADS of the University of Bordeaux, managed by the Bordeaux ‘Initiatives d’excellence’ (IdEx) programme, grant number (ANR-10-IDEX-03-02).

ETHICS STATEMENT

The i-Share study was approved by the Commission Nationale de l’Informatique et des Libertés (CNIL) [DR-2013-019].

ORCID

Justine Perino  <https://orcid.org/0000-0003-0039-0734>

Amélie Daveluy  <https://orcid.org/0000-0003-1922-8630>

REFERENCES

- McCrae K, Tobias S, Tupper K, et al. Drug checking services at music festivals and events in a Canadian setting. *Drug Alcohol Depend.* 2019;205:107589. doi:10.1016/j.drugalcdep.2019.107589
- Herauld J, Dano C. Use of psychoactive substances by medical residents in medicine. *Exercer.* 2013;107:122-123.
- Nutt D, King LA, Saulsbury W, Blakemore C. Development of a rational scale to assess the harm of drugs of potential misuse. *Lancet.* 2007;369(9566):1047-1053. doi:10.1016/S0140-6736(07)60464-4
- Galera C, Salla J, Montagni I, et al. Stress, attention deficit hyperactivity disorder (ADHD) symptoms and tobacco smoking: the i-Share study. *Eur Psychiatry.* 2017;45:221-226. doi:10.1016/j.eurpsy.2017.07.007
- Kinouani S, Pereira E, Tzourio C. Electronic cigarette use in students and its relation with tobacco-smoking: a cross-sectional analysis of the i-Share study. *Int J Environ Res Public Health.* 2017;14(11):1345. doi:10.3390/ijerph14111345
- Macalli M, Tournier M, Galera C, et al. Perceived parental support in childhood and adolescence and suicidal ideation in young adults: a cross-sectional analysis of the i-Share study. *BMC Psychiatry.* 2018;18(1):373. doi:10.1186/s12888-018-1957-7
- EMCDDA. Methods and definitions. 2012. Accessed January 5, 2022. <https://www.emcdda.europa.eu/stats07/GPS/methods>
- Gache P, Michaud P, Landry U, et al. The alcohol use disorders identification test (AUDIT) as a screening tool for excessive drinking in primary care: reliability and validity of a French version. *Alcohol Clin Exp Res.* 2005;29(11):2001-2007. doi:10.1097/01.alc.0000187034.58955.64
- République Française. Arrêté du 26 janvier 1995 portant création d’une application informatique nationale de gestion des enseignements et des étudiants. 1995. Accessed January 5, 2022. <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000186826/>
- Weinberger AH, Zhu J, Lee J, Anastasiou E, Copeland J, Goodwin RD. Cannabis use among youth in the United States, 2004-2016: faster rate of increase among youth with depression. *Drug Alcohol Depend.* 2020;209:107894. doi:10.1016/j.drugalcdep.2020.107894



11. Gukasyan N, Strain EC. Relationship between cannabis use frequency and major depressive disorder in adolescents: findings from the National Survey on Drug Use and Health 2012-2017. *Drug Alcohol Depend.* 2020;208:107867. doi:10.1016/j.drugalcdep.2020.107867
12. Verdoux H, Tournier M, Cougnard A. Impact of substance use on the onset and course of early psychosis. *Schizophr Res.* 2005;79(1):69-75. doi:10.1016/j.schres.2004.12.008
13. Jouanjus E, Raymond V, Lapeyre-Mestre M, Wolff V. What is the current knowledge about the cardiovascular risk for users of cannabis-based products? *A Systematic Review Curr Atheroscler Rep.* 2017;19(6):26. doi:10.1007/s11883-017-0663-0
14. Jouanjus E, Lapeyre-Mestre M, Micallef J. The French Association of the Regional Abuse and Dependence Monitoring Centres (CEIP-A) Working Group on Cannabis Complications*. Cannabis use: signal of increasing risk of serious cardiovascular disorders. *J Am Heart Assoc.* 2014;3(2):e000638. doi:10.1161/JAHA.113.000638
15. Zacny JP, Lichter JL, Coalson DW, et al. Time course of effects of brief inhalations of nitrous oxide in normal volunteers. *Addiction.* 1994;89(7):831-839. doi:10.1111/j.1360-0443.1994.tb00986.x
16. French Association of Addictovigilance Centres, Micallef J, Mallaret M, et al. Warning on increased serious health complications related to non-medical use of nitrous oxide. *Therapie.* 2021;76(5):478-479. doi:10.1016/j.therap.2020.01.002
17. Eiden C, Vincent M, Serrand C, et al. Health consequences of cocaine use in France: data from the French Addictovigilance Network. *Fundam Clin Pharmacol.* 2020;35(2):455-465. doi:10.1111/fcp.12603
18. Silins E, Copeland J, Dillon P. Qualitative review of serotonin syndrome, ecstasy (MDMA) and the use of other serotonergic substances: hierarchy of risk. *Aust N Z J Psychiatry.* 2007;41(8):649-655. doi:10.1080/00048670701449237
19. Morentin B, Callado LF. Sudden cardiac death associated to substances of abuse and psychotropic drugs consumed by young people: a population study based on forensic autopsies. *Drug Alcohol Depend.* 2019;201:23-28. doi:10.1016/j.drugalcdep.2019.03.021
20. Shenouda SK, Carvalho F, Varner KJ. The cardiovascular and cardiac actions of ecstasy and its metabolites. *Curr Pharm Biotechnol.* 2010;11(5):470-475. doi:10.2174/138920110791591526
21. Spilka S, Le Nézet O, Janssen E, et al. Les drogues à 17 ans: analyse de l'enquête ESCAPAD 2017. OFDT, 2018. Accessed January 5, 2022. <https://www.ofdt.fr/BDD/publications/docs/efxssy2.pdf>
22. EMCDDA and ESPAD. ESPAD Report 2015 — Results from the European School Survey Project on Alcohol and Other Drugs, EMCDDA-ESPAD joint publications, Publications Office of the European Union, Luxembourg, 2016. Accessed January 5, 2022. https://www.emcdda.europa.eu/publications/joint-publications/emcdda-espada-report_en
23. Beck F, Richard JB, Guignard R, et al. Les niveaux d'usage des drogues en France en 2014. OFDT, 2015. Accessed January 5, 2022. <https://www.ofdt.fr/publications>
24. Beck F, Spilka S, Nguyen-Thanh V, et al. Cannabis: usages actuels en population adulte. OFDT, 2017. Accessed January 5, 2022. <https://www.ofdt.fr/publications>

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Perino J, Tournier M, Mathieu C, et al. Psychoactive substance use among students: A cross-sectional analysis. *Fundam Clin Pharmacol.* 2022;36(5):908-914. doi:10.1111/fcp.12771