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ORIGINAL ARTICLE

Polydrug use among college students in Brazil: a nationwide survey

Lúcio Garcia de Oliveira,[1] Denis Guilherme Alberghini,[2] Bernardo dos Santos,[2] Arthur Guerra de Andrade[1,3]

[1]*Department of Legal Medicine, Ethics, and Occupational Health and Department of Psychiatry, School of Medicine, Universidade de São Paulo (USP), São Paulo, SP, Brazil.* [2]*Institute of Mathematics and Statistics, USP, São Paulo, SP, Brazil.* [3]*Department of Psychiatry, Faculdade de Medicina do ABC, Santo André, SP, Brazil.*

Objective: To estimate the frequency of polydrug use (alcohol and illicit drugs) among college students and its associations with gender and age group.
Methods: A nationwide sample of 12,544 college students was asked to complete a questionnaire on their use of drugs according to three time parameters (lifetime, past 12 months, and last 30 days). The co-use of drugs was investigated as concurrent polydrug use (CPU) and simultaneous polydrug use (SPU), a subcategory of CPU that involves the use of drugs at the same time or in close temporal proximity.
Results: Almost 26% of college students reported having engaged in CPU in the past 12 months. Among these students, 37% had engaged in SPU. In the past 30 days, 17% college students had engaged in CPU. Among these, 35% had engaged in SPU. Marijuana was the illicit drug mostly frequently used with alcohol (either as CPU or SPU), especially among males. Among females, the most commonly reported combination was alcohol and prescribed medications.
Conclusions: A high proportion of Brazilian college students may be engaging in polydrug use. College administrators should keep themselves informed to be able to identify such use and to develop educational interventions to prevent such behavior.

Keywords: Ethanol; illicit drugs; students; epidemiology; Brazil

Introduction

According to Martin,[1] polydrug use describes a wide variety of substance use disorders. In this regard, it is commonly classified as either concurrent polydrug use (CPU) or simultaneous polydrug use (SPU), depending on the timing of use of the involved drugs.[1] In this way, according to Martin,[1] CPU has been defined as the use of two or more substances within a given time period, while SPU has been defined as the use of two or more substances in combination.[1]

Given that alcohol use is reported by almost two billion people worldwide,[2] it would be expected to be present in most polydrug use combinations.[1,3-5] Among the many possibilities, alcohol-tobacco, alcohol-marijuana, alcohol-cocaine, alcohol-ecstasy, alcohol-heroin, and alcohol-methamphetamine are some of the combinations most frequently reported,[1,5-8] while the combinations of alcohol-prescribed medications[9,10] and alcohol-energy drinks[11] have attracted the attention of the scientific community.

The 2000 National Alcohol Survey found that 10.0% of the general U.S. population reported having used alcohol and marijuana on different days (CPU), and an additional 5.0% reported using alcohol and drugs other than marijuana on different days. Furthermore, 7.0% of the respondents reported SPU of alcohol and marijuana, and 1.7% reported SPU of alcohol and drugs other than marijuana.[5]

In Europe, polydrug use is a widespread drug use pattern[4] that seems to begin early in life. For instance, the 2003 European School Survey Project on Alcohol and Other Drugs (ESPAD) found that approximately 16% of 15- to 16-year-old students were consuming alcohol and cannabis at the same time, and approximately 5% reported using alcohol with prescribed medications.[12] Additionally, according to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) report,[4] the exposure of young people to a dynamic and expanding drug market with an increasing range of drugs or products that are easily and cheaply available increases their vulnerability to engage in polydrug use.

Among young adults, polydrug use by college students has been a cause of concern. For instance, a study conducted in Bolivia, Colombia, Ecuador, and Peru showed that polydrug use is frequently reported among college students. This study only considered combinations of illicit drugs (i.e., excluding alcohol and tobacco)

Correspondence: Lúcio Garcia de Oliveira, Departamento de Medicina Legal, Ética Médica e Medicina Social e do Trabalho, Faculdade de Medicina, Universidade de São Paulo (USP), Av. Dr. Arnaldo, 455, Cerqueira César, CEP 01246903, São Paulo, SP, Brazil.
E-mail: lucgoliver@gmail.com
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and found that the combination of marijuana and cocaine was the most frequently reported among college students.[13] Specifically regarding the combination of alcohol with other drugs among college students, the Harvard School of Public Health College Alcohol Study (CAS) found that, in the United States, between 87 and 98% of users of marijuana or other drugs developed a pattern of heavy alcohol use and many of them drink until they are drunk.[14] It is worrisome that alcohol intoxication increases the risk of individuals making ill-considered decisions about illicit drug taking, thereby biasing them towards engaging in polydrug use.[4]

Independently of the drug combinations, the primary concern is that as polydrug use becomes regular, there will come a time when users find themselves entangled in a vicious cycle in which the desire for one drug leads them to use another drug and so on.[15,16] Consequently, polydrug use may complicate the proper identification of existing substance use disorders (SUDs) and hinder adherence to, and the success of, possible therapeutic approaches.[17] Most worrisome is that the involvement of polydrug use in drug-induced deaths is increasingly high.[18]

In Brazil, polydrug use contributions to health indicators have been investigated. According to the recently launched Brazilian Report on Drugs, polydrug use has been found to contribute to 23.0% of hospital admissions, 9.6% of work dismissals, 4.0% of retirements, and 0.4% of deaths relating to drug use.[19]

However, this issue remains underexplored in Brazil. There are no existing data about the frequency of polydrug use in Brazil. Since the 1980s, nationwide surveys have been carried out to investigate drug use among the general Brazilian population, elementary and high school students and street children, but none of them has addressed polydrug use. Moreover, there is a lack of a database reflecting this problem on a nationwide basis.

Therefore, to fine-tune existing drug policies and drug-related interventions, it is necessary to explore the complexity of drug use patterns and their consequences, and gaining knowledge about polydrug use is a priority for investigation.[4] Hence, the main objective of this study was to present detailed epidemiological information on the frequency of co-occurring alcohol and illicit drug use (CPU and SPU) and their individual correlates (in terms of gender and age) among college students who reported having at least one alcoholic drink over the past 12 months and over the last 30 days.

Methods

Data presented in this manuscript are part of the recently launched report of the First Nationwide Survey on the Use of Alcohol, Tobacco and Other Drugs among College Students in the 27 Brazilian state capitals. The data for this report were gathered between May and December 2009.[20]

Study design

A nationwide probabilistic and stratified sample of college students from public and private higher education institutions (HEIs) was selected and recruited in unequally sized clusters. The five administrative regions of Brazil and the type of administrative organization of the HEI (public or private) were defined as the strata for sampling. The HEIs and the classes of students (here, class was defined as a group of students taking a given course) were considered the clusters (primary sampling units). Because individual college students are enrolled in more than one course, multiplicity sampling was used, enabling population elements to be related to more than one cluster.

We performed a two-stage cluster sampling. The first stage consisted of random selection of HEIs based on a sampling frame provided by the Anisio Teixeira National Educational Studies and Research Institute, Ministry of Education, Brazil. According to this list, in 2008, there were 2,252 HEIs in Brazil. Only HEIs located in the state capitals were considered for sampling. The sampling frame was therefore organized according to state capitals and then the type of administration system (i.e., public or private). Afterwards, the draw was performed by systematic selection based on a random starting-point, and the probability proportional to estimated size (PPeS) of the number of students enrolled was based on data from the sampling frame previously mentioned. Following the selection of the potential participating HEIs, a second systematic draw was held. The HEIs that agreed to take part in the survey provided a list of mandatory courses for all classroom-based undergraduate programs, which allowed the researchers to randomly select the classes (drawn according to course) from which the students would be invited to answer the research instrument. All classes of students of a given HEI were randomly selected and had the same probability of participation. The number of classes was proportional to the total number of students in the HEI units in a given state capital. A total number of 929 classes from 114 HEIs were randomly drawn to take part in this survey.

Data collection procedures

The governing body of each selected HEI was contacted by email and telephone so the researchers could informally communicate the random selection of the institution as a participant in the survey. The rector and/or dean of the institution were directly contacted whenever possible. After agreeing to participate in the survey, the HEIs were contacted again and asked to provide the academic information required to select the classes of students that would be asked to answer the survey instrument. This information included a list of mandatory courses for all classroom-based undergraduate programs broken down according to academic year, study period, and program. Whenever possible, the HEIs provided the following additional relevant information for the random selection and for planning the fieldwork: the number of students enrolled by course, the days of the week and timetables for the course, the name of the professor in charge of the course, and the location of the room where the course was taught. After obtaining this information,

the random selection of the classes of students, the planning of the survey logistics at the HEI and the consolidation of the fieldwork was carried out. During data collection, all students in any given selected class were invited to take part in the study. Participation was voluntary. After accepting, the students were asked to fill out and sign a free and informed consent statement. Their participation consisted of completing the research questionnaire. Once the student had completed the questionnaire, which took an average of 50 minutes, he or she put it and the informed consent form in separate ballot boxes. More details about the design and methods of this survey are described elsewhere.[20]

Main outcome measures

An individualized, self-completed, anonymous questionnaire with 98 closed questions was chosen as the research instrument. There were no spaces on the questionnaire for personal information, such as name, address, e-mail, name of HEI, etc., making identification impossible and guaranteeing confidentiality. The questionnaire was designed to describe the profile and lifestyle of Brazilian college students. Its content was based on the World Health Organization's research instrument as previously adapted by Stempliuk et al.[21] for use with Brazilian college students. The main outcome measure was drug use. Non-medical use of alcohol, tobacco, inhalants, marijuana, cocaine, crack-cocaine, *merla*, amphetamines, anticholinergics, tranquilizers, opiate analgesics, sedatives, anabolic androgenic steroids (AAS), hallucinogens, ecstasy, and synthetic drugs were measured over three time parameters: lifetime, past 12 months, and last 30 days. These measurements of drug use made it possible for the researchers to divide the college students into five groups: non-drug users (NU), alcohol users (AU), users of at least one illicit drug (drug users, DU), CPU, and SPU. Students who did not report any use of alcohol or other drugs were defined as NU. Students who reported having at least one alcoholic drink were defined as AU. Students who reported using at least one of the substances in the above list were defined as DU. Finally, students who reported using both alcohol and at least one other drug were defined as CPU. To fulfill the aims of this study, this categorization was carried out both for 12-month drug use and 30-day drug use. We also investigated how many of the college students gave a positive response to the question ''Have you ever used alcoholic beverages and other drugs simultaneously (in a single session)?'' The specifics of such behavior were estimated with the following question: ''If it has already happened to you, what other drugs have you used simultaneously with alcohol and how often?'' These questions allowed the researchers to calculate the percentage of college students who had engaged in SPU of alcohol and other drugs for comparison with the combinations most commonly reported in the literature, i.e., alcohol and tobacco; alcohol and marijuana; alcohol and cocaine (or its derivatives); alcohol and tranquillizers; alcohol and amphetamines; alcohol and sedatives; alcohol and anticholinergics; alcohol and ecstasy; and alcohol and synthetic drugs. The combination of alcohol with tobacco (CPU or SPU) was excluded from the data analysis because the aim of the present study was to determine the co-occurrence of alcohol use and illicit drug use. To guarantee the truthfulness of answers, a fictitious drug (Relevin®) was included in the research instrument as in the European School Project on Alcohol and Other Drugs (ESPAD)[10]; if the respondent indicated use of Relevin, the entire questionnaire was excluded from the data analysis stage. Finally, the criteria of the CCEB scale (Critério de Classificação Econômica Brasil - Brazilian Criterion of Economic Classification)[22] were also included in the body of the research instrument to enable researchers to estimate the interviewees' socio-economic status (SES) by estimating their purchasing power.

Participants

Throughout Brazil, 100 HEIs (88.0% of the estimated total) and 654 (70.6%) classes participated in the study. The response rate of students invited to participate was 95.6%, resulting in the participation of 12,721 college students. Of these, 10 were excluded because they claimed to use Relevin®, a dummy drug, bringing the final total to 12,711 college students nationwide.

Statistical analysis

The database was built using the SPSS software. Data analysis was performed based on the previous studies of Stinson et al.[23] and Falk et al.[24] Rates of NU, alcohol and drug use (AU, DU) and co-use (CPU and SPU) were estimated for each gender and for four age groups (up to 18 years old; 18-24; 25-34; 35 years and over). Rates and confidence intervals (CIs) were estimated by a logistic regression model using the Survey library of R software, version 2.12.0. All estimates were weighted according to the sampling weights to obtain unbiased estimates of the entire college student population in Brazil. CIs were defined using the Bonferroni correction with confidence coefficients (CCs) set previously to 97.5%. Intragroup and intergroup comparisons were carried out to evaluate gender-related and age-related effects. To make this possible, the CIs were compared two-by-two. The comparison of CIs with CCs of 97.5% (0.975) had a confidence level of 95% ($0.975^2 * 100$) such that the null hypothesis was accepted or rejected at a significance level of approximately 5%. For some categorical variables, intergroup comparisons were performed using Pearson's chi-square test. Finally, as SPU is a subset of the CPU group, the prevalence of SPU was evaluated among the college students who had reported engaging in CPU. Additionally, it is important to note that four out of the five groups mentioned above (AU, DU, CPU, and SPU) overlap and are not mutually exclusive; therefore, our findings should be interpreted with caution.

Research ethics committee approval

This study was approved by the Research Ethics Committee of the Hospital das Clínicas, Faculty of Medicine of the University of São Paulo (CAPPesq HC-FMUSP, protocol no. 0378/08).

Results

Sociodemographic data

A total of 12,711 students completed the survey. Students who did not answer the questions about alcohol use were excluded (n=167), resulting in a total of 12,544 questionnaires in the analysis. The majority of the sample was made up of female students (55.0%), young people aged between 18 and 24 years (67.5%), singles (80.6%), whites (55.5%), and individuals from very high and high-income families (classes A and B) (72.0%).

Drug use

Almost 26.0% of the college students reported never using alcohol or drugs in the past 12 months (NU), 70.1% declared that they had had at least one alcoholic drink (AU), and 30.8% declared that they had used at least one illicit drug (DU). Almost 26.0% of the students reported that they had co-used alcohol and at least one illicit drug over the past 12 months; i.e., they reported engaging in CPU. Almost 37.0% of the students who reported co-use of alcohol and other drugs (CPU) had used alcohol and another drug on the same occasion during the past 12 months; i.e., simultaneously or in temporal proximity. Finally, 43.6% (95%CI 40.3-47.0) of the interviewees reported use of alcohol only (62.0% of AU) and 2.9% (95%CI 1.7-5.0) reported use of other drugs only (9.4% of DU) in the past 12 months. All estimates were reduced when measured in the past 30 days, except for the estimate of NU, alcohol only and drug only, as follows: a) NU (35.2%); b) AU (58.1%); c) DU (21.3%); and d) CPU (17.0%). Approximately 35.0% (35.4%) of the CPU users may have also engaged in SPU over the last 30 days, consistent with the finding for the measure in the past 12 months. Finally, 39.9% (95%CI 35.1-45.0) of the interviewees reported only using alcohol (68.0% of AU) and 3.9% (95%CI 2.5-6.0) reported only using drugs (18.3% of DU) (Tables 1 and 2).

Non-drug users, alcohol users, and drug users

There were no gender-related or age-related effects in the estimates of NU and AU in the past 12 months. However, among male college students, the percentages of DU in the 18-24 and 25-34 year age groups were higher than those in the under 18- and over 35-year-old groups. Such differences were not observed among female college students. For the estimates of past 30-day drug use, no gender- or age-related effects were observed in the NU, AU, and DU groups.

Concurrent polydrug use

Analysis of the gender- and age-related effects on past 12-month CPU revealed nearly the same results described above. Among males, CPU was more frequently observed among students aged 18-24 and 25-34 years than students under 18 or who were 35 years of age or older. Again, these differences were not observed among female students. The frequency of female students aged 35 years and over who engaged in CPU (32.1%) was higher than that observed among male students within the same age range (12.1%). Similar findings were observed for past 30 days drug use, i.e., male students aged 18-24 and 25-34 more often engaged in CPU than those under 18 or 35 and older. Additionally, females aged 35 years and over engaged in CPU (24.0%) more often than their male peers (8.0%).

Marijuana, amphetamines, inhalants, tranquillizers, and hallucinogens were the five drugs most frequently co-used with alcohol both in the past 12 months and in the past 30 days. For past 12-month drug use, differences were observed between the genders relating to CPU use of alcohol with marijuana, amphetamines, inhalants, tranquilizers, ecstasy, opiate analgesics, cocaine, AAS, and sedatives. Similar findings were observed for past 30-day drug use, except that the gender-related differences previously observed for the use of inhalants, opiate analgesics, and cocaine were no longer observed. Conversely, an inter-gender difference was identified for the use of synthetic drugs; synthetic drug use was observed more often among female students. In brief, the combinations of alcohol and marijuana, ecstasy, and AAS were higher among male students for both measures of drug use. Conversely, female college students engaged more often in CPU use of alcohol and prescribed medications (amphetamines, tranquilizers, opiate analgesics, and sedatives) (Tables 3 and 4).

Simultaneous polydrug use

Among those college students who reported engaging in co-use of alcohol and other drugs, males co-used on the same occasion or in close temporal proximity (SPU) more often than their female peers did in the past 12 months (47.2 vs. 28.0%) but not in the past 30 days (43.1 vs. 29.1%). Regarding age-related effects, college students aged 35 years and over reported engaging in SPU less frequently than students in the age groups of 18-24 and 25-34 years old for both measures of drug use (in the past 12 months and in the past 30 days). Among male college students, there were no differences in SPU across age groups for either measure. Among females, college students aged 35 years and over engaged less often in SPU than those from the other age-ranges in the past 12 months. In the past 30 days, this difference was extended to the age range of 25-34 years old. Finally, male college students engaged in SPU more often than their female peers in the age groups of 25-34 and 35

Table 1 Twelve-month prevalence (and CIs) of alcohol use, drug use, concurrent polydrug use, and simultaneous polydrug use among Brazilian college students according to gender and age in Brazil in 2009 (rates and CIs were estimated using a logistic regression model; CIs were defined using the Bonferroni correction with confidence coefficients set at 97.5%)

	Non-drug use			Alcohol use			Drug use			Concurrent polydrug use			Simultaneous polydrug use		
	n*	%	(0.975) CI	n*	%	(0.975) CI	n*	%	(0.975) CI	n*	%	(0.975) CI	n*	%	(0.975) CI
Total	11,916	25.7	21.7-30.0	12,544	70.1	65.3-74.0	12,218	30.8	25.5-37.0	11,957	25.7	21.8-30.0	2,435	37.2	30.8-44.0
Male students	5,342	21.4	15.1-29.0	5,627	75.8	69.3-81.0	5,477	31.4	27.4-36.0	5,366	28.0	24.0-32.0	1,227	47.2	39.4-55.0
Female students	6,544	28.9	25.1-33.0	6,887	65.8	60.0-71.0	6,710	30.3	23.4-38.0	6,561	23.9	19.3-29.0	1,202	28.0	21.3-36.0
Age group															
< 18 years	299	27.8	14.8-46.0	306	70.5	53.6-83.0	301	15.6	8.9-26.0	299	13.4	7.6-22.0	40	21.3	5.8-54.0
18-24	7,520	24.0	20.3-28.0	7,835	74.0	69.7-78.0	7,664	29.7	26.0-34.0	7,540	26.6	22.3-31.0	1,653	41.1	31.3-52.0
25-34	3,053	27.3	21.7-34.0	3,260	67.5	61.9-73.0	3,152	33.2	26.7-40.0	3,064	26.4	21.8-31.0	613	10.1	32.5-48.0
35 and over	929	27.3	17.9-39.0	306	63.1	54.9-71.0	979	32.5	18.8-50.0	938	23.2	14.7-35.0	116	11.7	9.0-15.0
Male students															
< 18 years	162	29.2	10.5-59.0	165	68.9	40.7-88.0	163	11.2	4.8-24.0	162	11.0	4.6-24.0	26	19.5	5.4-50.0
18-24	3,340	20.2	13.3-30.0	3,458	78.8	71.2-85.0	3,410	32.6	27.6-38.0	3,351	29.8	24.6-36.0	814	44.5	34.7-55.0
25-34	1,401	20.3	10.0-37.0	1,497	76.4	61.0-87.0	1,440	37.7	29.6-47.0	1,407	33.3	25.8-42.0	336	54.4	46.2-62.0
35 and over	392	26.3	18.1-37.0	426	65.3	54.8-74.0	412	16.6	11.3-24.0	398	12.1	8.9-16.0	42	32.0	15.2-55.0
Female students															
< 18 years	137	26.2	13.0-46.0	141	72.3	54.8-85.0	138	20.0	10.8-34.0	137	15.9	7.0-32.0	14	23.8	2.6-78.0
18-24	4,162	26.7	21.4-33.0	4,332	70.5	63.1-77.0	4,236	27.6	23.8-32.0	4,171	24.4	19.6-30.0	834	38.0	24.7-53.0
25-34	1,648	33.1	30.8-35.0	1,759	60.3	55.6-65.0	1,708	29.5	22.8-37.0	1,653	20.5	16.5-25.0	276	21.3	13.6-32.0
35 and over	534	27.9	15.9-44.0	584	61.4	50.8-71.0	563	45.4	21.6-71.0	537	32.1	17.1-52.0	74	4.9	2.8-9.0

CI = confidence interval.
* Regarding the total sample size (n), the values are different between columns due to missing data.

Table 2 Thirty-day prevalence (and CIs) of alcohol use, drug use, concurrent polydrug use, and simultaneous polydrug use among Brazilian college students according to gender and age in Brazil in 2009 (rates and CIs were estimated using a logistic regression model; CIs were defined using the Bonferroni correction with confidence coefficients set at 97.5%)

	Non-drug use			Alcohol use			Drug use			Concurrent polydrug use			Simultaneous polydrug use		
	n*	%	(0.975) CI	n*	%	(0.975) CI	n*	%	(0.975) CI	n*	%	(0.975) CI	n*	%	(0.975) CI
Total	12,295	35.2	30.8-40.0	12,515	58.1	52.6-63.0	12,161	21.3	16.6-27.0	12,383	17.0	13.1-22.0	1,507	35.4	27.4-44.0
Male students	5,520	30.3	24.9-36.0	5,605	64.4	58.7-70.0	5,445	20.6	17.0-25.0	5,530	17.4	13.6-22.0	772	43.1	34.7-52.0
Female students	6,745	38.9	34.4-44.0	69	53.4	47.4-59.0	6,685	21.9	15.3-30.0	6,822	16.8	11.4-24.0	6,726	29.1	19.7-41.0
Age group															
< 18 years	302	46.7	35.3-59.0	307	48.5	37.6-59.0	300	7.2	3.5-14.0	305	6.5	3.1-13.0	22	19.4	3.8-60.0
18-24	7,714	34.7	30.4-39.0	1,011	61.6	55.9-67.0	7,619	20.1	16.7-24.0	7,717	17.5	13.6-22.0	981	44.4	33.7-56.0
25-34	3,185	34.7	27.9-42.0	7,811	57.1	50.9-63.0	3,144	23.1	17.8-30.0	3,217	17.3	12.6-23.0	3,131	29.9	17.5-46.0
35 and over	975	35.7	30.2-42.0	3256	49.9	44.5-55.0	976	24.4	14.3-38.0	1,012	17.0	10.8-26.0	80	13.4	11.1-16.0
Male students															
< 18 years	163	45.5	27.5-65.0	165	47.9	31.1-65.0	163	7.0	2.2-20.0	165	6.8	2.1-20.0	13	14.4	2.3-55.0
18-24	3,434	28.8	22.1-37.0	3,471	67.9	61.3-74.0	3,389	22.0	16.7-28.0	3,428	19.8	15.0-26.0	496	39.7	29.4-51.0
25-34	1,464	29.9	18.5-45.0	1,492	64.4	51.4-76.0	1,431	23.0	17.8-29.0	1,459	18.5	13.6-24.0	225	50.5	33.7-67.0
35 and over	410	34.3	25.0-45.0	423	54.4	41.2-67.0	410	12.5	8.4-18.0	422	8.0	6.0-11.0	32	44.3	24.1-67.0
Female students															
< 18 years	139	48.0	33.2-63.0	142	49.0	34.4-64.0	137	7.5	2.0-25.0	140	6.3	1.5-22.0	9	23.5	2.1-81.0
18-24	4,262	39.0	32.1-46.0	4,322	57.0	48.4-65.0	4,212	18.8	16.2-22.0	4,271	15.8	12.3-20.0	483	48.9	31.4-67.0
25-34	1,717	38.6	35.3-42.0	1,760	51.3	48.5-54.0	1,709	23.3	15.6-33.0	1,754	16.4	9.2-28.0	188	10.2	6.6-15.0
35 and over	562	36.7	26.4-48.0	585	46.6	38.2-55.0	562	34.0	17.0-56.0	586	24.0	14.1-38.0	48	5.2	2.4-11.0

CI = confidence interval.
* Regarding the total sample size (n), the values are different between columns due to missing data.

Table 3 Twelve-month prevalence (and CIs) of concurrent polydrug use and simultaneous polydrug use of alcohol and other drugs among Brazilian college students according to gender and type of psychoactive substance in Brazil in 2009 (rates and CIs were estimated using a logistic regression model; CIs were defined using the Bonferroni correction with confidence coefficients set at 97.5%)

	Concurrent polydrug use				Simultaneous polydrug use			
Drug	n*	%	(0.975) CI	p-value†	n*	%	(0.975) CI	p-value†
Marijuana								
Total	2429	46.7	40.3-53.0		754	79.4	67.7-88.0	
Male students	1227	60.4	54.3-66.0	< 0.001	480	87.6	80.8-92.0	< 0.001
Female students	1202	34.5	24.7-46.0		274	67.0	46.2-83.0	
Amphetamines								
Total	2429	28.1	17.5-42.0		754	13.3	7.3-23.0	
Male students	1227	15.9	8.5-28.0	< 0.001	480	7.6	2.8-19.0	0.06
Female students	1202	39.1	26.2-54.0		274	22.1	9.6-43.0	
Inhalants								
Total	2429	23.0	16.8-31.0		754	30.7	25.4-37.0	
Male students	1227	28.5	18.0-42.0	< 0.05	480	31.8	25.7-39.0	0.67
Female students	1202	18.1	14.4-22.0		274	29.0	18.6-42.0	
Tranquilizers								
Total	2429	19.9	16.9-23.0		754	13.2	10.0-17.0	
Male students	1227	13.0	9.7-17.0	< 0.001	480	8.2	3.8-17.0	< 0.05
Female students	1202	26.2	22.3-31.0		274	21.0	15.7-27.0	
Hallucinogens								
Total	2429	14.5	11.0-19.0		754	32.5	26.4-39.0	
Male students	1227	16.0	9.2-26.0	0.49	480	26.7	16.4-40.0	0.13
Female students	1202	13.2	11.1-16.0		274	41.5	29.4-55.0	
Ecstasy								
Total	2429	10.2	7.4-14.0		754	22.1	16.6-29.0	
Male students	1227	13.4	8.8-20.0	< 0.05	480	21.4	15.1-30.0	0.87
Female students	1202	7.4	4.8-11.0		274	23.1	10.0-45.0	
Opiate analgesics								
Total	2429	9.9	6.9-14.0		754	7.6	2.1-24.0	
Male students	1227	6.0	2.7-13.0	< 0.05	480	4.2	1.5-11.0	< 0.01
Female students	1202	13.3	10.1-17.0		274	12.8	3.0-41.0	
Cocaine								
Total	2429	9.7	8.0-12.0		754	22.2	15.5-31.0	
Male students	1227	13.6	8.9-20.0	< 0.05	480	24.8	15.5-37.0	0.39
Female students	1202	6.3	3.9-10.0		274	18.3	9.7-32.0	
Synthetic drugs								
Total	2429	3.7	2.0-7.0		754	9.5	4.3-20.0	
Male students	1227	2.9	1.7-5.0	0.31	480	5.0	2.5-10.0	< 0.001
Female students	1202	4.4	1.9-10.0		274	16.5	6.9-35.0	
Anabolic androgenic steroids								
Total	2429	3.0	2.0-5.0		754	2.9	1.4-6.0	
Male students	1227	6.0	3.6-10.0	< 0.001	480	4.8	2.3-10.0	< 0.05
Female students	1202	0.4	0.1-2.0		274	0.0	0.0-0.0	
Sedatives								
Total	2429	2.5	1.0-6.0		754	0.7	0.2-3.0	
Male students	1227	0.6	0.2-2.0	< 0.01	480	0.1	0.0-1.0	< 0.001
Female students	1202	4.3	1.6-11.0		274	1.7	0.3-9.0	

CI = confidence interval.
* Regarding the total sample size (n), the values are different between columns due to missing data.
† Intergroup comparisons were performed using Pearson's chi-square test.

years and over in both measures of drug use (Tables 1 and 2).

Marijuana was the drug most often associated with alcoholic beverages. Inter-gender differences in SPU were also observed. For instance, the combinations of alcohol with marijuana and alcohol with AAS were more frequently observed among males in both measures (in the past 12 months and in the past 30 days). Conversely, the frequency of the combined use of alcohol with prescribed medication (amphetamines, tranquilizers, opiate analgesics, and sedatives) was higher among females (Tables 3 and 4).

Discussion

Although descriptive in nature, this study presented epidemiologic data on alcohol and illicit drug co-use in the college student population of Brazil. Seven out of 10 college students (70.1%) declared that they had used alcohol (AU), 30.8% had used at least one illicit drug (DU), and 25.7% had engaged in the co-use of alcohol and illicit drugs (CPU) in the past 12 months. Among those college students who reported engaging in CPU, 37.0% engaged in SPU. This pattern of results was consistent between both measures of drug use adopted.

Table 4 Thirty-day prevalence (and CIs) of concurrent polydrug use and simultaneous polydrug use of alcohol and other drugs among Brazilian college students according to gender and type of psychoactive substance in Brazil in 2009 (rates and CIs were estimated using a logistic regression model; CIs were defined using the Bonferroni correction with confidence coefficients set at 97.5%)

	Concurrent polydrug use				Simultaneous polydrug use			
Drug	n*	%	(0.975) CI	p-value†	n*	%	(0.975) CI	p-value†
Marijuana								
Total	1504	43.4	32.2-55.0		553	69.6	59.0-79.0	
Male students	772	61.3	54.2-68.0	< 0.001	356	82.3	65.7-92.0	< 0.05
Female students	732	29.5	17.4-45.0		197	54.0	32.1-74.0	
Amphetamines								
Total	1504	33.8	19.6-52.0		553	9.6	5.7-16.0	
Male students	772	17.8	9.1-32.0	< 0.001	356	2.3	0.4-13.0	< 0.01
Female students	732	46.2	30.4-63.0		197	18.2	10.7-29.0	
Inhalants								
Total	1504	14.3	11.5-18.0		553	16.3	7.1-33.0	
Male students	772	17.2	11.6-25.0	0.18	356	12.8	6.3-24.0	< 0.05
Female students	732	12.0	8.3-17.0		197	20.4	7.9-43.0	
Tranquilizers								
Total	1504	20.7	16.0-26.0		553	7.1	5.1-10.0	
Male students	772	8.6	5.3-13.0	< 0.001	356	2.0	0.8-5.0	< 0.001
Female students	732	30.2	26.2-34.0		197	13.3	8.9-20.0	
Hallucinogens								
Total	1504	14.1	10.4-19.0		553	30.3	16.5-49.0	
Male students	772	16.2	9.0-28.0	0.36	356	26.5	13.8-45.0	0.12
Female students	732	12.4	9.5-16.0		197	34.8	18.5-56.0	
Ecstasy								
Total	1504	9.4	5.3-16.0		553	17.5	5.6-43.0	
Male students	772	13.3	5.6-28.0	< 0.01	356	16.7	5.5-41.0	0.66
Female students	732	6.5	4.2-10.0		197	18.3	5.4-47.0	
Opiate analgesics								
Total	1504	6.8	3.2-14.0		553	1.3	0.2-7.0	
Male students	772	4.1	1.3-12.0	0.11	356	0.1	0.0-0.0	< 0.001
Female students	732	8.8	3.7-20.0		197	2.7	0.4-15.0	
Cocaine								
Total	1504	9.0	7.4-11.0		553	18.5	12.5-27.0	
Male students	772	11.6	7.0-19.0	0.16	356	23.8	14.4-37.0	0.07
Female students	732	7.0	4.5-11.0		197	12.6	6.9-22.0	
Synthetic drugs								
Total	1504	3.8	1.4-10.0		553	9.4	2.1-33.0	
Male students	772	2.4	0.8-7.0	< 0.05	356	3.8	0.7-17.0	< 0.001
Female students	732	4.9	1.9-12.0		197	16.1	4.0-47.0	
Anabolic androgenic steroids								
Total	1504	2.0	1.1-4.0		553	3.2	1.3-8.0	
Male students	772	4.6	2.5-8.0	< 0.001	356	5.8	2.2-15.0	< 0.05
Female students	732	0.0	0.0-0.0		197	0.0	0.0-0.0	
Sedatives								
Total	1504	3.1	1.1-8.0		553	0.9	0.2-4.0	
Male students	772	0.6	0.1-3.0	< 0.01	356	0.1	0.0-1.0	< 0.001
Female students	732	5.0	1.9-12.0		197	1.8	0.3-10.0	

CI = confidence interval.
* Regarding the total sample size (n), the values are different between columns due to missing data.
† Intergroup comparisons were performed using Pearson's chi-square test.

However, it is important to note that those groups overlap and are not mutually exclusive. Also, it is important to keep in mind that tobacco use was excluded from all estimates of CPU and SPU.

Similar patterns of alcohol and illicit drug co-use were observed for both genders and across age groups; however, there are some specifics that deserve attention here. For example, although CPU was more frequent in females aged 35 years and over, SPU was more frequent among male college students aged 25 and over.

These findings are consistent with previous studies. For instance, an analysis of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) data showed that 5.6% of the U.S. general population used both alcohol and drugs; use of alcohol and drugs occurred more often among males and those in the youngest age group; and use of alcohol and drugs declined steadily in the older age groups.[23,24]

Marijuana was the illicit drug most often used by Brazilian college students who reported drinking at least one alcoholic drink (as either CPU or SPU) in the past 12 months and also over the last 30 days. These findings are consistent with previous studies that reported that marijuana is the most common illicit drug associated with alcohol.[5,14,25]

Results from the 2010 US National Survey on Drug Use and Health illustrate the relationship between alcohol and marijuana among college students; this study found that alcohol use was closely related to cannabis use. Specifically, increasing levels of alcohol consumption increased the odds of marijuana use, i.e., frequent or heavy AUs were, in general, between two and six times more likely to report the use of cannabis compared to the general population.[26] Similarly, Falk et al.[24] reported that the prevalence of past 12-month cannabis use and the rates of past 12-month cannabis use disorders increased monotonically with drinking levels.[27]

Moreover, it has been reported that cannabis is the most frequently used illicit drug among people with an alcohol use disorder (AUD; alcohol abuse or dependence).[24] For instance, in the U.S. general population, 29% of adults with an AUD in the past year also reported use of cannabis and 10% also had a comorbid cannabis use disorder. Taken together, these outcomes suggest that these types of paired consumption patterns may lead to a state of comorbidity.[24] Additionally, polydrug use may also be comorbid with other psychiatric conditions,[28] which may make it even more difficult to properly identify and treat one or both conditions.

Regarding the interference of gender and age with the many possible alcohol and drug combinations, the co-use of alcohol with marijuana was more prevalent among male college students, whereas the co-use of alcohol with prescription medications was observed more frequently among female students. In some ways, polydrug use reflects the drug use profiles of males and females and across age groups that has previously been described among college students.[20] Specifically, it has already been reported that male college students are more likely to use and engage in hazardous use of alcohol and marijuana than women, and women are more likely to use and engage in hazardous use of amphetamines than men.[20] Also, it is important to note that polydrug use seems to be more prevalent among drug users than AUs, as evidenced by the frequencies of students who only use alcohol and those who only use drugs.

Furthermore, this drug use profile of college students may reflect the population at large. A cross-sectional survey conducted among people over 12 years old from the general Brazilian population noted that the 12-month prevalence of alcohol and marijuana use was higher among males, young people, and those with higher educational level.[29,30] Conversely, in Brazil, an analysis of prescriptions obtained from compounding pharmacies and drugstores revealed that women, especially middle-aged women, received the majority of the prescriptions for amphetamines and benzodiazepines.[31,32] These findings may explain the higher use of controlled medication among middle-aged women in Brazil and the increased probability of using prescribed medication with alcohol that we observed for CPU among female college students. Finally, and similarly, in the United States, cannabis use and its disorders are more frequently reported among men who already have an AUD compared to their female counterparts.[24]

In general, studies have suggested that polydrug use is intentionally taken to boost the pleasant effects of alcohol or illicit drugs and, less frequently, to reduce their unpleasant effects.[3,15] In fact, the vast majority of polydrug users report a great deal of intentionality regarding their choice of drug combinations[33] and have substantial knowledge of the pharmacology of various drugs and how to combine them to produce the desired types of intoxication.[34] Additionally, among college students, polydrug use seems to have a specific role that was well described by Quintero.[35] The cultural environment for young adults in college is characterized by two competing dynamics: on the one hand, students expect to experience new freedom and enjoy the leisure time associated with their youth; but, on the other hand, they must exhibit enough control to meet academic demands and social expectations and successfully move into the next, more structured, phase of their adult lives. Thus, according to this author, specific types of polydrug use provide young adults with a means to navigate these competing demands that are typical of contemporary college life.

Polydrug use may concern public authorities because it potentially increases the likelihood of harm. Thus, drugs that are taken simultaneously or consumed close together in time may interact with each other in terms of their pharmacokinetic and pharmacodynamic mechanisms[17,36] or lead to the formation of novel psychoactive metabolites that may produce different effects than the precursor drugs[37]; these novel psychoactive metabolites may interact in such a way that the toxicity of one drug may be increased compared to use of that drug alone.[36]

Furthermore, it is not unusual for polydrug use to lead users to feel more irritable and become involved in interpersonal episodes of violence.[38] Polydrug users are also more frequently admitted to emergency rooms and are more prone to develop cardiovascular diseases.[39] Polydrug use also affects health in other ways because it leads to greater levels of psycho-behavioral problems, mental health problems and cognitive impairment.[17,39-42] Polydrug use increases the chance of unsafe sex episodes and, therefore, leads to an increased risk of contracting sexually transmitted diseases. For instance, adolescents and young adults who use multiple illicit drugs are less concerned about the risks associated with sexual intercourse without a condom than their non-using peers, which leads to unsafe sexual practices.[43] Finally, polydrug users perform worse academically because they miss more classes, socialize more, and study less[44] - all undesirable effects for college students, especially when taking into consideration that they are the portion of society that represents the nation's future leadership. Therefore, we believe that the risks of polydrug use and the potential harms of such use to college students warrant further detailed investigation.

In summary, these preliminary analyses suggest that a high proportion of Brazilian college students have been engaging in polydrug use and are vulnerable to its potential risks. Gender-related and age-related effects were found. These findings underscore the need for

comprehensive assessment and coordinated delivery of prevention and treatment services that match the profile and needs of Brazilian college students. Additionally, as polydrug use among college students is an emerging area of study, health practitioners and college administrators should keep themselves informed and trained to identify such use among college students and develop preventive educational interventions and tools for treatment. Finally, these results suggest that drug prevention and treatment policies must target polydrug use rather than single substances.

This study was unprecedented in that it assessed polydrug use in a national sample of Brazilian college students. The choice of a sample selected by clusters was in line with international studies with the same size and objectives. However, this study has some limitations that should be addressed. The cross-sectional design of this study limits our ability to assess causal relationships or make assumptions about risks and protective factors regarding polydrug use. Moreover, in spite of the large sample, the results are not generalizable to the entire population of Brazilian college students because the sample was limited to HEIs located in state capitals and failed to assess those located in the countryside. We hope our findings may encourage other research groups to study the same issue in further detail.

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Disclosure

The authors report no conflicts of interest.

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