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ORIGINAL ARTICLE

Profile of Brazilian Undergraduates Who Use Electronic Cigarettes: a Cross-Sectional Study on Forbidden Use

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Abstract

The use of electronic cigarettes (e-cigarettes) persists in Brazil, despite restrictions on sales, imports, and advertising. This study aimed to identify the prevalence of e-cigarette use and user profiles among university students. This cross-sectional study used a convenience sample of 3083 university students (female = 2253, male = 830; *M*=26.1; *SD* =8.43) who completed an online survey. We employed logistic regression models and network analysis to determine the profile of e-cigarette users. The prevalence of e-cigarette use in the past year was 12.2% (n =377). Men, single individuals, Caucasians, secular individuals, and non-heterosexual individuals were more likely to engage in e-cigarette use. Intense use of alcohol, tobacco products, and illicit drugs increased the likelihood of e-cigarette use. Brazilian college students continue to use electronic cigarettes despite the prohibition. The pattern of alcohol abuse and tobacco product use among e-cigarette users is concerning. These risky behaviors render young and highly educated individuals targets for public policies to control and regulate electronic cigarettes in the country.

Keywords Electronic nicotine delivery systems · Electronic cigarettes · Cross-sectional studies · Students' health · Higher education institutions

An electronic nicotine delivery system (ENDS), also known as an electronic cigarette (e-cigarette), is a device that uses a battery (usually lithium) to power an atomizer that

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heats and stores a liquid called e-liquid. E-liquids consist of propylene glycol, vegetable glycerin, distilled water, flavorings, and nicotine (Farsalinos & Polosa, 2014). As the battery heats, the e-liquid vaporizes, allowing the user to inhale the substances in the e-liquid.

E-cigarette use appears to be rapidly growing globally. An American study with more than 10,000 adults found that the number of people aware of the device increased from 16.4 to 32.2% from 2009 to 2010. Additionally, experimental use of the device rose from 0.6 to 2.7% (Regan et al., 2013). In the UK, smokers' knowledge of e-cigarettes increased from 2010 to 2012, and the number of users grew from 2.7 to 6.7% (Dockrell et al., 2013). A joint study between the USA, the UK, Australia, and Canada indicated that 46% of adult respondents were aware of e-cigarettes. Moreover, 16% reported having experimentally used e-cigarettes, and 2.9% used them regularly (Adkison et al., 2013).

Young people are also increasingly interested in using e-cigarettes. The variety of enticing flavors encourages them to try e-cigarettes (Harrell et al., 2016). In the USA, Gentzke et al. (2019) noted an increase in the current use of tobacco products among middle and high school students between 2011 and 2018. This increase was primarily due to the rise in e-cigarette use. Their research found that in 2018, 4.9% of middle school students and 20.8% of high school students reported using e-cigarettes in the past 30 days. A study conducted in South Korea showed that 10.2% of students were aware of the device, and 5% had used it (Cho et al., 2011).

In Brazil, the popularity of e-cigarette use is based on the image and similarity of what has been observed in other countries. A study by the International Tobacco Control Project (ITC) presented self-reported awareness, trial, and current use of e-cigarettes in probability sample adults aged 18 and older from 10 countries. According to their findings, 35% of Brazilians were aware of e-cigarette use, and 3% reported trying it in their lifetime (Gravely et al., 2014). Subsequently, Szklo et al. (2018) showed that knowledge and use of e-cigarettes increased over time in Brazil, between 2013 and 2016, among smokers and non-smokers. Another study estimated that 600,000 Brazilians were e-cigarette users, mainly consisting of young, high-income, and non-heterosexual individuals (Bertoni et al., 2019).

In a recent countrywide cross-sectional telephone-based survey conducted in 2022, which included 9004 Brazilians aged 18 or older, 7.3% reported using an e-cigarette during their lifetime. Young adults aged 18–24 and those with a high education level had the highest e-cigarette experimentation prevalence (Menezes et al., 2023).

It is interesting to note that electronic cigarettes cannot be commercialized in Brazil. The Brazilian Health Regulatory Agency (ANVISA) prohibited the sale, import, and advertising of these devices through ANVISA's Collegiate Directive Resolution, RDC n° 46, of August 28, 2009 (Brasil, 2009), which, in its first article, states "the marketing, import, and advertising of any smoking devices known as electronic cigarettes, e-cigarettes, e-ciggy, e-cigar, among others, especially those that claim to replace cigarettes, cigarillos, cigars, pipes and the like in the habit of smoking or aim at alternative in the treatment of smoking is prohibited." Later, in 2017, ANVISA removed 727 online advertisements for the product. However, the commercialization of e-cigarettes continues to occur widely in cities, where devices are sold in various stores and online (Okamura, 2019).

Scientific information about e-cigarette use is still scarce in Brazil, particularly among university students. It is concerning that alcohol and other drug use is higher among university students than among youth and adults of the same age in the general population in Brazil (Eckschmidt et al., 2013). University students are currently using a maladaptive coping strategy to cope with the difficulties and stressors that the transition to greater life stability poses. Moreover, the emergence of drug use trends among university students serves as a thermometer for

drug use by other social segments (Andrade et al., 2012; Eckschmidt et al., 2013), emphasizing the importance of conducting studies on drug use among them.

To our knowledge, only one study described the use of e-cigarettes among university students (Oliveira et al., 2018). That study pointed out that 37% of a probability sample of university students reported awareness about using e-cigarettes; among them, 2.7% reported having tried e-cigarettes in their lifetime, and 0.61% reported doing so more recently. However, the sample was selected from a single higher education institution, and the authors did not examine the relationship between e-cigarette use and alcohol or other drugs (Oliveira et al., 2018).

Thus, given the lack of a specific study on e-cigarette use in a more diversified sample of Brazilian college students and understanding the potential risk that this use poses to the user, this study aimed to identify the prevalence of e-cigarette use among university students, characterize the profile of the university student e-cigarette user, and assess whether e-cigarette users also use other substances, as well as the pattern of this use, especially alcohol and other tobacco products. Our initial hypothesis was that this use was being made significantly by a convenience sample of Brazilian university students.

Method

Ethical Aspects

The Research and Ethics Committee of Centro Universitario Faculdade de Medicina do ABC (FMABC) evaluated and approved this study's scientific and ethical merit (CAAE: 42182621.9.0000.0082). First, all participants in the study had to read and sign the informed consent form. After this, they could proceed to the next step in the data collection process.

Study Design

This cross-sectional study was conducted with convenience and non-probability sampling.

Participants

In total, 3139 Brazilian university students were recruited remotely due to the COVID-19 pandemic. Student inclusion criteria were (i) undergraduate enrollment, (ii) 18 years of age or older, and (iii) their response regarding the use of a fictitious substance named "Relevin®." Those who reported using this substance were not included in the study. Based on previous studies, the procedure was designed to reduce the risk of response bias (Andrade et al., 2012; Gomes et al., 2013). As a result, 56 participants were excluded due to the exclusion criteria: (a) those under 18 years (n= 32), (b) attended a technical or postgraduate course (n= 16), or (c) reported the use of the drug Relevin® (n= 8). Therefore, the data analysis included 3083 respondents.

Measures

Participants were invited to answer a questionnaire that consisted of closed and open-ended questions. It was designed and released on the Survey Monkey platform. The questionnaire was divided into three sections. The first section concerned the respondent's

sociodemographic information: age (open question), gender (female, male, or other), sexual orientation (heterosexual, homosexual, bisexual, or other), marital status (single, married, divorced/separated, or widowed), religion affiliation (yes or no), ethnicity (Caucasian, African, Asian, or indigenous), employment status (never worked, employed, or unemployed at the time of the interview), family income (estimated in numbers of minimum wages; open question), and household status (lived alone or with parents or other people, such as friends, relatives, or spouse).

The second section was related to academic information: geographic zone (rural or urban) in which the higher education institution (HEI) was located, the institution type (public or private), the field of study (biological sciences, humanities, or physical sciences), course period (daytime or nighttime), and course semester at the time of the interview (open question). All the variables mentioned above comprised the explanatory variables of the study.

The third section referred to alcohol, tobacco, and other drugs (marijuana, cocaine, crack, hallucinogens, ecstasy, and recreational drug use, such as benzodiazepines, opioid analgesics, barbiturates, amphetamines, and anabolic steroids). This measurement was made according to three measures of use: (1) lifetime use (equivalent to experimentation, which consisted of having tried a particular substance at least once in life), (2) use in the last year (in the period equivalent to 12 months before the interview), and (3) in the last month, which was 30 days prior to the interview. The measure adopted in this study was used in the last year. We conducted a pilot of the research instrument with 20 respondents before data collection began to assess (1) the clarity of the questions and resolve possible ambiguities, (2) improve the flow and rate of responses, and (3) determine how long participants took to complete the survey. Based on the results, some misunderstandings or ambiguities of meaning were removed and revised. Data analysis did not include the sample used for the pilot.

To measure the pattern of alcohol consumption over the past 12 months, we used the Alcohol Use Disorder Identification Test (AUDIT). The instrument consists of 10 items for screening alcohol consumption. The AUDIT measures the pattern of alcohol consumption on a Likert scale (ranging from 0 to 4). A score above 8 in the AUDIT indicates risky alcohol use (AUDIT>8). A two-study adaptation and validation of the AUDIT was conducted among university students in Brazil (Dos Santos et al., 2012) ($\alpha = 0.84$); (de Araujo Souza et al., 2020) ($\alpha = 0.85$; $\Omega = 0.89$). In our study, the Cronbach's alpha value for AUDIT was 0.785 (95% CI: 0.775–0.795).

We used the Fagerstrom Test for Nicotine Dependence (FTND) to estimate nicotine dependence among participants. The test consists of six rating scale questions, and each question in the test is scored. The total score ranges from 0 to 10; the higher the score, the more nicotine addiction. In Brazil, the instrument was adapted and validated with high internal consistency (Meneses-Gaya et al., 2009). In our study, the Cronbach's alpha value for FTND was 0.763 (95% CI: 0.753–0.772).

Procedures

All the instruments described above were compiled into an online Survey Monkey questionnaire. Descriptive text (describing the nature of the survey) and an access link to the research instrument were distributed on social media (such as Instagram, Facebook, and WhatsApp). The questionnaire could be completed on a smartphone, a computer, or a tablet only once.

Statistical Analysis

As a starting point, continuous variables were characterized by their mean, median, and standard deviation. Next, we evaluated categorical variables according to their prevalence and 95% confidence interval (95% CI). An analysis of numerical variables' normality (or not) was conducted using the Shapiro–Wilk test. Bivariate analyses were performed to identify the user's profile. The chi-square test was used for categorical variables, and Student's *t*-test or Mann–Whitney *U* test was used for numerical variables based on the normality of their distribution. Subsequently, a logistic regression model was developed for dependent variables, controlled for confounding effects of age and sex. The odds ratio (OR; 95% CI) provided information about the magnitude of the association between categorical variables (Gonçalves et al., 2021; Cunha et al., 2018). The network analysis also evaluated potential predictors directly or indirectly associated with using e-cigarettes (Andrade et al., 2022; Lins et al., 2022; Spritzer et al., 2022). A Gaussian graph was generated using the LASSO (least absolute shrinkage and selection operator) algorithm to estimate partial correlations. A positive correlation is represented by a green edge, while a red edge represents a negative correlation. Correlations are more robust when the edges are thicker. The data were analyzed using STATA software, and the network analysis was performed using the free software version 0.16.0 of JASP. Null hypotheses were rejected when $p < 0.05$.

Results

Most of the participants were young women (73.1%), single (77.4%), Caucasian (64.1%), unemployed (59.9%), affiliated with a religion (63.9%), identified as heterosexual (75.1%), and lived with their parents (57.7%). The mean age was 26 years (±8.43; range: 18–55), and the mean family income was three minimum wages (MW), equivalent to US $785. Most students attended private HEIs (78.7%) and urban HEIs (96.6%). Furthermore, most students (42.1%) were enrolled in biological sciences courses, during the day (55%), and 50% were at the beginning of their undergraduate program (semesters 1–4) (data not shown in tables).

Regarding e-cigarette use, 26.7% (n=822) reported having tried it in their lifetime, 12.2% (n=377) had used it in the last 12 months, and 5.5% (n=169) used it in the previous month. Table 1 shows the distribution of sociodemographic characteristics of the sample by e-cigarette use in the last 12 months.

The use of e-cigarettes was significantly higher among males, those aged 22 or younger, who identified themselves as non-heterosexual, without religious affiliation, Caucasian, who had never worked, were from families with income equal to or lower than one minimum wage (MW), lived with their parents, and studied biological sciences in daytime courses.

A comparison of the use of e-cigarettes and alcohol is shown in Table 2. In the past 12 months, most respondents who used e-cigarettes also consumed alcohol. Alcohol users were more likely to use e-cigarettes. Those who reported binge drinking weekly were more likely to use e-cigarettes.

Table 3 shows e-cigarette users' versus non-users use of other drugs in the last 12 months. Respondents who smoked cigarettes or used hookah were likelier to smoke e-cigarettes. Additionally, cigarette and hookah smokers, users of illicit drugs, and marijuana

Table 1 Distribution of sociodemographic characteristics of a sample of Brazilian university students according to their use of e-cigarettes in the last 12 months. Brazil, 2021 (n=3083)

	e-Cigarettes				χ^2 *test*	
	Non-users		Users		*OR*	*p*
	n	%	*n*	%		
Sex						*
Female	1,999	73.9	254	67.4	**1**	
Male	675	24.9	118	31.3	1.38 (1.09–1.74)*	
Other	32	1.2	5	1.3	1.23 (0.47–3.18)	
Age (years)						***
≤22	1,256	46.4	271	71.9	2.95 (2.33–3.74)*	
>22	1,450	53.6	106	28.1	**1**	
Sexual orientation						***
Heterosexual	2,062	76.2	252	66.8	**1**	
Homosexual/bisexual	535	19.8	118	31.3	1.80 (1.42–2.29)*	
Other	109	4.0	7	1.9	0.53 (0.24–1.14)	
Marital status						***
Single	2,031	75.1	356	94.4	5.63 (3.60–8.82)*	
Non-single	675	24.9	21	5.6	**1**	
Religion						***
No	938	34.7	175	46.4	1.63 (1.31–2.03)*	
Yes	1,768	65.3	202	53.6	**1**	
Ethnicity						***
White	1,695	62.6	280	74.3	1.85 (1.42–2.41)*	
Brown/Black	886	32.7	79	21.0	**1**	
Others	125	4.6	18	4.8	1.61 (0.94–2.79)	
Employment						***
Never worked	849	31.4	172	45.6	1.99 (1.50–2.66)*	
Employed	1,108	41.0	129	34.2	1.15 (0.85–1.54)	
Unemployed/separated	749	27.7	76	20.2	**1**	
Family Income						*
≤1 MW	1,474	54.5	228	60.5	1.28 (1.02–1.59)*	
>1 MW	1,232	45.5	149	39.5	**1**	
Living situation						***
With parents	1,522	56.2	257	68.2	1.98 (1.52–2.57)*	
Alone	224	8.3	38	10.0	1.99 (1.32–2.99)*	
With others	960	35.5	82	21.8	**1**	
HEI-type						0.10
Private	2,118	78.3	309	82.0	-	
Public	588	21.7	68	18.0	-	
HEI-zone						0.30
Urban	2,625	97.0	362	96.0	-	
Rural	81	3.0	15	4.0	-	
Field of study						***
Biological sciences	1,087	40.2	212	56.2	2.46 (1.74–3.48)*	
Humanities	1,090	40.3	123	32.7	1.42 (0.99–2.05)	

Table 1 (continued)

	e-Cigarettes				χ^2 *test*	
	Non-users		Users		*OR*	*p*
	n	%	*n*	%		
Physical sciences	529	19.5	42	11.1	**1**	
Course period						***
Morning	1,457	53.8	238	63.1	1.47 (1.17–1.83)*	
Night	1,249	46.2	139	36.9	**1**	
Semester						0.09
Beginning (semester 1–3)	1,315	48.6	175	46.4	-	
Middle (semester 4–6)	863	31.9	141	37.4	-	
Final (semester 7–8)	316	11.7	41	10.9	-	
Final (semester 9–12)	212	7.8	20	5.3	-	
Academic performance						*
Bad	88	3.3	16	4.2	1.52 (0.87–2.65)	
Medium	1,092	40.4	179	47.5	1.37 (1.10–1.71)*	
Good	1,522	56.3	182	48.3	**1**	

Note: *N*, number of participants; %, frequency; *p*, significance level; *OR*, odds ratio; Effect, the effect size of chi-squared was calculated using Cramer's V; *MW*, monthly wage; *HEI*, higher educational institution; *$p < 0.05$; ***$p < 0.001$

users were more likely to smoke e-cigarettes. Finally, approximately 12% of the students who reported using e-cigarettes in the last 12 months met the criteria for a moderate risk of developing nicotine dependence that required some intervention (data not shown in tables).

For the results of the network analysis, as seen in Fig. 1, when all university students (1A) were analyzed, e-cigarettes (item 7) showed a direct association with marital status (item 4), sexual orientation (item 3), cigarette use (item 10), risky alcohol use (AUDIT>8), and hookah use (item 8). Hence, being single, non-heterosexual, using a hookah, having smoked cigarettes in the last year, and having a score above 8 in the AUDIT were the main variables associated with e-cigarette use.

Discussion

This study aimed to identify the prevalence of e-cigarette use and user profile among Brazilian university students. In this regard, 26.7% of respondents reported having tried e-cigarettes in their lifetime, approximately 12% in the last 12 months, and 5.5% within the last 30 days. This prevalence was higher than the 7.3% recently reported for lifetime use among Brazilians aged 18 or older, as previously mentioned by Menezes et al. (2023).

Male university students were more likely to use e-cigarettes than female students. This result was consistent with previous results described in European countries, where the prevalence of use among men was five times higher than among women (Kapan et al., 2020). A systematic review also suggested that men were significantly more likely to know, have used, and recently use e-cigarettes than their female counterparts

Table 2 Use of alcohol in the last 12 months of a sample of Brazilian university students according to their use of e-cigarettes in the last 12 months. Brazil, 2021 (n= 3083)

	e-Cigarettes				χ^2 *test*	
	Non-users		Users		OR	*p*
	n	%	*n*	%		
Alcohol						***
No	886	32.7	11	2.9	**1**	
Yes	1,820	67.3	366	97.1	16.2 (8.84–29.66)*	
Number of doses						***
1 or 2	898	48.7	69	18.7	**1**	
3 or 4	541	29.3	123	33.3	2.96 (2.16–4.05)*	
5 or 6	243	13.2	90	24.4	4.82 (3.42–6.80)*	
7, 8, or 9	81	4.4	47	12.7	7.55 (4.89–11.67)*	
10 or more	81	4.4	40	10.8	6.43 (4.09–10.1)*	
Binge-drinking frequency (6 or + doses)						***
Never	839	45.5	50	13.5	**1**	
Less than monthly	708	38.4	164	44.4	3.89 (2.79–5.42)*	
Monthly	171	9.3	30	24.4	8.83 (6.02–12.96)*	
Weekly	118	6.4	65	17.6	9.24 (6.10–14.01)*	
Every day or almost every day	8	0.5	-	-	-	
AUDIT score						***
Low-risk use	1,519	83.0	206	56.1	**1**	
Risk use	245	13.4	122	33.2	3.67 (2.83–4.77)*	
Harmful use of alcohol	31	1.7	19	5.2	4.52 (2.51–8.15)*	
Dependence	35	1.9	20	5.5	(2.39–7.44)*	

Note: *N*, number of participants; %, frequency; *p*, significance level; *OR*, odds ratio; Effect, the effect size of chi-squared was calculated using Cramer's V; *AUDIT*, Alcohol Use Disorders Identification Test; ***p <0.001

(Hartwell et al., 2017). In Brazil, Oliveira et al. (2018) also pointed out that male university students were more likely to know about e-cigarettes.

We also observed that students with a family income of less than one minimum wage were more likely to use e-cigarettes. An American survey revealed that almost half of their sample of users (43.1%) belonged to low-income families (Pepper & Brewer, 2014). European literature has described the relationship between unemployment and a greater chance of using e-cigarettes. Unemployed people were more likely to have tried e-cigarettes than other groups (European Commission, 2017).

Regarding sexual orientation, the predominance of users of non-heterosexual orientation among e-cigarette users was observed in a survey conducted in California between 2017 and 2018 (Donaldson et al., 2021).

Significant consumption of alcohol among university students who reported using e-cigarettes was observed. Almost all e-cigarette users in our sample reported using alcohol in the last 12 months. Many reported having used alcohol in large amounts. The more intense the alcohol use, the higher the chance of engaging in e-cigarette use. A survey conducted in the USA in 2017 also reported the same association (Grant et al., 2019). Another study at an American university also identified that individuals

Table 3 Use of other drugs in the last 12 months of a sample of Brazilian university students according to their use of e-cigarettes in the last 12 months. Brazil, 2021 (n=3083)

	e-Cigarettes				χ^2 *test*	
	Non-users		Users		*OR*	*p*
	n	%	*n*	%		
Cigarette						***
No	2,318	85.7	150	39.8	**1**	
Yes	388	14.3	227	60.2	9.04 (7.16–11.40)*	
Hookah						***
No	2,486	91.9	175	46.4	**1**	
Yes	220	8.1	202	53.6	13.04 (10.21–16.66)*	
Any smoking product						***
No	2,167	90.8	83	22.0	**1**	
Yes	220	9.2	294	78.0	34.89 (26.4–46.2)*	
Marijuana						***
No	2,294	84.8	145	38.5	**1**	
Yes	412	15.2	232	61.5	8.91 (7.06–11.24)*	
Cocaine or crack						***
No	2,663	98.4	355	94.2	**1**	
Yes	43	1.6	22	5.8	3.84 (2.27–6.50)*	
Amphetamine						***
No	2,646	97.8	342	90.7	**1**	
Yes	60	2.2	35	9.3	4.51 (2.93–6.95)*	
Benzodiazepines						***
No	2,563	94.7	335	88.9	**1**	
Yes	143	5.3	42	11.1	2.25 (1.56–3.29)*	
Hallucinogens						***
No	2,643	97.7	316	83.8	**1**	
Yes	63	2.3	61	16.2	8.10 (5.59–11.7)*	
Any illicit drug use						***
No	2,102	77.7	127	33.7	**1**	
Yes	604	22.3	250	66.3	6.85 (5.43–8.64)	

Note: *N*, number of participants; %, frequency; *p*, significance level; *OR*, odds ratio; Effect, the effect size of chi-squared was calculated using Cramer's V; *** p <0.001

who consumed alcohol and reported "binge drinking" had an increased chance of using e-cigarettes (Hefner et al., 2019).

Another worrying point was the extensive use of tobacco products among respondents who reported using e-cigarettes: 78% of e-cigarette users reported smoking other tobacco products (cigarettes or hookah). Consistently, in Brazil, Menezes et al. (2023) recently pointed out that 1.5% of their sample reported using three forms of nicotine delivery systems (e-cigarettes, conventional cigarettes, and hookah), which corresponded to nearly 2 million individuals based on the estimated size of the Brazilian adult population.

Moreover, our study observed that using other smoking products increased users' chances of using e-cigarettes. This outcome is consistent with Dockrell et al. (2013), who observed that the frequency of individuals who used both conventional and e-cigarettes

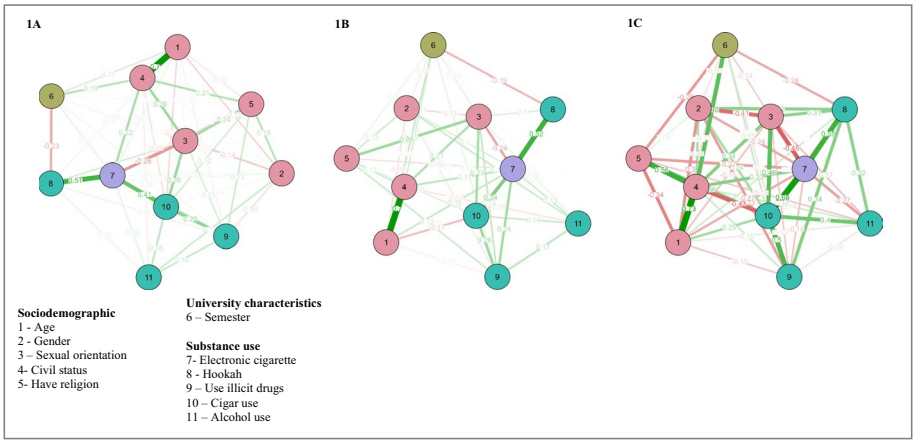

Fig. 1 Gaussian graphical model to detect the connections for e-cigarette use (purple node) regarding sociodemographic, university characteristics, and substance use among the general sample (**1A**), students from private (**1B**), and public (**1C**) universities. The green edges indicate positive correlations, whereas the red edges show negative correlations. The thickness of the edges indicates the strength of these correlations: the thicker the edge, the stronger the correlation between the nodes

increased from 2.7 to 6.7% in the UK between 2010 and 2012. Several explanations for this association exist, but we have no intention to exhaust all of them. One plausible hypothesis is that smokers may also use e-cigarettes due to their ease of use, i.e., they may be a nicotine source for smokers where conventional cigarette use is not allowed. Additionally, e-cigarettes are usually seen as more socially accepted than other alternatives to tobacco use (Meernik et al., 2019).

Besides, e-cigarettes and conventional cigarettes have similar actions on the central nervous system. Therefore, e-cigarettes have been seen as an alternative to reduce the use of conventional cigarettes by smokers (Dockrell et al., 2013). In this regard, promoting vaping use among adults has been one of the main policy interventions for England to achieve its smoke-free 2030 goal, defined as less than 5% smoking prevalence (Edwards & Hopkinson, 2022). However, in Brazil, this practice is not allowed (Brasil, 2009).

Finally, regarding illicit drugs, 66.3% of our sample reported using e-cigarettes and some other substance in the past 12 months. We also identified that using at least one illicit drug increased users' chances of using e-cigarettes. In an American survey, adolescents who used e-cigarettes were four to six times more likely to consume alcohol or marijuana than those who did not use e-cigarettes (Hershberger et al., 2020) (Hershberger et al., 2020). Additionally, Temple et al. (2017) found an association between e-cigarette use and marijuana, cocaine, amphetamines, inhalants, hallucinogens, ecstasy, and inappropriate medication use.

Considering the outcomes reported here, we believe that university students may be a target for policymakers regarding e-cigarette use, since vaping is a practice not free of risks (Layden et al., 2020; Siegel et al., 2019; Tzortzi et al., 2020). Measures taken to reduce smoking in Brazil over the years can be an example of reducing the use of e-cigarettes. For instance, in 2000, conventional cigarette advertising in mass media, such as newspapers, television, and radio, was banned. In 2011, this law was expanded, advertising was prohibited at points of sale, and products could only be displayed if accompanied by warnings on the packaging regarding the harmful effects of consumption.

Another ban on conventional cigarettes since 2011, at the federal level, was the use in enclosed public places for collective use (Brasil, Saúde, (INCA),, & (FioCruz), 2012). The Instituto Nacional de Câncer José Alencar Gomes da Silva (INCA) researched smoking prevalence among adults aged 18 and older between 1986 and 2008 and revealed a reduction from 34.8 to 18.2% (Brasil et al., 2012). In 2019, the prevalence was even lower, corresponding to 12.8% of adults over 18 years (Brasil & Saúde, 2021). Therefore, the trajectory of smoking in Brazil demonstrates the importance of implementing several combined public policies to reduce the consumption of e-cigarettes.

Future research should focus on understanding the specific factors that contribute to e-cigarette use among university students and explore the most effective strategies for preventing initiation and promoting cessation of e-cigarette use. Longitudinal studies can help establish causal relationships between e-cigarette use and associated factors. In contrast, intervention studies can provide evidence for the effectiveness of different approaches to reducing e-cigarette use. Furthermore, research should continue to monitor the prevalence and trends of e-cigarette use among diverse populations to inform public health policies and interventions.

Limitations must be considered in the present study. First, we recruited participants from social networks using data from a convenience sample. These data may reflect sampling bias in the characteristics of university students. Second, due to the exploratory nature of this study, causal relationships between e-cigarette smoking and other variables cannot be established. Third, because the data were collected during the COVID-19 pandemic, social and emotional stress may have altered the substance use profile. Finally, we did not use physiological measures to determine drug levels in the bloodstream, but only self-reported measures.

In conclusion, our study found that e-cigarette use is prevalent among Brazilian university students, with a higher prevalence in male students, those with a family income of less than one minimum wage, and those who consume alcohol, tobacco, or other illicit substances. These findings underscore the need for targeted interventions and public policies to reduce e-cigarette use among this population, drawing on the successful measures implemented to mitigate conventional cigarette smoking in Brazil.

Author Contribution Gabriella dos Santos Maximino: conceptualization, methodology, and original draft writing. André Luiz Monezi Andrade: conceptualization, methodology, formal analysis, original draft writing, review, and editing. Arthur Guerra de Andrade: conceptualization, review, and editing. Lucio Garcia de Oliveira: conceptualization, methodology, formal analysis, original draft writing, review, and editing.

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Declarations

Informed Consent All procedures followed the ethical standards of the responsible committee on human experimentation (institutional and national) and the Helsinki Declaration of 1975. Informed consent was obtained from all participants being included in the study.

Conflict of Interest The authors declare no competing interests.

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