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# E-cigarette users: Association between the demographic profile of smokers and harmful health symptoms

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**ABSTRACT.** This research seeks to analyze the socioeconomic profile of e-cigarette users, their frequency of use and symptoms induced by e-cigarettes. It is composed of 562 participants and divided into three stages: approach via social media, data collection by means of a self-administered online questionnaire, and descriptive data analysis. The demographic profile was characterized by young university students with higher education and middle/upper class income. The most prevalent symptoms were throat irritation and/or hoarseness (56.3%), cough (57.4%), nasal congestion (27.6%), anxiety (21.4%). In conclusion the results verified the association of demographic profile aspects, which pointed to a tendency for older individuals with a higher socioeconomic status to present more symptoms resulting from the use of electronic cigarettes; a greater proportion of individuals who reported not having knowledge about the composition of e-liquids was found, and this fact was associated with a greater presence and prevalence of symptoms harmful to health.

**Keywords:** Electronic cigarettes; Nicotine; Smoking.

## Introduction

According to the World Health Organization, in 2021, smoking was responsible for 160 thousand deaths per year in Brazil, therefore constituting a public health problem. The trend for the prevalence of smokers is declining for both sexes (Malta et al., 2017); however, even with this decrease, the number of adults and young people who try some tobacco-based product is worrying (Cancer National Institute, 2022).

In this context, electronic cigarettes (or e-cigarettes) emerged as a form of nicotine replacement developed by the Chinese pharmacist Hon Lik and patented in 2003. Electronic cigarettes, or electronic nicotine delivery systems (ENDS), consist primarily of a liquid containing nicotine, propylene glycol (PG), vegetable glycerin (VG), and various flavorings, with nicotine being the addictive substance responsible for dependence, while PG and VG are used as liquid bases to produce vapor, and flavorings are added to create a variety of flavors (Goniewicz et al., 2014).

Although oftentimes considered less harmful than traditional cigarettes, e-cigarettes still pose significant health risks. Officially identified and named in 2019, EVALI stands for E-cigarette, or Vaping Product, use Associated Lung Injury and is a severe lung disease caused by vaping. Studies indicate that inhaling vapor can cause airway irritation and lung inflammation, and some flavorings and pathologic findings support the notion that EVALI is a form of acute lung injury (MacMurdo et al., 2020; Kligerman et al., 2021).

Furthermore, chronic exposure to nicotine can contribute to cardiovascular problems and addiction (Leventhal et al., 2016). Although they may offer a less harmful alternative to conventional tobacco smoking, the long-term effects of ENDS are still being investigated and require caution (National Academies of Sciences, Engineering, and Medicine, 2018). Despite the passage of time, a considerable lack of knowledge and misperceptions about EVALI remain among those who smoke. Wackowski et al. (2023) suggest the need for continued efforts towards promoting a better understanding of EVALI and appropriate behavioral and policy responses.

In general, the use of electronic cigarettes has a significant association with age group; adolescents were mostly starting to smoke e-cigarettes because their friends were doing it, out of curiosity, or for being depressed or anxious, which implies that teenagers mostly started smoking in order to fit in and/or numb themselves (Hill et al., 2024). On the other hand, a large proportion of university students know about e-cigarettes; although the prevalence of those who have tried them is low, there is concern about an increased use of this type of device (Oliveira et al., 2018).

Health-related social media use positively correlates with e-cigarette use among current cigarette smokers through exposure to online anti-tobacco messages (Zhang et al., 2024). E-cigarette advertisements may play an important role in persuading high-risk youth to use nicotine and tobacco products (Pike et al., 2019). E-cigarettes marketing not only increases exposure to these products among young people, but can also influence their attitudes and behaviors towards smoking, which can be addictive, even if these individuals do not choose to use e-juice containing nicotine (Alexander et al., 2020).

Despite the literature, the prevalence of vaping among the youth is increasing, and environmental characteristics are associated with vaping in this demographic (Askwith et al., 2024). Among young people, curiosity about tobacco products is the main reason for experimentation and a risk factor for future use; one major problem is that a considerable lack of knowledge and misperceptions about EVALI remain among those who smoke (Wackowski et al, 2023). Based on the arguments presented, this research seeks to assess whether the demographic profile of electronic cigarette users is associated with their knowledge about the chemical composition of these devices, in addition to assessing prevalence of use and symptoms in relation to sex, age, social class and level of education.

## Methods

The study sample was calculated using data from the Brazilian Institute of Geography and Statistics (IBGE) on the estimated population for 2022 in the state of Paraná – 11,686,253 people, including an estimated population of 3 to 3.5 million inhabitants aged 12-29 years old. After the sample size was calculated, a necessary sample of 385 participants was reached, representing a 95% confidence level (z score = 1.96), with a sampling error of 5%.

In total, 562 responses were collected remotely through an electronic questionnaire created on the Google Forms platform and consisting of 22 objective questions. The 22 questions were divided into: Identification (residence, age, sex, level of education, socioeconomic status); Use of electronic cigarettes (type, length of use, frequency of use, reasons for use, knowledge about health symptoms, knowledge about the composition of electronic cigarettes, symptoms of electronic cigarette use, time of symptom onset, knowledge about THC, frequency of use of electronic cigarettes with tetrahydrocannabinol (THC), and knowledge about EVALI).

The respondents electronically signed a Free and Informed Consent Form. As inclusion criteria, the participants had to be residents of the state of Paraná, be between 12 and 29 years old and use electronic cigarettes. The research was approved by the Research Ethics Committee of Campo Real College (Research Ethics Committee - Campo Real/8947) under substantiated opinion Nº. 5.545.395.

The data were analyzed using SPSS software version 25.0. Descriptive and inferential statistics were adopted. Frequency and percentage were used as descriptive measures for categorical variables. The Chi-square test was employed to analyze the association of sociodemographic variables and e-cigarette use with prevalence of symptoms. A significance level of $p < 0.05$ was considered.

## Results

Among the participants included in the study. Table 1 shows a predominance of women (56.0%), individuals aged 18 to 29 years (94.5%), with complete secondary education (66.1%) and who identified themselves economically as middle class (79.6%).

Table 2 presents the participants' knowledge and symptoms derived from using electronic cigarettes. There is a predominance of individuals who use both cigarettes (42.9%), who use electronic cigarettes once a week or more (66.5%) and who have been using electronic cigarettes for more than 6 months (54.9%). Furthermore, it is observed that the majority of the participants did not start using electronic cigarettes with the intention of reducing the use of conventional cigarettes (80.5%), do not know the compound of e-liquids (56.0%), are not aware of Evali disease (77.7%) and have started to notice symptoms at least six months prior (51.6%).

According to the data in Table 3, it can be seen that the main symptoms reported by the participants were the following: cough (57.4%), irritation or hoarseness in the throat (56.3%) and nasal congestion (27.6%). Finally, it is worth noting that 26.3% of the participants reported having no symptoms resulting from the use of electronic cigarettes, 42.6% reported experiencing between one and two symptoms, and 31.1% reported experiencing more than two symptoms.

**Table 1.** Sociodemographic characterization of the research participants.

| Variables | ƒ | % |
|---|---|---|
| Sex | | |
| Male | 121 | 44.0 |
| Female | 154 | 56.0 |
| Age group | | |
| 12 to 17 years | 15 | 5.5 |
| 18 to 29 years | 260 | 94.5 |
| Education[a] | | |
| Incomplete/complete elementary education | 17 | 5.7 |
| Secondary education | 181 | 79.6 |
| Complete higher education | 76 | 14.7 |
| Socioeconomic level | | |
| Low | 15 | 5.7 |
| Medium | 211 | 79.6 |
| High | 39 | 14.7 |

A = Variable with missing cases. The authors.

**Table 2.** Profile of use and knowledge derived from using electronic cigarettes.

| Variables | ƒ | % |
|---|---|---|
| Cigarette type | | |
| Electronic and conventional cigarette | 117 | 42.9 |
| E-cigarette only | 158 | 57.1 |
| Frequency of electronic cigarette use | | |
| Once a month | 53 | 19.3 |
| Once every 15 days | 39 | 14.2 |
| Once a week | 58 | 21.0 |
| 3 to 4 times a week | 55 | 20.0 |
| Every day | 70 | 25.5 |
| Time using electronic cigarette | | |
| Up to 1 month | 7 | 2.6 |
| Up to 6 months | 74 | 26.9 |
| More than 6 months | 151 | 54.9 |
| More than 3 years | 43 | 15.6 |
| Started with the intention of reducing the use of conventional cigarettes[a] | | |
| Yes | 52 | 19.5 |
| No | 214 | 80.5 |
| Knowledge of the composition of e-liquids | | |
| Yes | 121 | 44.0 |
| No | 154 | 56.0 |
| How long ago did the symptoms start?[a] | | |
| No symptoms | 83 | 33.2 |
| Up to 1 month | 38 | 15.2 |
| Up to 6 months | 92 | 36.8 |
| More than 1 year | 37 | 14.8 |
| Does you know about Evali disease?[a] | | |
| Yes | 62 | 22.3 |
| No | 213 | 77.7 |

A = Variable with missing cases. The authors.

**Table 3.** Symptoms derived from using electronic cigarettes.

| Variables | ƒ | % |
|---|---|---|
| Symptoms | | |
| No symptoms | 71 | 25.8 |
| Irritation or hoarseness in the throat | 155 | 56.3 |
| Cough | 158 | 57.4 |
| Nasal congestion | 76 | 27.6 |
| Anxiety | 59 | 21.4 |
| Eye irritation | 31 | 11.2 |
| Difficulty swallowing | 18 | 6.5 |
| Number of symptoms | | |
| No symptoms | 71 | 26.3 |
| 1 to 2 symptoms | 115 | 42.6 |
| More than 2 symptoms | 84 | 31.1 |

A = Variable with missing cases. The authors.

About the association of sociodemographic variables with prevalence of symptoms resulting from the use of electronic cigarettes (Table 4), a significant association was found between prevalence of symptoms only with age group (p = 0.045) and socioeconomic level (p = 0.048). This association indicates a tendency for older individuals with higher socioeconomic status to present more symptoms resulting from the use of electronic cigarettes.

**Table 4.** Association of sociodemographic variables with prevalence of symptoms resulting from the use of electronic cigarettes.

| Variables | Number of symptoms | | | $X^2$ | p-value |
|---|---|---|---|---|---|
| | None (n = 71) | 1 to 2 (n = 115) | More than 2 (n = 84) | | |
| | *f (%)* | *f (%)* | *f (%)* | | |
| Sex | | | | | |
| Male | 38 (31.9) | 47 (39.5) | 34 (28.6) | 2.479 | 0.115 |
| Female | 33 (21.9) | 68 (45.0) | 50 (33.1) | | |
| Age group | | | | | |
| 12 to 17 years | 6 (40.0) | 8 (53.3) | 1 (6.7) | 4.028 | 0.045* |
| 18 to 29 years | 65 (25.5) | 107 (42.0) | 83 (32.5) | | |
| Education[a] | | | | | |
| Inc./complete elementary educat. | 6 (35.3) | 9 (52.9) | 2 (11.8) | | |
| Secondary education | 46 (25.8) | 73 (41.1) | 59 (33.1) | 0.440 | 0.507 |
| Complete higher education | 19 (25.7) | 33 (44.6) | 22 (29.7) | | |
| Socioeconomic level | | | | | |
| Low | 6 (40.0) | 6 (40.0) | 3 (20.0) | | |
| Medium | 57 (27.5) | 84 (40.6) | 66 (31.9) | 3.908 | 0.048* |
| High | 4 (10.5) | 21 (55.3) | 13 (34.2) | | |

*Significant association – p < 0.05: Chi-Square Test. The authors.

According to the data in Table 5, a significant association was found between prevalence of symptoms resulting from the use of electronic cigarettes and knowledge of the composition of e-liquids (p = 0.004) and duration of symptoms (p < 0.001). This association indicates a higher proportion of individuals who reported not having knowledge about the composition of e-liquids, and that a longer duration of symptoms was related to a higher prevalence of symptoms.

**Table 5.** Association of profile of use and knowledge derived from using electronic cigarettes with prevalence of symptoms.

| Variables | Number of symptoms | | | $X^2$ | p-value |
|---|---|---|---|---|---|
| | None (n = 71) | 1 to 2 (n = 115) | More than 2 (n = 84) | | |
| | *f (%)* | *f (%)* | *f (%)* | | |
| Cigarette type | | | | | |
| Electronic and conventional | 21 (18.3) | 56 (48.7) | 38 (33.0) | 3.437 | 0.064 |
| E-cigarette only | 50 (32.7) | 57 (47.3) | 46 (30.0) | | |
| Frequency of use | | | | | |
| Once a month | 18 (35.3) | 18 (35.3) | 15 (29.4) | | |
| Once every 15 days | 9 (24.3) | 19 (51.4) | 9 (24.3) | | |
| Once a week | 16 (27.6) | 27 (46.5) | 15 (25.9) | 2.847 | 0.092 |
| 3 to 4 times a week | 12 (22.2) | 23 (42.6) | 19 (35.2) | | |
| Every day | 16 (22.9) | 28 (40.0) | 26 (37.1) | | |
| Time using electronic cigarette | | | | | |
| Up to 1 month | 2 (28.6) | 4 (57.1) | 1 (14.3) | | |
| Up to 6 months | 25 (34.2) | 28 (38.4) | 20 (27.4) | 1.081 | 0.299 |
| More than 6 months | 31 (20.9) | 16 (38.1) | 13 (31.0) | | |
| Started with the intention of reducing the use of conventional cigarettes | | | | | |
| Yes | 11 (21.2) | 20 (38.5) | 21 (40.4) | 2.676 | 0.102 |
| No | 59 (28.2) | 91 (43.5) | 59 (28.2) | | |
| Knowledge of e-liquids | | | | | |
| Yes | 40 (33.3) | 52 (43.4) | 28 (23.3) | 8.261 | 0.004* |
| No | 31 (20.7) | 63 (42.0) | 56 (37.3) | | |
| How long ago did the symptoms start? | | | | | |
| No symptoms | 71 (91.0) | 6 (7.7) | 1 (1.3) | | |
| Up to 1 month | 0 (0.0) | 28 (73.7) | 10 (26.3) | | |
| Up to 6 months | 0 (0.0) | 47 (51.1) | 45 (48.9) | 130.10 | <0.001* |
| More than 1 year | 0 (0.0) | 20 (54.1) | 17 (45.9) | | |
| Do you know about Evali disease? | | | | | |
| Yes | 13 (21.3) | 26 (42.6) | 22 (36.1) | 1.460 | 0.227 |
| No | 58 (27.9) | 89 (42.8) | 61 (29.3) | | |

*Significant association – p < 0.05: Chi-Square Test. The authors.

# Discussion

The results showed that young university students of both sexes were the predominant users, although a high level of use was found among adolescents in countries where use has been authorized (Silva & Moreira, 2019). These young university students with higher education and middle/upper class income prefer to use electronic cigarettes (Qanash et al., 2019). Vaping prevalence among the youth is rising, and identifying neighborhood environment characteristics associated with vaping in this demographic – e.g., retailers, advertisements, and policies – is of paramount importance (Askwith et al., 2024).

Even though young smokers started it as a therapeutic way to quit smoking (Lima Menezes et al., 2021), because electronic cigarettes help in the transition from smokers to ex-smokers and, in the short term, are less toxic (Winnicka & Shenoy, 2020), studies are still inconclusive regarding their use as a cessation tool (Silva & Moreira, 2019), with Brazil being one of the first countries in the world to ban Electronic Smoking Devices (ESDs), and groups of users having argued that the ban prevented people from accessing a product that would help people quit smoking and would be less toxic.

As for adverse or harmful effects on health, the results showed that the most prevalent symptoms in this study were throat irritation and/or hoarseness (56.3%), cough (57.4%), nasal congestion (27.6%) and anxiety (21.4%). With the evolution of electronic nicotine delivery devices, reports mention a decrease in throat irritation, as these devices increase the amount of nicotine released in protonated form (Virgili et al., 2022). Regarding coughing resulting from the use of electronic cigarettes, this was the most reported symptom, along with dyspnea and chest tightness (Pinto et al., 2020), with coughing and throat irritation being reported in both chronic and acute use in the study conducted by Walele et al. (2016); moreover, Carvalho et al. (2024) concluded that e-cigarettes users had high rates of alcohol consumption and experienced significant impacts on their general health, including increased cotinine and carbon monoxide concentration in exhaled air, decreased oximetry, and low salivary viscosity.

When consumption begins in adolescence, it has been found that the use of electronic cigarettes has a greater chance of becoming a chronic lung disease (Winnicka & Shenoy, 2020; Filho et al., 2021), which is a major concern; as seen in the teenage population, EVALI is characterized by centrilobular ground-glass nodules and ground-glass opacities with subpleural sparing (Thakrar et al., 2021), and Sund et al. (2023) raise concern about an underreporting of e-cigarette or vaping-associated lung injury internationally.

It is worth noting that e-liquids are a solution composed of nicotine, flavorings, water, and other additives that are dissolved in solvents; one of these additives may be THC. In the study by Trivers et al. (2021), almost half of the respondents (1,980 users) reported daily or weekly THC-EVP use and had access to the products through both informal and formal sources, even after EVALI began. Krishnasamy et al. (2019) concluded the patients who developed Evali, 82% used any product containing THC, and only 14% used nicotine exclusively. When asked about THC use, 12.5% reported using it, 8.7% did not know how to answer, and 77.5% were unaware of Evali. These findings support the suggestion by Wackowski et al. (2023) about the need for continued efforts towards promoting a better understanding of EVALI, its health impairments, and the appropriate behavioral and policy responses.

The results of this study verified associations for e-cigarette smokers' demographic profile aspects, indicating a tendency for older individuals with higher socioeconomic status to present more symptoms resulting from the use of electronic cigarettes. The current literature has found that youth, women, and racial/ethnic minorities are more likely to use flavored cigars than their peers are because flavored cigars have characteristics that appeal to members of these populations, which may contribute to their long-term use and potential for addiction (Hinds et al., 2018). Considering the reasons for using e-cigarettes/vaping in Asian contexts, the most common ones for frequent vaping were a desire to quit smoking and the ability to vape indoors, whereas in western contexts, the reasons were nicotine concentration, nicotine dependence, and more daily vaping sessions (ko et al., 2024).

Another association found indicates a greater proportion of individuals who reported not having knowledge about the composition of e-liquids, as well as longer duration of presence of symptoms with a higher prevalence of symptoms due to the wide availability of flavored tobacco products, illustrating the need to regulate the characteristic flavors of all tobacco products (Jackler et al, 2018). In this sense, Odani et al. (2020) found an association between the use of flavors and increased tobacco dependence, concluding that banning the selling of flavored products can reduce access to and dependence on tobacco. News about vaping-attributable health situations may prevent e-cigarette/vape use and encourage cessation among young

people, and tobacco control campaigns should address uncertain health effects of e-cigarettes or tobacco products (Kreslake et al., 2022).

The most important limitation of this study is that the responses to the questionnaire were self-reported, making it difficult to accurately verify the quantities of e-liquids inhaled by users, as well as the exact frequency of electronic cigarette use. Another limitation arises from the sample selection, since the participants were invited to join on social networks. The questionnaire was prepared specifically for the study, a fact that leads to specific information and does not reach information that could better elucidate chronic issues from electronic cigarette use; longitudinal studies with greater control of variables are suggested.

Among practical applications, the results point to the need to monitor changes in the use of non-cigarette alternatives for therapeutic purposes and additional research that examines the factors that contribute to the change from recreational use to habitual use. It also highlights the need to monitor the prevalence of consumption of available e-cigarettes and the development of population-based intervention programs to prevent and reduce tobacco consumption among young people.

## Conclusion

The demographic profile of e-cigarette users was characterized by young university students of both sexes, with higher education and middle/upper class income. As the most prevalent symptoms, these users presented, first of all, throat irritation and/or hoarseness, followed by coughing, nasal congestion and anxiety.

These young university students with higher education and higher socioeconomic status experienced two or three of the symptoms resulting from using electronic cigarettes; these individuals reported not having knowledge about the composition of e-liquids, and these e-liquids are associated with symptoms that are harmful to their health and that persist over time.

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