

Proficiency, attitudes and practices of university students as regards smoking electronic cigarettes

Proficiência, atitudes e práticas de estudantes universitários em relação ao uso de cigarros eletrônicos

Competencia, actitudes y prácticas de estudiantes universitarios respecto al uso de cigarrillos electrónicos

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Abstract

Objectives: This research was created as a review on the topic and conducted research among university students, by using a questionnaire to assess the use of EC's and knowledge of risks and oral changes caused by them. **Materials and Methods:** A review was made on the topic, searched in the Medline and Latindex databases, period from 2011 to 2023. An exploratory and cross-sectional research was made by collecting data obtained with use of a semi-structured Google Forms questionnaire. **Results:** In total 486 responses were obtained, with 114 (23.46%) respondents declaring they were smokers and 83 users of EC; 92.77% used nicotine; 7.22% recognized the EC as being the “door of entry” to smoking CC; 49.4% had never smoked before using these devices; and 26.5% declared that the EC was a strategy to reduce the use of CC. The most frequently declared effects related to EC use were yellow-brown staining of teeth (35.53%), absence of saliva (30.12%) and ulcers (22.51%); 54.22% of the users had never searched information regarding the effects on oral health. **Conclusions:** The results demonstrate the need to expand information among the population, particularly young people, with the purpose of preventing an increase in the use of EC.

Keywords: Electronic cigarettes; Nicotine; Cigarettes.

Resumo

Objetivos: Foi realizada uma revisão sobre o tema e uma pesquisa através de questionário, entre estudantes universitários, para avaliar a utilização dos CE e o conhecimento dos riscos e alterações bucais provocadas pelo seu uso. **Materiais e Métodos:** Uma revisão foi realizada utilizando as bases de dados Medline e Latindex, período de 2011 a 2023. Uma pesquisa exploratória e transversal foi feita por meio dos dados que foram obtidos através de um questionário Google Forms semiestruturado. **Resultados:** Foram obtidas 486 respostas, sendo 114 entrevistados fumantes declarados e 83 usuários apenas de CE, sendo 92,77% com nicotina; 7,22% reconheceram o CE como a “porta de entrada” para o cigarro convencional; 49,4% nunca tinham fumado antes do uso desses dispositivos; 26,5% declaram que o CE foi uma estratégia para reduzir o uso de cigarro convencional. Os efeitos bucais declarados, mais frequentemente relacionados ao seu uso foram manchas (35,53%), falta de saliva (30,12%) e aftas/feridas (22,51%); 54,22% dos usuários nunca procurou informações a respeito dos efeitos na saúde bucal. Os resultados demonstram a necessidade de ampliar a informação para a população, principalmente para adolescentes e jovens, a fim de evitar o aumento na utilização de CE e, conseqüentemente, do tabagismo.

Palavras-chave: Cigarros eletrônicos; Nicotina; Cigarro.

Resumen

Objetivos: Se llevó a cabo una revisión sobre el tema y una investigación mediante un cuestionario entre estudiantes universitarios para evaluar el uso de los cigarrillos electrónicos (CE) y el conocimiento de los riesgos y alteraciones bucales provocadas por su uso. **Materiales y Métodos:** Se realizó una revisión utilizando las bases de datos Medline y Latindex, en el período de 2011 a 2023. Se llevó a cabo una investigación exploratoria y transversal a través de los datos obtenidos mediante un cuestionario semiestructurado en Google Forms. **Resultados:** Se obtuvieron 486 respuestas, con 114 entrevistados que eran fumadores declarados y 83 usuarios exclusivos de CE, de los cuales el 92,77% contenía nicotina. El 7,22% reconoció que el CE era la "puerta de entrada" al cigarrillo convencional; el 49,4% nunca había fumado antes de usar estos dispositivos; el 26,5% afirmó que el CE fue una estrategia para reducir el consumo de cigarrillos convencionales. Los efectos bucales declarados con mayor frecuencia relacionados con su uso fueron manchas (35,53%), falta de saliva (30,12%) y aftas/heridas (22,51%). El 54,22% de los usuarios nunca buscó información sobre los efectos en la salud bucal. Los resultados muestran la necesidad de ampliar la información para la población, especialmente para adolescentes y jóvenes, con el fin de evitar el aumento en el uso de CE y, por ende, del tabaquismo.

Palabras clave: Cigarrillos electrónicos; Nicotina; Cigarrillo.

1. Introduction

Electronic cigarettes (EC), also known as e-cigarettes or electronic nicotine delivery systems (ENDS), were developed to help conventional cigarette (CC) smokers to quit the habit or gradually reduce the levels of nicotine ingested (the purpose was to provide physical sensations similar to those obtained from CC, with flavor options), thereby minimizing harm caused by smoking. The first device, created in Pennsylvania, in 1963, and cataloged by Herbert Gilbert, was not disseminated due to the insufficiency of technological know-how at the time (INCA – Instituto Nacional do Câncer. 2016). In 2003, Hon Link, a Chinese smoker, researcher and pharmacist developed a new model and patented it as an electronic cigarette, with commercialization starting in 2004 (Cahn & Siegel, 2011; Knorst et al., 2014).

The use of electronic devices, dissociated from programs to stop using tobacco, has had no scientific proof of effectiveness and their indiscriminate use can even increase the frequency of smoking and risk of alcohol and illicit drug use. According to a study conducted in England, 14% (fourteen percent) of smokers who participated in a structured program had a positive result with the associated use of EC to stop smoking (Lindson et al, 2023).

The EC represents a challenge to public health, as it can serve as a point of entry into smoking common cigarettes (INCA – Instituto Nacional do Câncer. 2016). Many device users believe that its use does not pose major health risks (Cavalcante, et al., 2017).

Important work has to be done relative to prevention and awareness about the consequences of smoking on oral health, research has revealed that although dentistry professionals and university students are aware of their role, they do not feel fully qualified. For many the information available is scarce and difficult to access (Diniz-Freitas, et al., 2017).

Trials that enable the development of policies campaigns and regulations on the trade of these products are necessary with the aim of reducing their use. Furthermore, it is essential to make the population aware of the potential damage caused by ECs, as there is still a shortage of information in this regard.

The aims of this study were to carry out a narrative review on the effects of EC on oral cavity and use a questionnaire to evaluate the prevalence and pattern of use of EC devices by college students (time of use, types, essence refill pattern), the influence on cessation or initiation of CC use, perception of clinical changes caused in the oral cavity and knowledge of the legislations.

2. Methodology

A narrative, qualitative, descriptive review was carried out, based on an electronic data search in the Medline and Latindex databases, with the descriptors e-cigarettes, vape, nicotine, conventional cigarette (Medical Subject Headings - MeSH

terms), using Boolean operators (OR, AND), period from 2011 to 2023. After selecting the studies, the information was organized and presented in the results (Silva, et al., 2022).

An exploratory and cross-sectional research was conducted by collecting data obtained with use of a semi-structured Google Forms questionnaire (20 questions divided into 4 sessions). This was also characterized as explanatory since information was generated about the knowledge of professionals in the area. After preparation, the questionnaire was subjected to a pilot test, which proved its ease of access and effectiveness in obtaining responses. After the test, the number of responses was reset.

The research protocol was approved by the Ethics and Research Committee with Human Beings of the Pontifical Catholic University of Minas Gerais (PUCMG).

The sample was obtained by convenience and the research was conducted after obtaining a signed Term of Free and Informed consent from participants, prior to this, students had been invited to participate in the work by weekly e-mails, instant messaging applications, such as WhatsApp® (Santa Clara, California, U.S.A.) and messages via Facebook and Instagram social networks. The questionnaire was made available for three months, from 05/08/2023 to 08/08/2023.

3. Discussion and Results

Conventional cigarettes (CCs) are made up of several chemical substances that may have cytotoxic carcinogenic and antigenic properties (Huang, et al., 2018).

The EC releases aerosols and the vapor first makes contact with the oral cavity. Bacteria of the oral microbiome are affected, and the literature has shown evidence that changes in the composition of biofilm are associated with stimulation of the inflammatory response and development of oral diseases (Ganesan, et al., 2020).

Petrusic et al. (2015) mentioned that xerostomia was one of the most common side effects occurring among EC users, and it was associated with the presence of the substance propylene glycol contained in essences (that are characterized by absorption humidity), and both the prolonged and frequent use of nicotine.

Smoking is a risk factor for the development of periodontal disease, especially when cigarette use is associated with the use of legal and illicit drugs (alcohol and narcotics) (Atuegwu, et al., 2019). ECs containing nicotine cause vasoconstriction that can reduce signs of gum bleeding, despite recurrent reports of swelling and gum pain by users and worsening of the plaque index and probing depth on clinical examination (Silva, 2022).

According to Torres (2021) black hairy tongue and nicotinic stomatitis can occur due to heat generated during vaporization, causing inflammation, this in turn, can generate metaplasia in the salivary glands. The use of EC also significantly increases the chances of neoplasms in the oral cavity (Goniewicz, et al., 2013).

According to the review by Yang et al. (2020). studies have suggested that the use of EC increases the incidence of candidiasis, mucosal ulcerations, angular cheilitis, periodontal diseases and caries lesions. Substances present in the liquids, propylene glycol and vegetable glycerin, make them more viscous, with greater potential for adhering to the teeth and oral cavity structures, thereby favoring bacterial adhesion (Huang, et al., 2018).

Nicotine contributes to the development of Gastroesophageal Reflux Disease (GERD), by reducing the pressure of the lower esophageal sphincter, (favoring the return of gastric juice), alteration of salivary secretion levels and by causing chronic coughing (increases the frequency of reflux episodes and prolongs the presence of acidic content in the esophagus) (de Castro Vieira, et al., 2022). Studies have previously shown severe esophagitis due to the use of EC with nicotine (Pasricha & Kochar, 2021). Contact with stomach acid increases the chances by two to four times of the occurrence of dental structures wear caused by contact (Jordão, et al., 2020). Furthermore, the increase in temperature can contribute to the wear of the teeth caused by acids by accelerating chemical reactions and changing the crystalline structure of dental tissues (by reducing wear resistance)

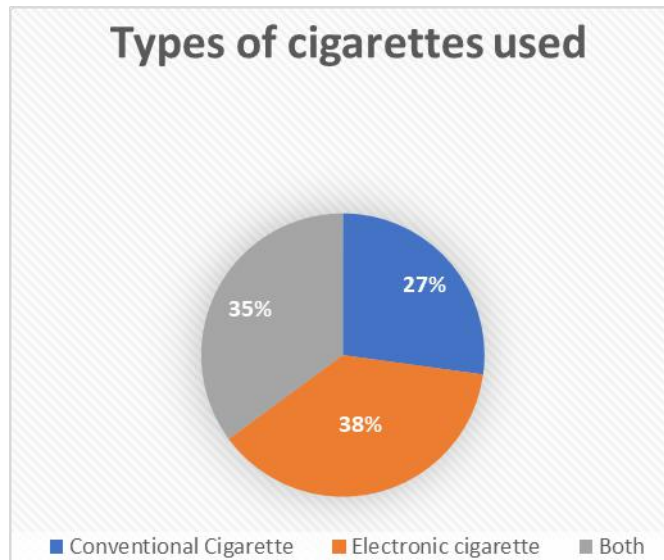
(Ferraz, et al., 2019).

According to Irusa et al (2022), who showed an association between the use of EC and increased risk of caries, during the anamnesis, the dentist should ask the patient about the use of these devices, to establish a preventive monitoring plan with the aim of controlling the development of lesions.

This research involved the participation of 486 college students (Graph 1), within the scope of three areas of knowledge (human, exact and biological); 114 (23.46%) declared themselves to be smokers of CC and/or EC, and answered all the questions in the questionnaire on the topic (35 students / 30.7% from the area of humanities. 44 students / 38.6% from the area of health and 35 students / 30.7% from the area of exact sciences) (Flowchart 1).

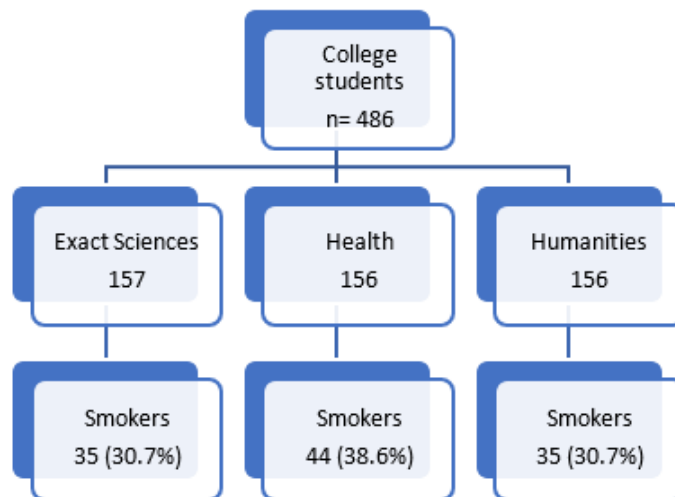
Of the 83 students using EC, 7.22% reported having started using CC after using the electronic devices, which confirmed the possibility of these functioning as a “point of entry” into smoking (Lindson, et al., 2023).

Graph 1 - Types of cigarettes used.



*From Table 1 to Table 11, only those who declared themselves to be users of EC and EC / CC (n=83). Source: Authors (2023).

Flowchart 1 - Percentage of university students who declared themselves to be smokers and not smokers.



Source: Authors (2023).

As regards the time of use, 49.39% of individuals declared that they had been using the device for approximately 1 to 2 years (Table 1). Which led to the hypothesis that this time was influenced by the pandemic isolation of Covid-19, and the possibility that users had sought an alternative that would allow smoking in closed places.

Table 1 - If you still use electronic cigarettes. How long have you been doing so? (n=83).

Time to use	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Less than 6 months	2	2.41	3	3.61	4	4.82	9	10.84
From 6 months to 1 year	4	4.82	6	7.23	9	10.84	19	22.89
From 1 to 2 years	13	15.66	19	22.89	9	10.84	41	49.39
From 3 to 4 years	2	2.41	1	1.20	5	6.02	8	9.63
I don't use it anymore	2	2.41	4	4.82	0	0.00	6	7.23
Amount	2	27.71	33	39.76	27	35.53	83	100

Source: Authors (2023).

Table 1 shows that majority of the students have been using EC for two years or less. An important issue to emphasize is that the dissemination of content, whether through images or videos, which may not necessarily be of an advertising nature, might mask the real danger resulting from the use of these devices. Furthermore, since the virtual world has controlled people's minds, an association of this increase was believed to be attributable to the widespread use of EC by influencers, celebrities, athletes and even dentists.

Of the options found on the market, those with the highest frequency of use were disposable vaporizers, POD and VAPE (Table 2).

Table 2 - Electronic cigarette users (n=83) divided by type of device declared.

Device type	Exact Sciences	%*	Humanities	%	Health	%	Amount	%
Jull	3	3.61	7	8.43	3	3.61	13	15.66
POD	11	13.25	18	21.69	17	20.48	46	55.42
Vape	6	7.23	11	13.35	8	9.64	24	28.92
Vape pen	3	3.61	6	7.23	1	1.20	10	12.05
Disposable vaporizers	13	15.66	20	24.10	21	25.30	54	65.06
More than one type	8	9.64	12	14.46	10	12.04	30	36.14

*In this question, the student had the option to select more than one type of device. This is why the sum of the final percentage is not 100%. Source: Authors (2023).

The frequency of use may be related to ease of obtaining them at newsstands, street vendors, and even via fast

delivery apps (Boykan, et al., 2019). According to the responses collected, 49.4% of users were not smokers before starting with the practice of using electronic cigarettes (Table 3).

Table 3 - Did you smoke conventional cigarettes before using electronic cigarettes? (n=83).

Before the EC. I used conventional cigarettes	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Yes	7	8.43	20	24.10	15	18.07	42	50.6
No	16	19.28	13	15.66	12	14.46	41	49.4
Amount	23	27.71	33	39.76	27	35.53	83	100

Source: Authors (2023).

These data make one think that if EC had not been introduced, many users would probably not be smokers, therefore supporting the concern and reinforcing the need for awareness programs, especially among young people and teenagers.

The goal of quitting smoking motivated 26.5% of individuals to start using ECs, even without knowledge of scientific evidence or monitoring programs of tobacco cessation (Table 4). Among users, 92.77% claimed that they knew they were using EC with nicotine, despite information about the harm to health, a factor that are widely disseminated (Table 5).

Table 4 - Did you start using the device as a way to stop smoking conventional cigarettes? (n=83).

Used the CE as a way to stop the smoke	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Yes	6	7.23	7	8.43	9	10.84	22	26.5
No	17	20.48	26	31.33	18	21.69	61	73.5
Amount	23	27.71	33	39.76	27	32.53	83	100

Source: Authors (2023).

Interestingly, more than 70% of EC users did not have the goal of quitting conventional cigarettes.

Table 5 - Does the device you use /or have used - contain nicotine? (n=83).

Contains Nicotine	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Yes	21	25.30	30	36.14	26	31.33	77	92.77
No	1	1.20	1	1.20	1	1.20	3	3.61
I don't know	1	1.20	2	2.41	0	0.00	3	3.61

Source: Authors (2023).

Relative to knowledge on the effects of CE on oral health, 45.78% of the students reported that they had researched the topic of harm caused by the device (27.71% in the area of health) a fact that was expected since these students normally have greater access to studies and classes that point out such effects, and only 12.05% and 6.02% in the areas of exact and human knowledge, respectively (Table 6).

Table 6 - Have you ever tried to find out about the effects of electronic cigarettes on oral health? (n=83).

Effects in oral health	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Yes	5	6.02	10	12.05	23	27.71	38	45.78
No	18	21.69	23	27.71	4	4.82	45	54.22
Amount	23	27.71	33	39.76	27	32.53	83	100

Source: Authors (2023).

Among the adverse effects on the oral cavity recognized by college students, attention is drawn to 36.14% who responded that the device did not cause any effect on oral health, which shows the absence of knowledge about the topic and the need for educational campaigns. The presence of stains was mentioned in 35.5% of the responses, sensation of dry mouth (xerostomia) in 30.12%, mouth ulcers in 22.51%, dental wear in 20.48%, halitosis in 19.28% and caries lesions in 14.46% (Table 7).

Table 7 - What effects do you consider to be a result of using electronic cigarettes? (n=83).

Intraoral consequences	Exact Sciences	%	Humanities	%	Health	%	Amount	%
None	7	8.43	11	13.25	12	14.46	30	36.14
macule	7	8.43	10	12.05	10	12.05	27	35.53
feeling of little saliva	5	6.02	9	10.84	11	13.25	25	30.12
ulcers	4	4.82	12	14.46	6	7.23	22	22.51
dental wear	5	6.02	8	9.64	4	4.82	17	20.48
Bad breath	4	4.82	7	8.43	5	6.02	16	19.28
Caries	3	3.61	6	7.23	3	3.61	12	14.46

Source: Authors (2023).

The most used flavors, in descending order were watermelon, strawberry, menthol, blueberry, grape, mango, lemon, cherry, apple, vanilla, orange, tobacco and coffee (Table 8).

Table 8 - Which are the flavors of the essences that you use or have used? (n=83).

Flavors	Exact Sciences	%	Humanities	%	Health	%
Vanilla	4	4.82	5	6.02	6	7.23
Blueberry	8	9.64	20	24.10	11	13.25
Coffee	1	1.20	1	1.20	1	1.20
Cherry	2	2.41	10	12.05	7	8.43
Orange	2	2.41	8	9.64	2	2.41
Lemon	5	6.02	9	10.84	7	8.43
Mango	6	7.23	13	15.66	12	14.46
Apple	5	6.02	5	6.02	6	7.23
Watermelon	11	13.25	22	26.51	17	20.48
Menthol	7	8.43	14	16.87	20	24.10
Strawberry	8	9.64	21	13.13	16	19.28
Tobacco	2	2.41	3	1.88	2	2.41
Grape	4	4.82	21	13.13	12	14.46
No preference	2	2.41	8	5.00	2	2.41

Source: Authors (2023).

Thus, it is interesting to note that sweet and mentholated flavors, shown in Table 8, had more adherence compared with those that were closer to the taste and odor of common cigarettes (Bhatnagar, et al., 2014; Hess, et al., 2017).

Moreover, an important factor to highlight is that these essences may contain sugar in their composition and contribute to the development of caries lesions. Propylene glycol, present in essences makes sugar more easily adhered to the oral cavity structures, making it difficult for saliva to wash it off since the saliva flow can also be altered (generating symptoms of xerostomia in users). As though this were not enough, flavoring fluids have different pH levels, which may vary (between 3.3 and 8.9), depending on the brand, on bioavailable nicotine and other compound levels. These pH can reach close to that of lemon juice, being extremely harmful to oral structures, since pH values below 5.5 have previously been considered critical for enamel (Lisko, 2015).

About commercialization and advertising that are prohibited in Brazil (Ministério da Saúde, 2009), 84.34% of the students declared that they were aware of this fact (Table 9). It is interesting to note that even knowing about the absence of regulation (68.68% of users) (Table 10) and declaring that they did not feel safe about using the devices (54.22% of users) (Table 11), the majority of students continued to use ECs. The fact that an EC does not taste or smell like a CC could contribute to the non-perception of harm. In fact, the attractive flavors and the fact that they are permitted in closed places would appear to have contributed to the increasing frequency of their use, mainly among young people.

Table 9 - Did you know that the sale of electronic cigarettes is prohibited in Brazil? (n=83).

Knowledge about the ban on the commercialization of CE	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Yes	15	18.07	33	39.76	22	26.51	70	84.34
No	8	9.64	0	0	5	6.02	13	15.66
Amount	23	27.71	33	39.76	27	32.53	83	100

Source: Authors (2023).

Table 10 - Did you know that there is no regulation for brands available in the country? (n=83)

Knowledge about the lack of regulation	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Yes	7	8.43	29	34.94	21	25.31	57	68.68
No	16	19.28	4	4.82	6	7.23	26	31.32
Amount	23	27.71	33	39.76	27	32.53	83	100

Source: Authors (2023).

Table 11 - Do you feel safe using a product that is not regulated? (n=83).

Do you feel Safe to use CE?	Exact Sciences	%	Humanities	%	Health	%	Amount	%
Yes	9	10.84	16	19.28	13	15.66	38	45.78
No	14	16.87	17	20.48	14	16.87	45	54.22
Amount	23	27.71	33	39.76	27	32.53	83	100

Source: Authors (2023).

4. Conclusion

Of the 486 university students who participated in this study, 114 declared themselves to be smokers (23.46%), 83 (72.81%) of whom were EC users. Health students represented the highest percentage of smokers (38.6%), in spite of being those with greater knowledge about the negative effects of cigarettes.

The fact that 49% of ECs users had never smoked before they started using the dispositives, shows the possibility of an increase in the habit of smoking, a chronic disease with a significant impact on the population. It is important to highlight that not only nicotine, but other components present in these devices can generate systemic and oral health problems.

Regulatory and control policies covering EC trade are necessary, in addition to promoting awareness campaigns among the population, especially young people. Furthermore, it is extremely important for professionals to know about and explain the possible consequences of EC use to their patients, in order to contribute to the prevention and cessation of their use.

Some limitations of this study need to be highlighted, such as the absence of a comprehensive clinical analysis of the pathologies found in the oral cavity of interviewed EC users. This clinical analysis would be crucial to assess clinical changes and to monitor issues generated by this habit.

As suggestions for future research, it is recommended to expand the study by considering variables such as the income

and region of the interviewees. This would allow a better understanding of user patterns and enable the creation of high-quality content, aiming to increase awareness of the harms associated with the use of this device.

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