

# Level of knowledge of undergraduate dental students about electronic cigarettes

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## ABSTRACT

The electronic cigarette has emerged as an alternative to the conventional cigarette, being considered by some as a smoking cessation aid. The device has attracted the interest of many young people in search of new experiences, sensations, and recreation. The aim of this study was to assess, using a questionnaire, the level of knowledge of undergraduate dental students from the Federal University of Santa Catarina (Florianópolis, Brazil) about electronic cigarettes. Information was also collected on the interest in trying the device, the approach of the subject in the course, and the self-perceived ability to inform patients about electronic cigarettes. The questionnaire was applied in April and May 2019 to 209 students over 18 years old, who were divided into 3 groups: freshmen (1st and 2nd semesters of the course), junior (4th and 5th semesters), and senior (9th and 10th semesters). The descriptive and statistical analyses were performed, and the significance level of 95% was adopted. The results showed that senior students had higher knowledge about electronic cigarettes than freshmen or junior students. However, the level of knowledge was considered unsatisfactory, as about 40% of the senior students had adequate level of knowledge (at least 60% of correct answers). Most students reported not having had contact with the topic during the undergraduate course. Likewise, most senior students reported not feeling prepared to advise patients on electronic cigarettes. The results of this study indicate the dental curriculum should include this topic in the training of future dentists, enabling them to inform their patients about the risks and benefits of using electronic cigarettes.

**Descriptors:** Electronic Nicotine Delivery Systems. Knowledge. Education, Dental.

## 1 INTRODUCTION

Nicotine dependence is recognized as a chronic disease, and is included in the International Classification of Diseases

(ICD-10) as a group of mental and behavioral disorders due to the use of tobacco (ICD F17). Despite the recognized health risks related to smoking, it remains a major public

health problem in Brazil<sup>1</sup>.

The electronic cigarette (EC) is a device that has emerged as an alternative to the conventional cigarette and has been seen as a smoking cessation aid, but its effectiveness has yet to be proven<sup>2-7</sup>. The device has attracted the attention of young people in the search for new experiences, sensations, and recreation<sup>8-11</sup>. EC users usually call themselves vapers, and not smokers<sup>12</sup>.

Although ECs are designed to deliver nicotine in aerosol form, they can also be sold as nicotine-free devices<sup>9</sup>. The number of users of EC has been increasing every year, and at least 500 different brands and several designs are available in the market<sup>13,14</sup>. In Brazil, although the sale, importation, and advertising of ECs, as well as of any accessories and refills, are prohibited<sup>15,16</sup>, there is evidence of illegal trade<sup>16</sup>.

As a novel product, users are likely to have little knowledge about the possible associated health risks<sup>6,13,17-19</sup>. Health professionals should, therefore, be up-to-date on the topic and prepared to guide their patients regarding the use of ECs. Ideally, the training of health professionals would cover information about EC and accessories, the content of refills, the possible health risks of its use, and its value as a smoking cessation strategy. A well-informed dentist could guide patients and answer their questions and, thus, take action in health promotion and prevention of disease, most importantly, oral cancer.

Within this context, the objective of this study was to evaluate the level of knowledge of the dental students at the Federal University of Santa Catarina (Florianópolis, Brazil) about the EC, tracing a knowledge curve between freshmen, junior, and senior students. In addition, students' perceptions

regarding (a) information received on the topic during the course, (b) the importance of the dentists having the knowledge, and (c) self-perception about preparedness to guide a patient about the use of EC was assessed.

## 2 METHODOLOGY

The study protocol was submitted to the Ethics Committee on Human Research, and approved with the number 3,232,604. Students older than 18 years and regularly enrolled in the 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 9<sup>th</sup>, and 10<sup>th</sup> semesters of the course were invited to participate.

As no Portuguese validated tool was available, a questionnaire (box 1) was prepared based on previously published works<sup>16,20</sup>. The collected data were organized in spreadsheets and the participants were divided into three groups: G1 - freshmen (1st and 2nd semesters of the course), G2 - junior (4th and 5th semesters), and G3 - senior (9th and 10th semesters). The categories allow a knowledge curve to be drawn across the different stages of the course including the year when Oral Pathology and Stomatology courses are thought, when the content related to oral cancer is covered more thoroughly.

The information collected was grouped as follows: demographic data; curiosity and influence of friends in the use of EC; knowledge about EC; knowledge received during the course and opportunities for discussions; and self-assessment of the level of knowledge, importance of the dentist knowledge, and confidence to instruct patients.

Descriptive analysis was performed for all questions using the Microsoft Office Excel<sup>®</sup> 2010 program (Microsoft Corporation, Redmond, Washington, USA). For questions related to knowledge about EC, a score of 1 was assigned for correct answers and 0 was assigned for wrong ones. For questions that

were not answered or whose answer was “do not know”, a score of zero was also assigned.

Box 1: Questionnaire answered by participants.

<p><b>DEMOGRAPHIC DATA</b></p> <p>1. Age: _____ 2. Sex: _____</p> <p>3. Course semester: ( ) 1st or 2nd ( ) 4th or 5th ( ) 9th or 10th</p> <p>4. Smoking status: ( ) Smoker ( ) Ex-smoker ( ) never smoker</p> <p>5. Is (or was) electronic cigarette smoker? ( ) Yes ( ) No</p> <p><b>[If you answered YES to item 5, skip to item 10]</b></p> <p>6. Have you heard about electronic cigarette? ( ) Yes ( ) No</p> <p>7. Are you curious about the feeling of smoking an electronic cigarette? ( ) Definitely yes ( ) Probably yes ( ) Probably no ( ) Definitely no</p> <p>8. Do you intend to try an electronic cigarette? ( ) Definitely yes ( ) Probably yes ( ) Probably no ( ) Definitely no</p> <p>9. If one of your best friends offered you an electronic would you smoke it? ( ) Definitely yes ( ) Probably yes ( ) Probably no ( ) Definitely no</p> <p>➤ <b><u>Knowledge about electronic cigarettes</u></b></p> <p>10. How do you rate your level of knowledge about electronic cigarettes? ( ) I have no knowledge ( ) Low ( ) Medium ( ) High</p> <p>11. Smoking conventional cigarettes is considered a health risk. Compared to conventional cigarettes, do you believe that electronic cigarettes are: ( ) More harmful ( ) Similarly harmful ( ) Less harmful ( ) Do not know</p> <p><i>Answer as true or false</i></p> <p>12. Electronic cigarettes are allowed where conventional cigarettes are not. ( ) True ( ) False ( ) Do not know</p> <p>13. The use of electronic cigarettes can help people to stop smoking conventional cigarettes. ( ) True ( ) False ( ) Do not know</p> <p>14. Electronic cigarettes have pleasurable flavors. ( ) True ( ) False ( ) Do not know</p> <p>15. Electronic cigarettes are a source of second-hand smoke. ( ) True ( ) False ( ) Do not know</p> <p>16. Electronic cigarettes are cheaper than conventional cigarettes. ( ) True ( ) False ( ) Do not know</p> <p>17. Electronic cigarettes have no carcinogenic substances in their composition. ( ) True ( ) False ( ) Do not know</p> <p>18. Electronic cigarettes may contain nicotine. ( ) True ( ) False ( ) Do not know</p> <p>➤ <b><u>Content about electronic cigarettes received in the dental course</u></b></p> <p>19. ... have you received any information about the health effects of using electronic cigarettes? ( ) Yes ( ) No</p> <p>If yes, indicate at when and in which situation: _____</p> <p>20. ... have you had any opportunity to discuss in class the reasons why people use electronic cigarettes? ( ) Yes ( ) No</p> <p>➤ <b><u>Opinion about the importance of the dental surgeon to have information about the electronic cigarette</u></b></p> <p>21. In your opinion, is it the role of the dentist to have knowledge about electronic cigarettes? ( ) Yes ( ) No</p> <p>22. Do you, as a future dentist, feel prepared to inform a patient who asks about the use of electronic cigarettes? ( ) Yes ( ) No</p>
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Subsequently, the scores were added up, totaling a maximum of 7 correct answers. For statistical analysis (group comparison on issues related to knowledge about electronic cigarettes) the IBM SPSS® version 23 software (IBM, Armonk, New York, USA) was used, using a significance level of 95%.

### 3 RESULTS

Data collection was carried out in April and May 2019. Two hundred and nine students participated in the research: 84 from G1, 77 from G2, and 48 from G3 groups. The average age was 20, 22, and 24 years for G1, G2, and G3, respectively. Table 1 shows the number and percentage of participants in each group in relation to sex and smoking status.

Twenty percent of G1, as well as 2.6% of G2 and 12.5% of G3 reported past or present use of EC. For those who never used an EC, additional questions were asked about knowledge of the device, curiosity and intention to try one, as well as the effect of social pressure to try the device. Most students in the three groups said they had heard about the device (G1 = 86.6%; G2 = 86.7%, and G3 = 88%).

Half of those who never used an EC reported that they were not interested in trying it (50%) or intended to try it (50%) (figure 1). However, the refusal rate dropped to 38% if the EC was offered by a best friend, with 28% stating that they probably would not use it and 24% that they would probably use it (figure 1).

Table 1 - Distribution of participants' responses according to groups, demographic factors, and smoking status

Variable	Category	G1		G2		G3	
		n	%	n	%	n	%
Sex	Male	26	31	23	29.9	16	33.3
	Female	58	69	54	70.1	32	66.7
Smoking status	Smoker	16	19	1	1.3	1	2.1
	Ex-smoker	7	8.3	5	6.5	1	2.1
	Non-smoker	57	67.9	71	92.2	46	95.8
	No response	4	4.8	0	0	0	0

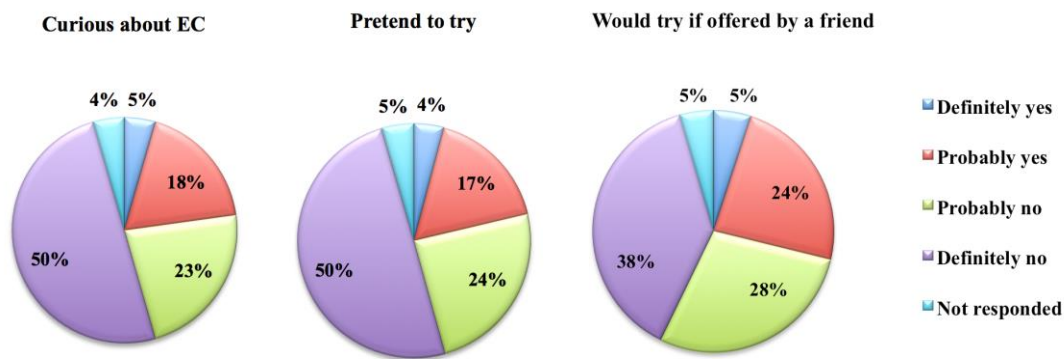


Figure 1. Percentage of the answers about curiosity and intended use, as well as the impact of social pressure in the decision to try the EC among students who reported never having used it

The majority of participants considered their level of knowledge about EC to be low (figure 2) (G1 = 57.1%, G2 = 59.7%, and G3 = 50%). In the senior group, 20.8% of students reported no knowledge at all about the EC, and 4.2% said they had a high level

of knowledge. None of the freshmen and junior students reported a high level of knowledge.

Most students thought EC to be less than (37.7%) or as harmful as (43.9%) conventional cigarettes (figure 3).

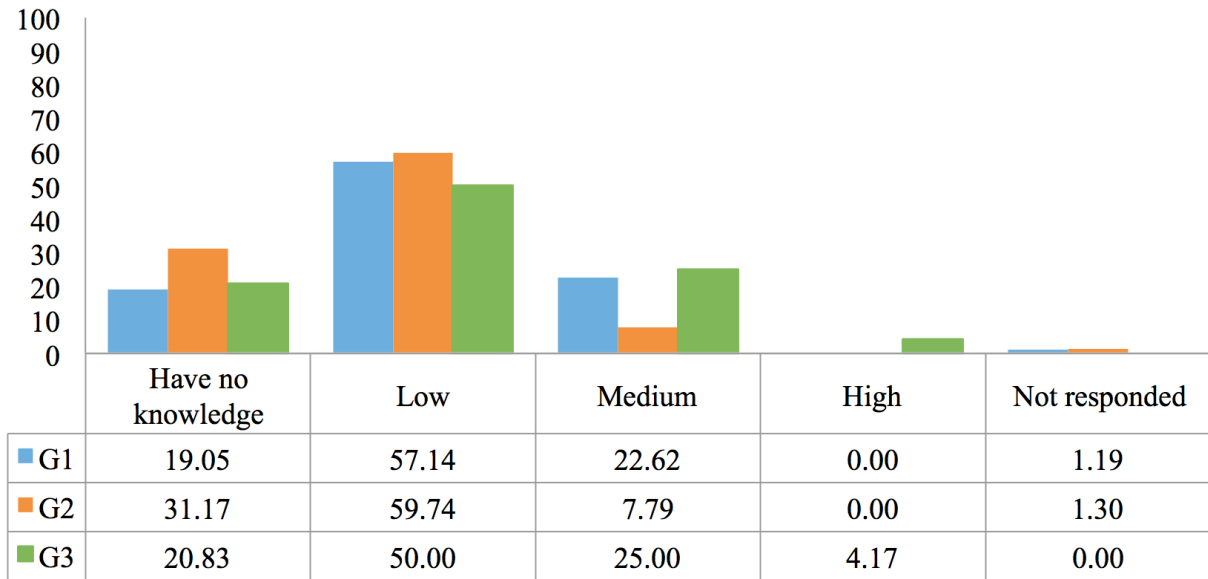


Figure 2. Percentage of responses related to self-knowledge about electronic cigarettes

**Compared to conventional cigarettes, electronic cigarettes are:**

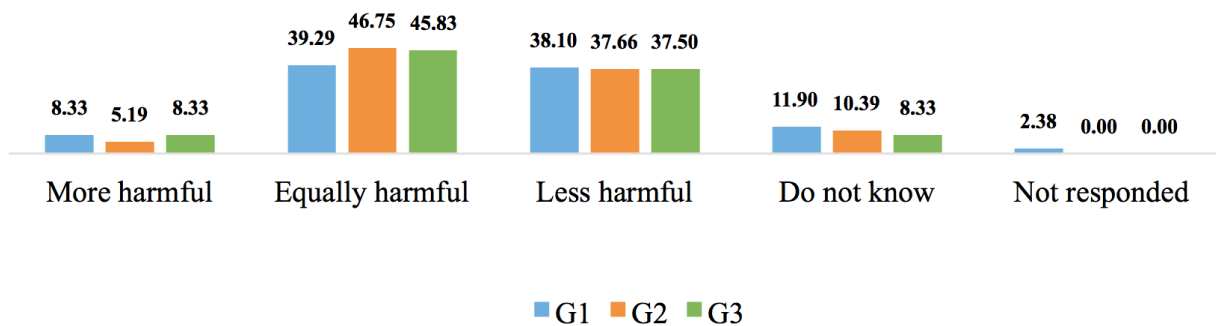


Figure 3. Students' perception (%) about health risks of using electronic cigarettes, compared to the use of conventional (combustible) cigarettes

Figure 4 shows the data regarding correct answers of the participants' knowledge about EC. Fifty percent of G3 students, 39% of G2, and 34.5% of G1 correctly answered false for the statement saying that EC would be allowed where conventional smoking is prohibited (closed and public places).

The statement saying that the use of EC can help people stop smoking conventional cigarettes was correctly answered as true by 47.9% of the senior, 35.1% of junior, and 36.9% of freshmen students.

The availability of ECs with attractive aroma and flavors was known by 54.8% of the freshmen, 54.2% of the seniors, and 46.8% of the juniors.

The statement saying that the EC would

not generate the so-called second-hand smoking was correctly found false by 66.7% of the senior students, a much higher percentage than that in freshmen (47.5%) and juniors (41.6%). The sentence saying that EC are cheaper than conventional cigarettes (considered to be true based on international data), received fewer correct answers (G1 = 2.4%, G2 = 0%, and G3 = 4.2%).

More senior students also correctly answered as false that the EC do not have carcinogenic substances in its composition, with 66.7% of correct answers, against 51.9% in G2, and 45.2% in G1. Finally, the statement that EC could contain nicotine was correctly answered as true by 79.2% of G3, as well as 60.7% of G1, and 45.5% of G2.

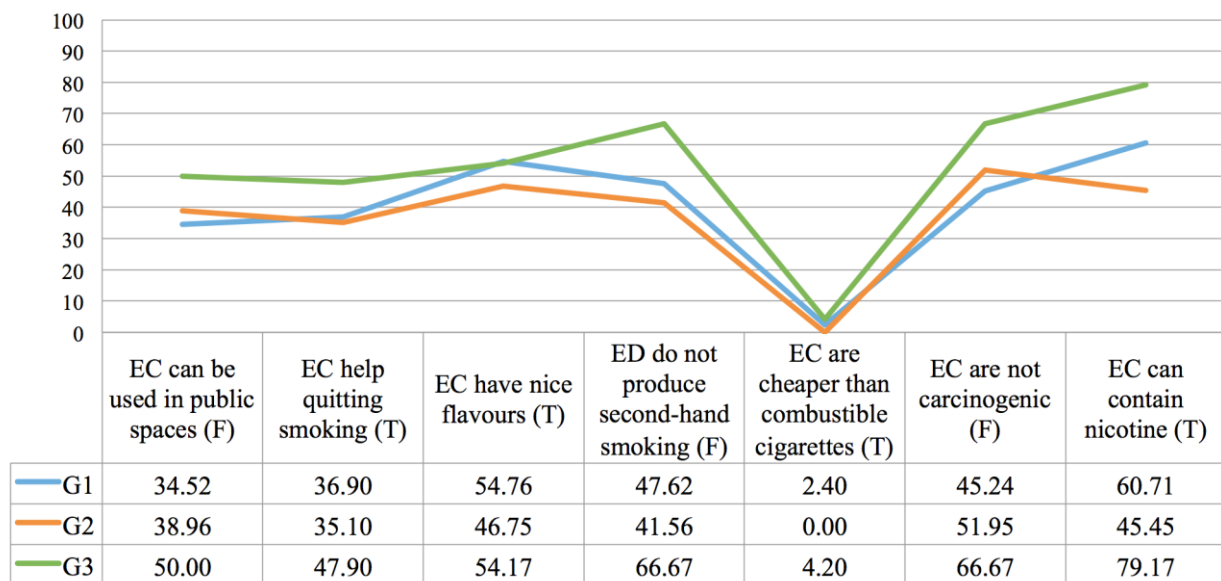


Figure 4. Percentage of correct answers to questions related to knowledge about electronic cigarettes in groups G1, G2, and G3. (F) false statement, (T) true statement

To allow comparison between the level of knowledge between the groups, participants were categorized into A (satisfactory knowledge, with over 60% or a total of 7, 6, and 5 correct answers) and B (poor knowledge, total of 4, 3, 2, 1, and 0 correct answers). Figure 5 shows a comparative

visual analysis of this result, indicating that the majority of students in the three groups were classified as B. The senior students presented the highest percentage of A classification (39.5%). The knowledge curve increased as students college year increased.

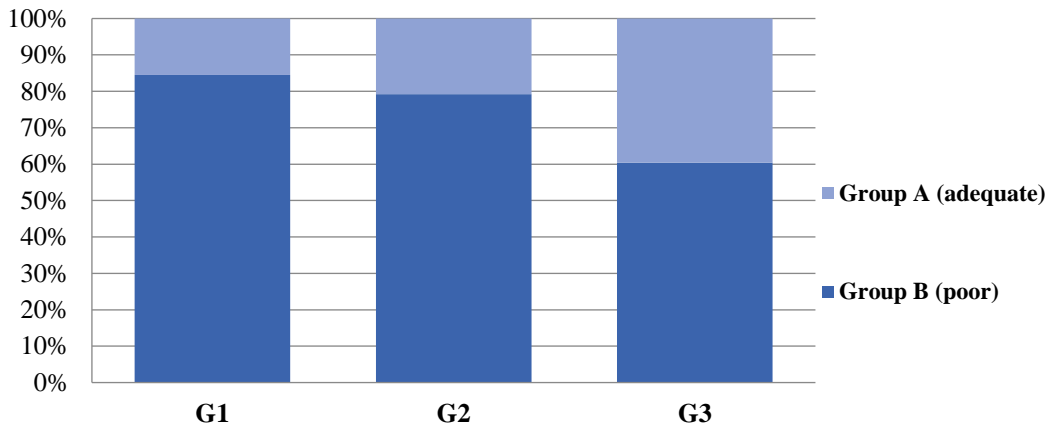


Figure 5. Comparison of the EC level knowledge classification among the groups

By comparing the groups with the chi-square test, no significant difference in knowledge level was found between G1 and G2 ( $p = 0.382$ ). However, a statistical difference was observed between G1 and G3 ( $p = 0.002$ ) and between G2 and G3 ( $p = 0.023$ ), showing that senior students have more knowledge about EC than the other two levels.

An interesting fact about our data should be mentioned. To avoid arbitrary responses, the questionnaire provided the students with the “I do not know” answer option in questions related to EC knowledge. For data analysis, this option was considered as a wrong answer; however, the percentage of participants who admitted not knowing the answers to the questions is shown in figure 6.

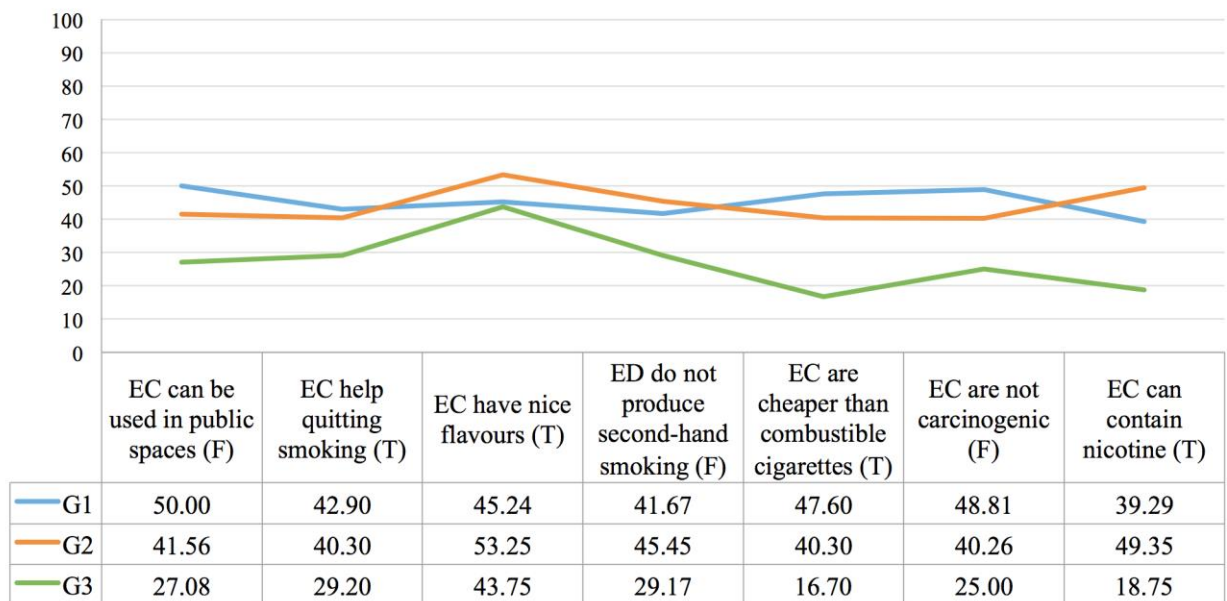
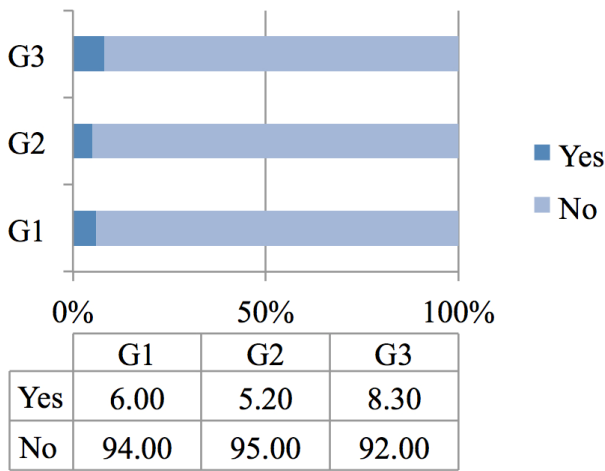


Figure 6. Percentage of students in each group who did not know the answer to questions related to knowledge about electronic cigarettes

The vast majority of participants stated that they had not received information about the impact of the EC on health or discussed the reasons why people use them (figure 7).

However, the vast majority of students (100% of G3) believed that the dentist must have knowledge on the subject, and most of them felt unprepared to inform patients that would ask about the use of EC (figure 8).

**Did you receive information about the health impact of EC?**



**Did you have the chance of discussing in class the reason why people use EC?**

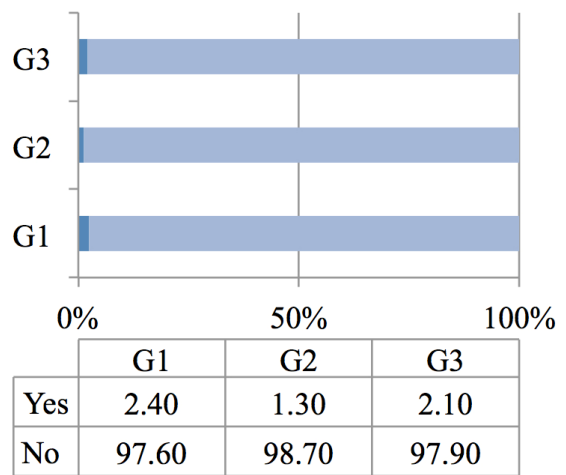
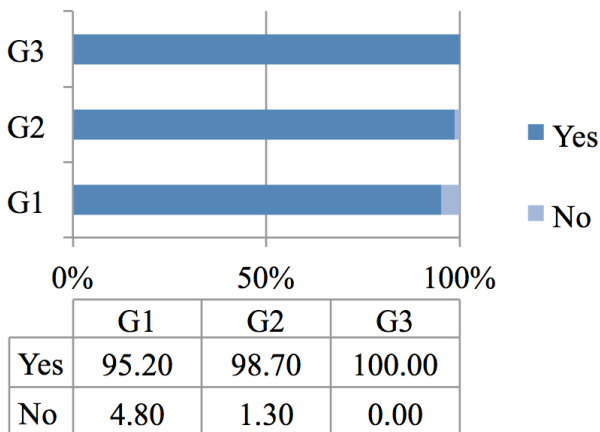


Figure 7. Knowledge on electronic cigarettes received during the Dentistry course

**Do you think the dentist should have knowledge about EC?**



**Do you feel prepared to inform a patient about EC?**

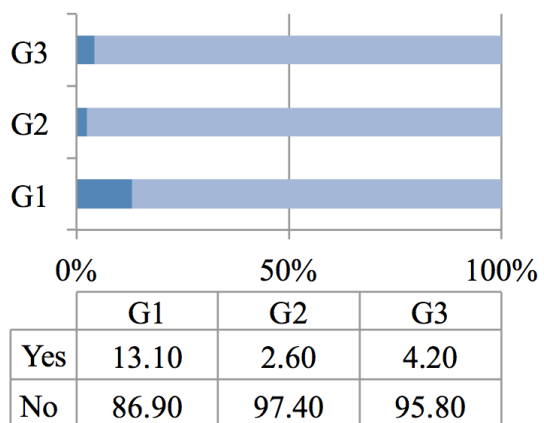


Figure 8. Perception of dental students on the role of the dentist and feeling prepared to inform patients about electronic cigarettes



#### 4 DISCUSSION

Of the 209 respondents, only 11.76% reported being current or former user of ECs, and the majority declared themselves non-smokers (85.3%). G1 had the highest number of smokers (19%) or ex-smokers (8.3%), which may indicate that starting students have more contact with tobacco products than those who entered the course two or four years earlier. It is worth mentioning that 4.8% of G1 respondents chose not to answer the question about smoking status, which may indicate that they are smokers but did not feel comfortable providing such information. On the other hand, the possibility that smoker status was underreported in junior and senior students should also be considered, as it is not socially acceptable for future health professionals to use EC. Interestingly, 95.8% of the senior group, declared themselves non-smokers, but 12.5% reported using or having used EC; this inconsistency may reflect the underreporting of the smoker status or the possibility that EC users do not consider themselves to be smokers, as previously mentioned<sup>12,21</sup>. In all groups there were EC users.

Among non-users, the vast majority said they knew about the device, and half stated that they definitely had no curiosity or intent on trying it, while 23% were curious, and 21% had the intention to try it (probably or definitely). However, 29% reported they would try it if a best friend offered it, decreasing the rate of those would definitely not try it to 38%. These findings suggest that half of the students would likely not use the equipment, but that social pressure or interpersonal trust could make about 12% of respondents change the decision, which has also been reported in the literature<sup>8,22</sup>.

When asked about the health risks of using EC in relation to conventional

cigarettes, most students thought that EC are equally or less harmful than conventional cigarettes. Although experts opinions are conflicting as to the safety of ECs, there is an agreement that EC is a safer option to health when compared to conventional cigarettes,<sup>7,14,23,24</sup> but the long-term effects are not yet known<sup>16,17,24,25</sup>. An editorial in the Journal of the American Dental Association highlighted the urgency for studies to verify the effects of EC in the oral cavity, recommending that dentists inform their patients - especially adolescents - about possible unknown risks, as the use of ECs by high school students has recently increased 9-fold in the USA<sup>25</sup>.

The overall number of correct answers to EC questions was low, with the vast majority of students having insufficient knowledge, which corroborates the self-perception analysis. The senior students had the greatest percentage of satisfactory knowledge level, but even in this group only 39.5% were rated as level A. Although the knowledge curve increased from beginner to senior level, overall knowledge was considered to be very low.

Most students not knowing that ECs cannot be used in closed or public places may indicate that they are using ECs (or observing its use) in these places, or that they are unaware that ECs are prohibited in Brazil<sup>15</sup>.

Similarly, the results showed that more than half of students in all groups are unaware that ECs can help people quit smoking. However, it should be made clear that smoking cessation in the studies is considered as the decrease or interruption of conventional (combustible) cigarettes use, which is often simply replaced by the EC<sup>2,4,6,7</sup>. Because the EC does not involve the burning of tobacco, it has been considered safer than conventional

cigarettes<sup>21,26</sup>. For many authors, the EC is comparable to other nicotine replacement methods (such as patches or chewing gums), with the advantage of simulating the sensory and motor sensations of smoking<sup>5,14</sup>. It is noteworthy, however, that conventional cigarettes cessation rates are not high, varying from 7.3 to 26% and are not maintained in the long term<sup>2,4-7</sup>.

Almost half of the respondents were unaware of the presence of attractive taste in ECs. On the one hand, this can confirm that these participants did not have contact with ECs but on the other hand, it indicates that the chances are low of these students adding questions about this in patient anamnesis. Concerning health care provided to adolescents and young people, it is important that dentists are prepared for such an approach, since the addition of tastes and smells seems to be a great factor of attraction for this age group to start smoking EC<sup>8,9,11,13</sup>.

Potentially harmful substances can be found in the EC vapor<sup>13,27</sup>, causing involuntary exposure by non-users. When asked about secondhand smoking from ECs, the majority of G3 students (66.7%) knew about the risk. In G1 and G2, the rate of correct answers was lower (47.6% and 41.6%, respectively). This may indicate that students are receiving information about secondhand smoking during the course; however, the result is still quite poor, since the number of senior students who did not know the answer to this question was greater than 30%.

The question about the cost of EC compared to conventional cigarettes was the one with the least number of correct answers. The cost related to EC was based on publications in the USA and Europe, which show that the annual cost of the EC is very low, although the initial cost may be higher

due to the purchase of equipment<sup>22,28</sup>. As the sale of EC is prohibited in Brazil, we did not use data from the internal market (although the equipment can be found in specialized stores). As there is no control over the sale, it is also possible that costs in Brazil are higher than in the external market. Thus, this result should be considered with caution, although the cost is an important factor when choosing a device, either to be used recreationally or as a nicotine replacement method.

With regard to the presence of carcinogenic substances in the EC, the G3 had again the highest correct answer rate (66.7%), followed by G2 (51.9%) and G1 (45.2%). Studies show that the liquid heated in the EC is composed of several substances, of which some are inert for humans in room temperature, but form potentially carcinogenic by-products when heated<sup>13,14</sup>.

Senior students correctly answered true for presence of nicotine in the electronic device (79%), followed by freshmen (60.7%) and junior (45.5%) students; the greater number of correct answers by freshmen than junior students may be related to this group having more students who use or had used ECs. The composition of the EC liquid can vary, and studies indicate that nicotine may or may not be present; when present, concentrations also vary<sup>3,13,26</sup>. Another concern is that the information on the EC liquid label may not be accurate or consistent about the nicotine content; there are reports of packaging labeled "nicotine-free", but that had nicotine detected by chemical analysis<sup>29</sup>.

Finally, the fact that a very small percentage of students had received information about the effects of EC or had the opportunity to understand the reasons why people use this equipment is a cause for concern, considering the increasing use of the

device in the world and, potentially, in Brazil, especially among young people. On the other hand, students seem to be open to learning about the subject, understanding that such content should be part of the dentist training program. Considering the results found, it is understandable that students feel unprepared to inform their patients; interestingly, although the level of knowledge was higher in senior students, this group felt less prepared for patient counseling.

Two previous studies evaluated the knowledge and attitudes of dental students towards ECs, with data from Spain and the United States<sup>30</sup> and Saudi Arabia<sup>31</sup>. Despite the difficulty in comparing the results because of the different methodologies, both studies found a similar gap in students' knowledge about the topic and perception about not feeling prepared to provide reliable information to patients.

To the best of the authors' knowledge, this is the first study that evaluated knowledge about EC among dentistry students in Brazil. A limitation to be considered is the possibility that a portion of the students did not feel comfortable sharing habits and beliefs, given it is a sensitive topic in the health field. Although the sample was representative of the dental course population, it can be considered small. Future studies should recruit a greater number of students from different educational institutions for a representative sample of the national dental student population.

From the results of this study, it is recommended that the Structuring Professoriate Groups reflect on the pertinence of including activities that allow students to develop skills for approaching and informing smoking patients, taking into account the novel methods of absorbing nicotine. Considering the potential increase in the use

of ECs by adolescents and young adults in Brazil, the anamnesis should contain questions that allow identifying EC users so that information regarding the potential health risks of this habit can be provided.

## 5 CONCLUSIONS

The findings of this study provide an important warning about the need to train dental students to develop skills for approaching and informing patients that are smokers, considering the new methods of nicotine use. Although the students reported knowing about ECs and an upward knowledge curve was observed with course progression, the level of knowledge was considered poor. Despite thinking that such knowledge should be part of dentistry training, the vast majority of students reported not having received information about EC during the course and not feeling prepared to answer questions from patients about the use of these devices.

## RESUMO

### **Nível de conhecimento de estudantes do curso de graduação em Odontologia sobre cigarros eletrônicos**

O cigarro eletrônico vem despontando como uma opção ao cigarro convencional, sendo considerado por alguns como uma alternativa para quem deseja parar de fumar tabaco. Muitos jovens também têm usado o dispositivo em busca de novas experiências, sensações e diversão. O objetivo desse estudo foi avaliar o nível de conhecimento dos alunos do Curso de Graduação em Odontologia da Universidade Federal de Santa Catarina (Florianópolis, Brasil) sobre os cigarros eletrônicos, com base em um questionário. Também foram coletadas informações sobre o interesse para experimentar o dispositivo, a abordagem do assunto durante o curso de graduação e a autopercepção sobre o preparo para orientar pacientes sobre este assunto. O questionário foi

aplicado em abril e maio de 2019 a 209 estudantes maiores de 18 anos, que foram divididos em 3 grupos: ingressantes (1ª e 2ª fases do curso), intermediários (4ª e 5ª fases) e concluintes (9ª e 10ª fases). A análise descritiva foi realizada em todas as questões, e na estatística analítica assumiu-se o nível de significância de 95%. A análise dos resultados demonstrou que estudantes concluintes possuem mais conhecimento sobre o cigarro eletrônico que ingressantes ou intermediários. No entanto, o nível de conhecimento foi considerado insatisfatório, pois mesmo entre os concluintes apenas cerca de 40% alcançaram o conceito considerado satisfatório (e que corresponderia a pelo menos 60% de acertos). A maioria dos estudantes relatou não ter tido contato com o tema durante o Curso de Graduação. Da mesma forma, a maioria dos concluintes declarou não se sentir preparada para orientar pacientes sobre cigarros eletrônicos. Os resultados deste estudo apontam para a necessidade de o currículo contemplar este conteúdo na formação dos futuros cirurgiões-dentistas, para capacitá-los a orientar seus pacientes sobre riscos e benefícios da utilização dos cigarros eletrônicos.

**Descritores:** Sistemas Eletrônicos de Liberação de Nicotina. Conhecimento, Educação em Odontologia.

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