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Article

# Knowledge and Perceptions of Dentists Regarding E-Cigarettes: Implications for Oral Health and Public Awareness

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**Abstract:** *Background and Objectives:* The growing prevalence of e-cigarette use presents new challenges for oral health care. This study aimed to evaluate dentists' knowledge and perceptions regarding e-cigarettes, focusing on their health effects, regulatory status, and potential risks to oral health. *Materials and Methods:* A cross-sectional survey was conducted among 189 dentists in Kosovo, comprising both general dentists and specialists. The questionnaire assessed participants' awareness of e-cigarettes' FDA approval status, their perceptions of health impacts, and their understanding of e-cigarettes' association with oral conditions such as caries, periodontal disease, and oral cancer. Data were analyzed using SPSS 22, with significance set at  $P < 0.05$ . *Results:* The findings revealed significant knowledge gaps, with 74.1% of respondents uncertain about the FDA approval status of e-cigarettes and 82.0% recognizing their harmful effects on general and oral health. Nearly half (49.7%) of the participants identified e-cigarettes as a potential risk factor for caries, while 66.1% and 64.6% associated their use with oral cancer and periodontal disease, respectively. Gender and professional specialization did not significantly influence these perceptions. *Conclusions:* Dentists need better education on the risks of e-cigarette use, including their harmful effects on oral health. Incorporating this knowledge into dental curricula and professional training is essential to give dentists the information needed to advise patients effectively. Raising public awareness through dental health professionals can help mitigate the oral health risks associated with e-cigarettes.

**Keywords:** dentists' knowledge; e-cigarettes; vaping; oral health; nicotine; periodontal disease; dental education; public health; smoking cessation; oral microbiome

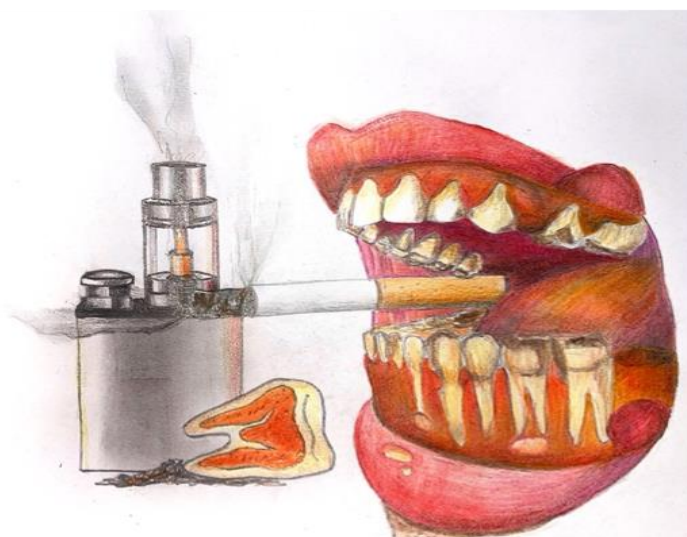
## 1. Introduction

Electronic cigarettes (e-cigarettes) were first invented in 1965 and introduced in North America in 2007. Since then, the market has grown including over 400 brands and more than 7,000 e-liquid flavors, some targeting younger users [1,2].

Initially branded as a healthier alternative to traditional tobacco products, e-cigarettes have become increasingly popular. These devices, also known as vaping devices or vape pens, deliver

nicotine to users in the form of aerosol vapor. When the liquid inside is heated, it turns into vapor, which can be inhaled, mimicking the sensation of smoking regular tobacco cigarettes but without the burning of tobacco [3,4]. E-cigarettes have gained significant traction among young people, drawn to the novelty, sensations, and recreational appeal they offer [5,6].

The World Health Organization (WHO) Study Group on Tobacco Product Regulation has recommended that e-cigarettes include proper labeling and health warnings due to concerns about their potential impact on health [7]. While e-cigarettes are a relatively new product, their long-term health effects are not yet fully understood, raising significant concerns about their safety and possible risks. Dentists are increasingly aware of the potential oral health problems linked to e-cigarette use. Similar to traditional smoking, e-cigarettes can contribute to periodontal issues because nicotine reduces blood flow to the gums [8]. This can lead to various oral health problems, including tooth decay (caries), gum disease (gingivitis and periodontal inflammation), tooth staining, premature tooth loss, dry mouth (xerostomia), oral tumors and softening of tooth enamel (Figure 1). These findings emphasize the potential short-term risks of e-cigarette use on oral health and highlight the need for greater awareness among healthcare professionals and the public [8–11].



**Figure 1.** The image depicts the effects of smoking and tobacco heating systems on oral health. It highlights potential issues such as tooth decay, gum disease, staining, enamel damage, dry mouth, and risk of oral tumors. Illustration by Nensi Kalfani.

As the popularity of e-cigarettes continues to grow, many users are still unaware of the potential health risks associated with their use. Therefore, health professionals need to stay informed about the latest research on e-cigarettes. This includes understanding their components, the ingredients in refill liquids, and the health risks associated with their use [12,13].

Dentists play a crucial role in raising awareness about e-cigarettes to promote better oral health. Training for healthcare professionals should ideally include a comprehensive understanding of e-cigarettes and their components, the chemical composition of e-liquids, associated health risks, and their effectiveness as a smoking cessation tool. With this knowledge, dentists and other providers can offer informed guidance, address patient concerns, and contribute to health promotion and disease prevention [14,15].

This study aimed to evaluate dentists' level of knowledge regarding the use of e-cigarettes and their effects on oral health. The objectives were to assess the importance of this knowledge for dental practice and to examine dentists' self-perception of their preparedness to guide patients about e-cigarette use. The study highlights the need for continuing education, recommending that dental professionals participate in workshops and seminars focused on tobacco cessation and the impacts of vaping on both oral and general health.

## 2. Materials and Methods

### 2.1. Study Design and Participants

This study collected data from 189 dentists licensed by the Kosovo Dental Chamber. Participants included both general dentists and specialists working in public and private healthcare institutions across Kosovo. The study was conducted between July and August 2024.

### 2.2. Ethical Considerations

The study objectives were explained to all participants, and informed consent was obtained. Participation was voluntary, and respondents were instructed to complete the survey only once. No personal identifiers were collected to ensure anonymity. Ethical approval for this study was granted by the Research Ethics Committee of the Dental Chamber of Kosovo under approval number No: 48-1-30.05.2024.

### 2.3. Survey Instrument

A structured questionnaire was used to gather data. The questionnaire consisted of four sections:

#### 2.3.1. Participant Demographics

The first section collected basic demographic and professional information, such as participants' gender, professional background, and level of education. This data was used to categorize respondents and analyze findings based on these factors.

#### 2.3.2. Knowledge of E-Cigarette Usage

The second section assessed participants' knowledge of e-cigarette usage. Key aspects included:

- Identifying the percentage of dentists who use e-cigarettes or tobacco.
- Determining the frequency and duration of e-cigarette use among dentists.
- Comparing usage patterns based on gender, specialization, and years of practice.

#### 2.3.3. Knowledge of the Health Effects of E-Cigarettes

The third section evaluated participants' understanding of the general health implications of e-cigarette use. Key points included:

- Assessing knowledge of the overall health risks and benefits associated with e-cigarettes.
- Evaluating awareness of regulatory approval, such as FDA certification, and perceptions of their safety.

This section contained 10 statements with three response options: "YES", "NO", and "DO NOT KNOW".

#### 2.3.4. Knowledge of Oral Health Impacts of E-Cigarettes

The fourth section focused on participants' knowledge of how e-cigarettes impact oral health. Key points included:

- Understanding the association between e-cigarettes and oral health issues, such as caries, periodontal disease, xerostomia, and mucosal lesions.
- Assessing the impact of e-cigarettes on the oral microbiome and related disorders.
- Comparing the long-term effects of e-cigarettes on oral health to those of traditional tobacco products.

This section included eight statements based on existing literature [16–19], with response options of "YES", "NO", and "DO NOT KNOW".

### 2.4. Data Analysis

The data collected from the questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS) version 22.0. Fisher's exact test or Chi-square ( $X^2$ ) test was used depending on the nature of the data. Results were considered statistically significant if the p-value was less than 0.05.

### 3. Results

#### 3.1. General Characteristics of Participants

The study included a total of 189 dentists, comprising 103 general dentists (54.5%) and 86 specialists (45.5%). Among the participants, 108 (57.1%) were female, and 81 (42.9%) were male. These general characteristics are summarized in Table 1.

**Table 1.** General Characteristics of the Participants.

Parameters	N	%
<b>Total</b>	<b>189</b>	<b>100.0</b>
<b>Gender</b>		
F	108	57.1
M	81	42.9
<b>Education</b>		
Dentist	103	54.5
Specialist	86	45.5

#### 3.2. Use of E-Cigarettes by Gender

The use of e-cigarettes and tobacco was analyzed by gender, as shown in Table 2. Among the 189 participants, 46.0% reported using either e-cigarettes or tobacco, with a significantly higher prevalence among males (59.3%) compared to females (36.1%) ( $P=0.003$ ). Additionally, 43.9% of participants reported that a family member used e-cigarettes, with no significant difference between genders ( $P=0.783$ ).

Exclusive e-cigarette use was reported by 9.5% of participants (10.2% females vs. 8.6% males), while males were more likely to use only tobacco (33.3% vs. 14.8% in females;  $P=0.026$ ). Among e-cigarette users, 14.3% reported using them for more than two years.

**Table 2.** Use of E-Cigarettes by Gender.

	Female		Male		Total		P-value
	N	%	N	%	N	%	
<b>Total</b>	<b>108</b>	<b>100.0</b>	<b>81</b>	<b>100.0</b>	<b>189</b>	<b>100.0</b>	
<b>Have you ever used e-cigarettes or tobacco?</b>							
Yes	39	36.1	48	59.3	87	46.0	P=0.003
No	69	63.9	33	40.7	102	54.0	
<b>Does any member of your family use e-cigarettes?</b>							
Yes	46	42.6	37	45.7	83	43.9	P=0.783
No	62	57.4	44	54.3	106	56.1	
<b>Do you use tobacco or e-cigarettes?</b>							
E-cigarettes	11	10.2	7	8.6	18	9.5	P=0.026
Not anyone	74	68.5	44	54.3	118	62.4	
Both	7	6.5	3	3.7	10	5.3	

Only tobacco	16	14.8	27	33.3	43	22.8	
<b>How long have you been using e-cigarettes?</b>							
Did not use it	84	77.8	60	74.1	144	76.2	P=0.814
1-2 months ago	3	2.8	-	-	3	1.6	
1 - 2 years	7	6.5	8	9.9	15	7.9	
> 2 years	14	13.0	13	16.0	27	14.3	
<b>Approximately, how much do you consume e-cigarettes during the day?</b>							
< 20 times a day	4	3.7	6	7.4	10	5.3	P=0.267
≥ 20 times a day	2	1.9	4	4.9	6	3.2	
Did not use it	88	81.5	65	80.2	153	81.0	
A few times a day	14	13.0	6	7.4	20	10.6	

### 3.3. Use of E-Cigarettes by Professional Training

The study analyzed e-cigarette and tobacco use according to professional training, comparing general dentists and specialists. As shown in Table 3, 45.6% of general dentists and 46.5% of specialists reported having used either e-cigarettes or tobacco, with no statistically significant difference (P=0.904).

Among general dentists, 78.6% reported never using e-cigarettes, compared to 73.3% of specialists. A slightly higher proportion of specialists (17.4%) reported using e-cigarettes for more than two years compared to general dentists (11.7%), though this difference was not statistically significant (P=0.690).

**Table 3.** Use of e-cigarettes according to education/professional training.

	Dentist		Specialist		P-value
	N	%	N	%	
<b>Total</b>	<b>103</b>	<b>100.0</b>	<b>86</b>	<b>100.0</b>	
<b>Gender</b>					
F	53	51.5	55	64.0	P=0.114
M	50	48.5	31	36.0	
<b>Have you ever used e-cigarettes or tobacco?</b>					
Yes	47	45.6	40	46.5	P=0.904
No	56	54.4	46	53.5	
<b>Does any members of your family use e-cigarettes?</b>					
Yes	47	45.6	36	41.9	P=0.709
No	56	54.4	50	58.1	
<b>Do you use tobacco or e-cigarettes?</b>					
E- cigarettes	8	7.8	10	11.6	P=0.629
Not anyone	64	62.1	54	62.8	
Both	7	6.8	3	3.5	
Only tobacco	24	23.3	19	22.1	
<b>How long have you been using e-cigarettes?</b>					
Did not use it	81	78.6	63	73.3	P=0.690
1-2 months ago	2	1.9	1	1.2	
1 - 2 years	8	7.8	7	8.1	

> 2 years	12	11.7	15	17.4	
<b>Approximately, how many e-cigarettes do you consume during the day?</b>					
Did not use it	84	81.6	69	80.2	P=0.217
A few a day	11	10.7	9	10.5	
< 20 times a day	3	2.9	7	8.1	
≥ 20 times a day	5	4.9	1	1.2	

### 3.4. Knowledge and Perceptions of E-Cigarette Safety, Health Effects, and Usage Implications

The study assessed participants' knowledge and perceptions regarding the safety, health effects, and implications of e-cigarette use, as summarized in Table 4. A majority of participants (74.1%) were unsure whether e-cigarettes are FDA-approved for safe consumption, with only 3.7% affirming that they are approved. A significantly higher percentage of males (7.4%) compared to females (0.9%) believed in FDA approval ( $P=0.047$ ). Regarding the perception of harm, 82.0% of participants agreed that e-cigarettes are harmful to general and oral health, while only 1.6% believed otherwise and 16.4% remained uncertain. No significant gender differences were observed ( $P=0.373$ ).

Opinions were divided on whether e-cigarettes do not affect passive smoking, with 22.2% of participants agreeing, 22.8% disagreeing, and 55.0% being unsure. Similarly, when comparing e-cigarettes to traditional tobacco products, 19.6% believed that e-cigarettes are less harmful, 37.6% disagreed, and 42.9% expressed uncertainty. In both cases, no significant gender differences were identified ( $P=0.485$  and  $P=0.253$ , respectively).

When asked if e-cigarettes help relieve daily stress, 17.5% of participants agreed, 32.8% disagreed, and 49.7% were uncertain, with no significant differences between genders ( $P=0.944$ ). Nearly half of the participants (48.7%) agreed that e-cigarettes create addiction, 10.6% disagreed, and 40.7% were unsure, with no significant gender differences observed ( $P=0.487$ ). In terms of carcinogenic effects, 16.4% of participants believed that e-cigarettes are less carcinogenic than tobacco cigarettes, 32.8% disagreed, and 50.8% were unsure, with no significant gender differences ( $P=0.398$ ).

The perspectives on whether e-cigarettes aid in smoking cessation varied, with 22.2% of participants agreeing, 42.9% disagreeing, and 34.9% expressing uncertainty, with no significant gender differences observed ( $P=0.197$ ). Finally, regarding knowledge of the composition of e-cigarettes, 31.7% of participants reported being aware of the composition, 30.2% were not, and 38.1% were unsure, with no significant gender differences observed ( $P=0.737$ ).

**Table 4.** Knowledge and perceptions of e-cigarette safety, health effects, and usage implications.

	Female		Male		Total		P-value
	N	%	N	%	N	%	
<b>Total</b>	<b>108</b>	<b>100.0</b>	<b>81</b>	<b>100.0</b>	<b>189</b>	<b>100.0</b>	
<b>Are e-cigarettes FDA-approved as safe for consumption?</b>							
Yes	1	0.9	6	7.4	7	3.7	P=0.047
No	27	25.0	15	18.5	42	22.2	
I don't know	80	74.1	60	74.1	140	74.1	
<b>Are e-cigarettes harmful to general and oral health?</b>							
Yes	92	85.2	63	77.8	155	82.0	P=0.373
No	1	0.9	2	2.5	3	1.6	
I don't know	15	13.9	16	19.8	31	16.4	
<b>Does the use of e-cigarettes have no effect on passive smoking?</b>							
Yes	23	21.3	19	23.5	42	22.2	P=0.485
No	28	25.9	15	18.5	43	22.8	

I don't know	57	52.8	47	58.0	104	55.0	
<b>Are e-cigarettes less harmful than tobacco cigarettes?</b>							
Yes	19	17.6	18	22.2	37	19.6	
No	46	42.6	25	30.9	71	37.6	P=0.253
I don't know	43	39.8	38	46.9	81	42.9	
<b>Do E-cigarettes help to relieve daily stress?</b>							
Yes	18	16.7	15	18.5	33	17.5	
No	36	33.3	26	32.1	62	32.8	P=0.944
I don't know	54	50.0	40	49.4	94	49.7	
<b>Although there are not many long-term studies on the effects of e-cigarettes, they have fewer side effects on patients than tobacco cigarettes?</b>							
Yes	21	19.4	21	25.9	42	22.2	
No	32	29.6	17	21.0	49	25.9	P=0.325
I don't know	55	50.9	43	53.1	98	51.9	
<b>E-cigarettes create addiction?</b>							
Yes	56	51.9	36	44.4	92	48.7	
No	12	11.1	8	9.9	20	10.6	P=0.487
I don't know	40	37.0	37	45.7	77	40.7	
<b>Are e-cigarettes less carcinogenic than tobacco cigarettes?</b>							
Yes	15	13.9	16	19.8	31	16.4	
No	39	36.1	23	28.4	62	32.8	P=0.398
I don't know	54	50.0	42	51.9	96	50.8	
<b>Do you believe that e-cigarettes help to stop or reduce smoking?</b>							
Yes	19	17.6	23	28.4	42	22.2	
No	48	44.4	33	40.7	81	42.9	P=0.197
I don't know	41	38.0	25	30.9	66	34.9	
<b>Do you know the composition of electronic cigarettes?</b>							
Yes	33	30.6	27	33.3	60	31.7	
No	35	32.4	22	27.2	57	30.2	P=0.737
I don't know	40	37.0	32	39.5	72	38.1	

### 3.5. Knowledge and Perceptions of E-Cigarettes by Professional Training

The study examined the knowledge and perceptions of e-cigarettes among general dentists and specialists, as presented in Table 5. A large majority of both general dentists (77.7%) and specialists (69.8%) were unsure whether e-cigarettes are FDA-approved for safe consumption, while only 2.9% and 4.7%, respectively, affirmed FDA approval. No statistically significant difference was found between the groups ( $P=0.454$ ).

Regarding the harmfulness of e-cigarettes, 81.6% of general dentists and 82.6% of specialists agreed that they are harmful to general and oral health, with no significant difference ( $P=0.702$ ). Similarly, uncertainty was evident in participants' perceptions of e-cigarettes' effects on passive smoking, with 60.2% of general dentists and 48.8% of specialists reporting they did not know, and no significant difference between the groups ( $P=0.078$ ).

When comparing the harm of e-cigarettes to traditional tobacco, 19.4% of general dentists and 19.8% of specialists believed e-cigarettes were less harmful, while a comparable proportion (36.9%

and 38.4%, respectively) disagreed. The majority remained uncertain, with no significant difference observed ( $P=0.967$ ).

About stress relief, 13.6% of general dentists and 22.1% of specialists agreed that e-cigarettes help relieve daily stress, while the majority were unsure ( $P=0.228$ ). Regarding the addictive potential of e-cigarettes, 53.4% of general dentists and 43.0% of specialists agreed they are addictive, while 12.6% and 8.1%, respectively, disagreed ( $P=0.107$ ).

In terms of carcinogenicity, 16.5% of general dentists and 16.3% of specialists believed e-cigarettes were less carcinogenic than traditional tobacco, while 29.1% and 37.2%, respectively, disagreed. Most participants remained uncertain, with no significant differences ( $P=0.471$ ).

When asked whether e-cigarettes help with smoking cessation, 27.2% of general dentists and 16.3% of specialists agreed, while 42.7% and 43.0%, respectively, disagreed, with the remainder being unsure ( $P=0.134$ ). Knowledge of the composition of e-cigarettes was slightly higher among specialists (36.0%) than general dentists (28.2%), though the difference was not significant ( $P=0.458$ ).

Overall, the findings reveal similar levels of knowledge and perceptions between general dentists and specialists, with significant uncertainty across both groups about e-cigarettes' safety, health effects, and their role in smoking cessation.

**Table 5.** Level of knowledge of dentists about cigarettes according to professional education/training. .

	Dentist		Specialist		P-value
	N	%	N	%	
<b>Total</b>	<b>103</b>	<b>100.0</b>	<b>86</b>	<b>100.0</b>	
<b>Are e-cigarettes FDA-approved as safe for consumption?</b>					
Yes	3	2.9	4	4.7	P=0.454
No	20	19.4	22	25.6	
I don't know	80	77.7	60	69.8	
<b>Are e-cigarettes harmful to general and oral health?</b>					
Yes	84	81.6	71	82.6	P=0.702
No	1	1.0	2	2.3	
I don't know	18	17.5	13	15.1	
<b>Does the use of e-cigarettes have no effect on passive smoking?</b>					
Yes	24	23.3	18	20.9	P=0.078
No	17	16.5	26	30.2	
I don't know	62	60.2	42	48.8	
<b>Are e-cigarettes less harmful than tobacco cigarettes?</b>					
Yes	20	19.4	17	19.8	P=0.967
No	38	36.9	33	38.4	
I don't know	45	43.7	36	41.9	
<b>Do E-cigarettes help to relieve daily stress?</b>					
Yes	14	13.6	19	22.1	P=0.228
No	33	32.0	29	33.7	
I don't know	56	54.4	38	44.2	
<b>Although there are not many long-term studies on the effects of e-cigarettes, they have fewer side effects on patients than tobacco cigarettes?</b>					
Yes	24	23.3	18	20.9	P=0.078
No	20	19.4	29	33.7	
I don't know	59	57.3	39	45.3	

<b>E-cigarettes create addiction?</b>					
Yes	55	53.4	37	43.0	
No	13	12.6	7	8.1	P=0.107
I don't know	35	34.0	42	48.8	
<b>Are e-cigarettes less carcinogenic than tobacco cigarettes?</b>					
Yes	17	16.5	14	16.3	
No	30	29.1	32	37.2	P=0.471
I don't know	56	54.4	40	46.5	
<b>Do you believe that e-cigarettes help to stop or reduce smoking?</b>					
Yes	28	27.2	14	16.3	
No	44	42.7	37	43.0	P=0.134
I don't know	31	30.1	35	40.7	
<b>Do you know the composition of electronic cigarettes?</b>					
Yes	29	28.2	31	36.0	
No	34	33.0	23	26.7	P=0.458
I don't know	40	38.8	32	37.2	

### 3.6. Perceptions of the Oral Health Effects of E-Cigarettes by Gender

The study examined participants' perceptions of how e-cigarettes affect oral health, with results presented in Table 6. Regarding the impact of e-cigarettes on caries incidence, 49.7% of participants agreed that e-cigarettes increase the risk of caries, with slightly more females (50.9%) than males (48.1%) affirming this. However, 11.1% believed there was no effect, and 39.2% were uncertain, with no significant gender difference ( $P=0.166$ ).

When asked whether e-cigarettes affect the oral cavity, 75.1% of participants agreed, with nearly identical responses from females (75.0%) and males (75.3%). A small percentage (2.6%) believed there was no effect, while 22.2% were unsure ( $P=0.991$ ). Similar responses were observed for xerostomia, mouth burning, and halitosis, with 70.4% agreeing that e-cigarettes had an impact, 1.6% disagreeing, and 28.0% being unsure ( $P=0.629$ ).

In terms of cancer risk, 66.1% of participants believed that e-cigarettes increase the risk of oral cancer through cytotoxic, genotoxic, and oncogenic effects. Only 0.5% disagreed, and 33.3% were unsure, with no significant gender difference ( $P=0.773$ ). Regarding the prevalence of periodontal lesions, 64.6% of participants agreed that e-cigarettes have an impact, 7.9% disagreed, and 27.5% were unsure, again with no significant gender difference ( $P=0.403$ ).

For other oral conditions such as lingua nigra villosa, nicotinic stomatitis, and tongue discolorations, 61.4% of participants agreed that e-cigarettes could cause these effects, 3.2% disagreed, and 35.4% were uncertain ( $P=0.812$ ). When asked about the impact on teeth, including discoloration, fractures, pain, and increased cariogenic bacteria, 64.0% of participants agreed, 6.9% disagreed, and 29.1% were uncertain ( $P=0.720$ ).

Lastly, perceptions of e-cigarettes' impact on the oral microbiome showed that 65.1% agreed, 4.2% disagreed, and 30.7% were uncertain ( $P=0.793$ ). Across all these areas, no significant gender differences were identified.

**Table 6.** Level of knowledge about the impact of e-cigarettes on oral health by gender.

	Female		Male		Total		P-value
	N	%	N	%	N	%	
<b>Total</b>	<b>108</b>	<b>100.0</b>	<b>81</b>	<b>100.0</b>	<b>189</b>	<b>100.0</b>	
<b>Do e-cigarettes affect the increase in the incidence of caries?</b>							

Yes	55	50.9	39	48.1	94	49.7	
No	8	7.4	13	16.0	21	11.1	P=0.166
I don't know	45	41.7	29	35.8	74	39.2	
<b>Does the use of e-cigarettes affect the oral cavity?</b>							
Yes	81	75.0	61	75.3	142	75.1	
No	3	2.8	2	2.5	5	2.6	P=0.991
I don't know	24	22.2	18	22.2	42	22.2	
<b>Do e-cigarettes affect Xerostomia, mouth burning, Halitosis?</b>							
Yes	74	68.5	59	72.8	133	70.4	
No	3	2.8	-	-	3	1.6	P=0.629
I don't know	31	28.7	22	27.2	53	28.0	
<b>Do e-cigarettes increase the risk of oral cancer (cytotoxic, genotoxic, oncogenic effect)?</b>							
Yes	70	64.8	55	67.9	125	66.1	
No	1	0.9	-	-	1	0.5	P=0.773
I don't know	37	34.3	26	32.1	63	33.3	
<b>Do e-cigarettes affect the prevalence of periodontal lesions?</b>							
Yes	72	66.7	50	61.7	122	64.6	
No	10	9.3	5	6.2	15	7.9	P=0.403
I don't know	26	24.1	26	32.1	52	27.5	
<b>Do e-cigarettes affect lingua nigra villosa, nicotinic stomatitis, and other tongue discolorations?</b>							
Yes	65	60.2	51	63.0	116	61.4	
No	6	5.6	-	-	6	3.2	P=0.812
I don't know	37	34.3	30	37.0	67	35.4	
<b>Do e-cigarettes affect teeth (tooth discoloration, pain, fractures, and increase in cariogenic bacteria)?</b>							
Yes	71	65.7	50	61.7	121	64.0	
No	8	7.4	5	6.2	13	6.9	P=0.720
I don't know	29	26.9	26	32.1	55	29.1	
<b>Do e-cigarettes affect disorders of the oral microbiome?</b>							
Yes	69	63.9	54	66.7	123	65.1	
No	4	3.7	4	4.9	8	4.2	P=0.793
I don't know	35	32.4	23	28.4	58	30.7	

### 3.7. Perceptions of the Oral Health Effects of E-Cigarettes by Professional Training

The study assessed participants' perceptions of the oral health effects of e-cigarettes based on their professional training as general dentists or specialists, as shown in Table 7. Regarding the effect of e-cigarettes on caries incidence, 54.4% of general dentists and 44.2% of specialists agreed that e-cigarettes increase caries risk, while 10.7% of general dentists and 11.6% of specialists believed there was no effect. The remaining participants were uncertain, with no significant difference observed between the two groups (P=0.361).

When asked if e-cigarettes affect the oral cavity, 76.7% of general dentists and 73.3% of specialists agreed, while a very small proportion (1.0% and 4.7%, respectively) disagreed. Approximately 22% of both groups were uncertain, and no significant difference was found (P=0.290). A similar trend was observed for the effect of e-cigarettes on xerostomia, mouth burning, and halitosis, with 71.8%

of general dentists and 68.6% of specialists agreeing, 3.5% of specialists disagreeing, and the remaining participants unsure ( $P=0.745$ ).

In terms of the potential for e-cigarettes to increase the risk of oral cancer, 68.0% of general dentists and 64.0% of specialists agreed, while only 1.2% of specialists disagreed. A notable proportion of participants were uncertain (32.0% of general dentists and 34.9% of specialists), but no significant difference was observed ( $P=0.670$ ).

Regarding the prevalence of periodontal lesions, 64.1% of general dentists and 65.1% of specialists believed e-cigarettes have an effect, while 9.7% of general dentists and 5.8% of specialists disagreed. Approximately 26%–29% of participants were unsure, with no significant difference between the groups ( $P=0.594$ ). For other conditions such as lingua nigra villosa, nicotinic stomatitis, and tongue discolorations, 65.0% of general dentists and 57.0% of specialists agreed, while a small proportion (1.9% and 4.7%, respectively) disagreed. Uncertainty remained high, with 33.0% of general dentists and 38.4% of specialists expressing doubts ( $P=0.375$ ).

When asked whether e-cigarettes affect teeth (e.g., discoloration, pain, fractures, and increased cariogenic bacteria), 67.0% of general dentists and 60.5% of specialists agreed, while 6.8% and 7.0%, respectively, disagreed, and the remainder were unsure ( $P=0.618$ ). Finally, regarding the impact of e-cigarettes on disorders of the oral microbiome, 69.9% of general dentists and 59.3% of specialists agreed, while 2.9% and 5.8%, respectively, disagreed. A substantial proportion of both groups were uncertain, with no significant difference between them ( $P=0.266$ ).

**Table 7.** Level of knowledge about the impact of e-cigarettes on oral health according to education/professional training.

	Dentist		Specialist		P-value
	N	%	N	%	
<b>Total</b>	<b>103</b>	<b>100.0</b>	<b>86</b>	<b>100.0</b>	
<b>Do e-cigarettes affect the increase in the incidence of caries?</b>					
Yes	56	54.4	38	44.2	P=0.361
No	11	10.7	10	11.6	
I don't know	36	35.0	38	44.2	
<b>Does the use of e-cigarettes affect the oral cavity?</b>					
Yes	79	76.7	63	73.3	P=0.290
No	1	1.0	4	4.7	
I don't know	23	22.3	19	22.1	
<b>Do e-cigarettes affect Xerostomia, mouth burning, Halitosis?</b>					
Yes	74	71.8	59	68.6	P=0.745
No		0.0	3	3.5	
I don't know	29	28.2	24	27.9	
<b>Do e-cigarettes increase the risk of oral cancer (cytotoxic, genotoxic, oncogenic effect)?</b>					
Yes	70	68.0	55	64.0	P=0.670
No		0.0	1	1.2	
I don't know	33	32.0	30	34.9	
<b>Do e-cigarettes affect the prevalence of periodontal lesions?</b>					
Yes	66	64.1	56	65.1	P=0.594
No	10	9.7	5	5.8	
I don't know	27	26.2	25	29.1	
<b>Do e-cigarettes affect lingua nigra villosa, nicotinic stomatitis, and other tongue discolorations?</b>					

Yes	67	65.0	49	57.0	
No	2	1.9	4	4.7	P=0.375
I don't know	34	33.0	33	38.4	
<b>Do e-cigarettes affect teeth (tooth discoloration, pain, fractures, and increase in cariogenic bacteria)?</b>					
Yes	69	67.0	52	60.5	
No	7	6.8	6	7.0	P=0.618
I don't know	27	26.2	28	32.6	
<b>Do e-cigarettes affect disorders of the oral microbiome?</b>					
Yes	72	69.9	51	59.3	
No	3	2.9	5	5.8	P=0.266
I don't know	28	27.2	30	34.9	

#### 4. Discussion

The increasing prevalence of e-cigarette use highlights the need for dental professionals to understand their potential impact on oral health and provide informed guidance to patients [20]. This study explored dentists' knowledge and perceptions of e-cigarettes, focusing on their associated risks, regulatory status, and dentists' ability to communicate this information effectively.

The survey revealed significant trends in e-cigarette and tobacco use among participants, with notable gender differences. Approximately 46.0% of respondents reported using e-cigarettes or tobacco, with a higher prevalence among males (59.3%) compared to females (36.1%). Additionally, 43.9% of participants reported having family members who use e-cigarettes, emphasizing the role of social acceptance and peer influence in normalizing their use [21]. Exclusive e-cigarette use was low (9.5%), with females more likely to use both e-cigarettes and tobacco, while males predominantly used tobacco alone ( $P<0.05$ ). These findings underscore the influence of social and cultural factors on e-cigarette use.

Among e-cigarette users, 14.3% had been using them for more than two years, often multiple times daily. This aligns with findings that e-cigarettes are perceived as addictive, comparable to alcohol, and more so than marijuana [22,23]. The relatively recent adoption of e-cigarettes highlights the importance of monitoring their long-term effects and patterns of use [23].

The study uncovered significant knowledge gaps regarding FDA approval, with 74.1% of respondents uncertain about whether e-cigarettes are FDA-approved for safe consumption. Female dentists (25.0%) were more likely than males (18.5%) to believe e-cigarettes are not FDA-approved ( $P<0.05$ ). Public health strategies should focus on promoting FDA-approved smoking cessation methods, which remain the most reliable option for quitting smoking [24,25]. E-cigarettes, which lack robust evidence supporting their safety and effectiveness, should not be promoted as an alternative to approved treatments. The introduction of FDA regulations in 2016 requiring ingredient labeling has improved consumer awareness, but further oversight is necessary to ensure safety [26].

Health impacts were another significant concern, with 82.0% of respondents acknowledging the harmful effects of e-cigarettes on general and oral health. Female respondents expressed slightly higher concern (85.2%) than males (77.8%), though this difference was not statistically significant. These findings align with research suggesting that e-cigarettes contribute to oral health issues such as xerostomia, halitosis, and increased caries risk. For example, Irusa et al. [27] linked vaping to an increased risk of tooth decay, exacerbated by dry mouth.

Concerns about oral cancer risk and periodontal disease were also prominent, with 66.1% and 64.6% of respondents, respectively, acknowledging potential impacts. Studies by Jeong et al. [28] and Xu et al. [29] support these findings, linking vaping to periodontal damage and adverse effects on oral biofilms. Additionally, Ramenzoni et al. [30] highlighted the cytotoxic and inflammatory effects of vaping on oral tissues, further underscoring the risks.

Uncertainty persists regarding the relative safety of e-cigarettes compared to traditional tobacco. While 19.6% of respondents believed e-cigarettes are less harmful than tobacco, 37.6% disagreed, and 42.9% were unsure. Similarly, only 22.2% of participants considered e-cigarettes effective for smoking cessation, with 42.9% disagreeing and 34.9% uncertain. Results align with prior studies indicating that the long-term safety and efficacy of e-cigarettes remain poorly understood [31,32]. The lack of conclusive evidence warrants a cautious approach, emphasizing the need for further research to fully understand the implications of e-cigarette use [32,33].

The study also revealed low awareness of the composition of e-cigarettes, with 38.1% of respondents unsure about their contents. This lack of knowledge is concerning, as flavored vaping liquids have been shown to negatively impact biofilm formation and bacterial proliferation in the oral microbiome [32]. Over 60% of respondents expressed concern about conditions such as black hairy tongue, tooth discoloration, and oral microbiome disorders, reflecting growing awareness of these risks.

Emerging research highlights the potential of salivary biomarkers, such as microRNAs, in detecting oral health issues associated with tobacco and alternative smoking devices. Another study [34] demonstrated that salivary microRNAs could serve as innovative biomarkers for the early diagnosis of oral diseases, comparing conventional cigarette smokers with users of tobacco heating systems. Their findings revealed significant differences in the expression of salivary microRNAs between the two groups, indicating that alternative smoking devices, such as tobacco heating systems, also pose risks to oral health. These results align with our study's findings, which emphasize the adverse effects of e-cigarette use on oral health, including increased risks of periodontal disease, xerostomia, and disruption of the oral microbiome. Incorporating salivary biomarkers as diagnostic tools in future research could provide valuable insights into the biological impact of e-cigarettes and similar products, enabling earlier detection and intervention for vaping-related oral conditions.

This study has several limitations. The sample size, while sufficient for an exploratory study, may not fully capture the diversity of opinions among dental professionals. Self-reported data may also be subject to recall or social desirability bias, potentially affecting accuracy. Furthermore, the study's geographic focus on Kosovo may limit generalizability to other regions with differing regulatory and cultural contexts. The cross-sectional design precludes assessment of changes in knowledge and perceptions over time.

Future research should include larger, more diverse samples and longitudinal designs to track changes in perceptions and knowledge over time. Additionally, targeted educational interventions should be developed to address gaps in knowledge about FDA approval, health risks, and the role of e-cigarettes in smoking cessation. Collaborative efforts with dental associations and regulatory bodies can support the dissemination of evidence-based information. Expanding research on the long-term effects of e-cigarette use, particularly on oral and general health, is crucial to inform clinical practice and public health policies.

In conclusion, this study highlights significant knowledge gaps and mixed perceptions among dental professionals regarding e-cigarettes. Addressing these gaps through targeted education and evidence-based guidance will enable dental practitioners to play a vital role in mitigating the risks associated with e-cigarette use and promoting better oral health outcomes.

## 5. Conclusions

This study highlights the critical need for increased awareness and education among dental professionals regarding the use of e-cigarettes and their potential impact on oral and general health. While most participants recognized the harmful effects of e-cigarettes, significant gaps in knowledge were evident, particularly concerning FDA approval, the composition of e-cigarettes, and their role in smoking cessation. The findings emphasize the importance of equipping dental professionals with evidence-based knowledge to address patient inquiries and promote informed decision-making.

The study also revealed substantial uncertainty among participants about the long-term safety and efficacy of e-cigarettes compared to traditional tobacco products. Although e-cigarettes are often

perceived as a safer alternative, their effects on oral health, including increased risks of caries, xerostomia, periodontal disease, and potential carcinogenic impacts, warrant cautious consideration.

To bridge these knowledge gaps, targeted educational initiatives, including workshops, seminars, and collaborations with dental associations, are essential. These efforts should focus on providing up-to-date information about e-cigarettes' health risks, regulatory status, and best practices for patient counseling.

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