

Perceptions Related to Use of Electronic Cigarettes among California College Students

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Abstract

Purpose: To assess electronic cigarette (e-cigarette) use, factors associated with use, and exposure to e-cigarette-related information from health professionals in a sample of college students attending a public university in northern California, using a web-based survey.

Methods: In this quantitative cross-sectional study, survey items assessed e-cigarette use, perceived risks and benefits, and exposure to e-cigarette-related information from health professionals and were pilot tested for feasibility and acceptability. Participants were recruited from three courses taught at a northern California public university and were given an electronic link to the survey with informed consent information. Frequency distributions and cross-tabulations were calculated for survey responses. The Mann-Whitney U-test was used to compare differences in perceived risks, benefits, and social consequences between ever-users and never-users.

Results: Ninety-one individuals completed the web-based survey. Among respondents, 89% were aware of e-cigarettes, 49% were ever-users, and 10% were current (past-30 day) e-cigarette users. Compared to e-cigarette ever-users, never-users perceived a higher chance of experiencing 5 out of 8 physical and social risks from e-cigarette use ($P < 0.05$). E-cigarettes, marijuana, and hookah were perceived to be less harmful to health than cigarettes. Few participants reported receiving counseling regarding e-cigarettes from health professionals, including dental hygienists. Counseling about the adverse health effects of cigarettes was more common in this study population.

Conclusion: Dental hygienists must stay current with the scientific evidence related to e-cigarette use and incorporate such information into their client tobacco-related counseling. Addressing the perceived physical and social risks associated with e-cigarette use when counseling college students may deter them from initiating or continuing e-cigarette use.

Keywords: electronic cigarettes, awareness, perceptions, health promotion

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Introduction

Despite declines in cigarette smoking among adolescents and adults in the United States (US), the use of electronic cigarettes (e-cigarettes) is increasing rapidly.^{1, 2} The percentage of adults who have ever used e-cigarettes rose from 3.3% in 2010 to 8.5% in 2013.³ Current e-cigarette use (defined as use in the past 30 days) among high school students increased from 1.5% in 2011 to 16% in 2015.¹

E-cigarettes are battery-operated devices that work by heating and converting a liquid mixture, often called e-liquid, into an aerosol, commonly termed vapor, and delivering nicotine to the user without the combustion of tobacco.⁴ E-cigarettes contain nitrosamines (potent cancer-causing chemicals), diethylene glycol, and other contaminants potentially harmful to humans.⁵ The adverse health effects of e-cigarette use are currently under study.

As a possible alternative product for conventional cigarettes, it has been suggested that e-cigarettes have the potential to reduce harm.⁶ However, it also has been proposed that e-cigarettes could act as a gateway product to cigarette smoking and encourage dual use with other forms of tobacco and/or marijuana.⁷ Moreover, e-cigarettes are heavily marketed and portrayed as a safe alternative to tobacco.⁸ Mixed messages and lack of consensus may lead college students to rely on their own risk and benefit perceptions of e-cigarettes in their decision making about whether or not to use.

Dental hygienists, like other healthcare professionals, play an important role in preventing initiation and encouraging cessation of tobacco use among their patients.⁹⁻¹¹ The current Clinical Guideline for the Treatment of Tobacco Use and Dependence recommends that the 5A's, consisting of the following:

Asking about tobacco use at each appointment, advising users to quit, assessing readiness to quit, providing assistance with the quitting process, and arranging follow up, be implemented at each patient visit.¹² Studies have documented that a physician's brief advice to quit smoking significantly increased long-term smoking abstinence rates by about 10%.¹² Moreover, brief tobacco interventions by non-physician clinicians can result in estimated long-term abstinence rates of 16%.¹³

A 1996 telephone survey of first-year college students, however, revealed that only 26% of those who reported a medical visit within the past 12 months (89% of the total sample) had received any information from their physician about traditional tobacco products.¹⁴ Because e-cigarettes are a relatively new product, they are not explicitly mentioned in the Clinical Guideline for Treatment of Tobacco Use and Dependence.¹² It is unknown whether or not healthcare professionals, including dental hygienists, address e-cigarettes in their delivery of tobacco related counseling to their patients.

Although e-cigarette use has been documented among college students generally, little is known about factors associated with use or exposure to health professional counseling about use among college students.¹⁵ Therefore, the purpose of this study was to assess e-cigarette use; factors associated with use (e.g., perceptions of risks and benefits); and exposure to e-cigarette-related information from health professionals, in a sample of college students attending a public university in the San Francisco bay area using a web-based survey.

Methods

This quantitative cross-sectional study surveyed a sample of English-speaking students aged 18 years or older at a public university in the San Francisco Bay Area. The study was implemented using the online survey software program, Qualtrics™ (Qualtrics, Provo, UT). The Institutional Review Board of the University of California, San Francisco approved the study.

Recruitment and Informed Consent: The researcher contacted two faculty members teaching a total of three courses at the university to explain the study and to solicit help recruiting study participants. They agreed to distribute the recruitment letter explaining the study and to provide an electronic link to the survey and an attached consent form. A follow-up email message was sent to all students two weeks later as a reminder to complete the survey.

Measurements: The 18-item survey, developed in part by study investigators, consisted of 1 e-cigarette related awareness item (yes/no response option); 7 e-cigarette use status items (measured on frequency sliding scales); 2 harmfulness items related to use of e-cigarettes, other tobacco products, and marijuana (measured on a 5-point Likert-scale ranging from

“not at all harmful”, to “extremely harmful” or “don't know”); 1 addiction item related to use of e-cigarettes, other tobacco products, and marijuana (measured on a 5-point Likert-scale ranging from “extremely unlikely I would become addicted” to “extremely likely I would become addicted” or “don't know”); 1 healthcare counseling item assessing which of 5 healthcare professionals (physicians, dentists, dental hygienists, psychologist, student health physician) had provided counseling for each of 6 investigated products (cigarettes, smokeless tobacco, e-cigarettes, hookah, cigars, marijuana); 1 social acceptability item (level of agreement with the statement: “My friends think it's ok (socially acceptable) for me to use [specific product]” measured on a 5 point Likert-scale ranging from “strongly disagree” to “strongly agree” or “don't know”); 1 previously developed conditional risk assessment of e-cigarette use item^{16, 17} (measured on a frequency sliding scale) where participants were asked to estimate the chance (perceived probability) from 0-100% that 15 specific health or social outcomes would happen to them given the hypothetical scenario: “Imagine that you just began using e-cigarettes. You use e-cigarettes 2-3 times/day, some-times... alone and sometimes... with friends;”^{16, 17} and 4 demographic items (age, ethnicity, gender, year in college).

Pre-testing: The survey was pretested for feasibility and acceptability by a convenience sample of 10 college students, aged 18-24 years old who did not take part in the final survey. The pre-test sample was debriefed after survey administration to address their understanding of questionnaire items and questions were revised based on their feedback.

Data analysis: Responses to the survey items were tabulated for each respondent using Microsoft Excel (2010) and the mean response frequency for each item was calculated. Perceived harmfulness, perceived environmental harm to others, and perceived social acceptance, respectively, were cross-tabulated by various tobacco products and marijuana. SPSS software (Version 22.0; IBM Corporation, Armonk, NY, USA) was used to analyze the perceived chance (from 0-100%) of developing physical and social risks and benefits associated with daily use of e-cigarettes among ever-users and never-users. The Mann-Whitney *U*-test was utilized with a level of significance set at ≤ 0.05 . Respondents who did not complete the item related to risks and benefits of e-cigarettes use were removed from this particular analysis.

Results

Of 300 online surveys distributed, 91 were completed (response percentage: 30%). The majority of the participants were 18-21 years of age, female, Caucasian or Asian, and in their second or third year of college (Table I).

Nearly all respondents were aware of e-cigarettes;

Table I. Demographic Characteristics of Sample N=91

	%	(n)
Age n=55		
18-21	60	(33)
22-24	22	(12)
25+	18	(10)
Year in College		
1st Year	7	(4)
2nd Year	31	(17)
3rd Year	29	(16)
4th Year	16	(9)
5th Year	7	(4)
Graduate	9	(5)
Gender		
Male	40	(22)
Female	60	(33)
Race/Ethnicity		
White	35	(9)
American Indian or Alaska Native	2	(1)
Hispanic/Latino	15	(8)
Asian	33	(18)
Black or African American	2	(1)
Native Hawaiian or other Pacific Islander	0	(0)
Middle Eastern	24	(13)
Don't Know	4	(2)

almost half were ever-users (defined as having used at least once in their life) and 10% were current users (defined as having used in the past-30 days). All e-cigarette never-users reported it was unlikely that they would try e-cigarettes in the next 6 months. The remaining 6% did not answer the question. Ever-users' most frequently stated reasons for using e-cigarettes were, "I enjoy sampling different e-juice flavors with friends" and "I enjoy watching the exhaled vapor" (Table II).

Of the ever-users who responded, almost half reported using hookah pens. Most ever-users either used 0-6mg/ml of nicotine in their e-liquid, or did not know the concentration of nicotine used. The most common e-liquid flavors preferred by ever-users were fruit, mint/wintergreen, and candy (Table III).

When given a hypothetical scenario of using e-cigarettes routinely, never users perceived a statistically significantly higher chance of experiencing 5 out of 8 physical and social risks from e-cigarette use than ever-users ($P \leq 0.05$) (Table IV). Although never-users perceived a lower chance of experiencing

Table II. E-Cigarette Use Status (N=91)

	%	(n)
Awareness		
Heard of EC	89	(81)
Never heard of EC	6	(5)
Missing	6	(5)
EC Use Status		
Ever users of EC	49	(45)
Current-users	10	(9)
Never users of EC	45	(41)
Missing	6	(5)
Gender		
Male	40	(22)
Female	60	(33)
Likelihood of never users trying EC within next 6 months		
Very Unlikely	89	(25)
Somewhat Unlikely	11	(3)
Somewhat Likely	0	(0)
Very Likely	0	(0)
Ever users reason for use (n=45)*		
Enjoy sampling e-juice flavors w/ friends	36	(16)
Enjoy watching the exhaled vapor	33	(15)
For the calming affect	20	(9)
No worries about second hand smoke	16	(7)
Healthier than smoking	16	(7)
Enjoy not having to go outdoors to smoke	11	(5)
Enjoy using different EC with friends	11	(5)
Alternative to cigarettes	9	(4)
More satisfaction "vaping" than smoking	4	(2)
Other nicotine products have not worked as well to help me stop smoking	4	(2)

*Respondents were given the option of checking all that apply

physical and social benefits from e-cigarette use than ever-users, this difference was not statistically significant (Table IV).

Most of the respondents perceived cigarettes, cigars and smokeless tobacco (dip and chewing tobacco) as "extremely harmful." Whereas 60%

Table III. Characteristics Associated with Ever-use of EC (N=45)

	%	(n)
Type of EC*		
Hookah-	45	(9)
E-pen	20	(4)
MODs	20	(4)
Tanks	15	(3)
Ciga-likes	0	(0)
Missing	56	(25)
Concentration of Nicotine in E-liquid		
0-6 mg/ml	47	(14)
7-18 mg/ml	10	(3)
Don't know	43	(13)
Missing	33	(15)
E-liquid Flavors* (n=45)		
Fruit	56	(25)
Mint/Wintergreen	29	(13)
Candy	27	(12)
Tobacco	11	(5)
Dessert	11	(5)
Coffee or Cola	9	(4)

*Respondents were given the option of checking all that apply

perceived marijuana to be “not at all harmful” or “slightly harmful,” and 47% perceived e-cigarettes as “moderately harmful” (Table V).

Sixteen percent of respondents thought that e-cigarettes caused extreme environmental harm to those around someone using e-cigarettes (Table VI). In general, e-cigarettes, hookah, and marijuana were perceived as causing less environmental harm to others than cigarettes and cigars (Table VII).

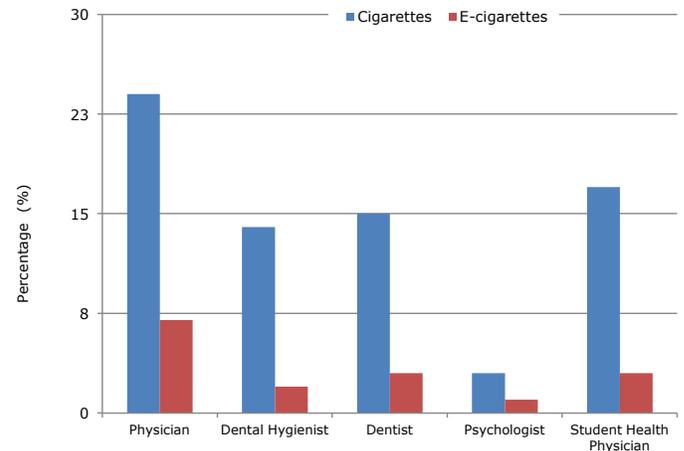
Over half of the respondents perceived e-cigarettes, hookah, and marijuana as being socially acceptable, whereas cigarettes, cigars, and smokeless tobacco were perceived as less socially acceptable products (Table VII).

Students were more likely to report receiving counseling about the adverse health effects of cigarettes from physicians than from dental professionals. Few respondents reported receiving counseling regarding e-cigarettes from any health professional (Figure 1).

Discussion

Consistent with the 2011 findings of Trumbo and Harper, the majority of the college student participants in this study had heard of e-cigarettes.¹⁵ Moreover, one-tenth of the respondents were current

Figure 1: Health Professionals Counseling About Cigarettes and E-cigarettes (N=40)



e-cigarette users, and 49% of the survey population had used e-cigarettes at least once. In contrast though, Trumbo and Harper found that only 13% of college students in their study had ever used e-cigarettes.¹⁵ This discrepancy may be explained by the study’s small convenience sample size, as well as by the fact that the Trumbo and Harper study was conducted in 2011 three years prior to this study. Studies report that e-cigarette use has been increasing over time.^{1,3} The increase has been particularly rapid among high school adolescents, for whom e-cigarette use has been reported at 16% in 2015.¹

In 2014, e-cigarette advertising was the most widely circulated of all marketing for non-combustible tobacco products.¹⁸ E-cigarettes entered the US market in 2007, and the affordability, availability, and marketing of these products has increased over recent years.¹⁹ A 2014 study indicated that young adult cigarette smokers were receptive to television ads and reported intentions to use e-cigarettes after viewing an advertisement that was televised on numerous US cable networks.²⁰ Advertising of tobacco products such as e-cigarettes have been shown to influence consumer awareness, experimentation, and current use among young people.²¹

Among the ever-users of e-cigarettes in this study, less than half did not know the concentration of nicotine in the e-liquid that they used. Most users preferred an e-liquid flavored with fruit, mint/wintergreen, and candy as the most preferred flavors, illustrating that e-cigarette flavors are appealing to young adults. Farsalinos et al. reported that most of their adult respondents commonly used a fruit flavored e-liquid.²²

Most e-cigarette ever-users in this study used pen-type devices. In contrast, other studies have shown that ever-users are more likely to use first generation devices, which look similar to a cigarette and are classified as “ciga-likes.” Established

Table IV. Mean Percent (%) Chance Out of 100% of Developing Physical and Social Risks and Benefits Associated With Daily Use of EC Among Ever-Users or Never-Users Use (N=91)

	Health or Social	Ever-User Mean Perceived Chance %	n*	Never-User Mean Perceived Chance %	n*	Mann Whitney U Test P-value
Perceived Risks						
You'll have bad breath	Physical	47	21	62	16	0.015**
You'll have trouble catching your breath	Physical	47	25	51	19	0.545
You'll get a bad cough	Physical	46	24	57	19	0.056
You will feel jittery/nervous	Physical	43	24	56	19	0.023**
You will get mouth sores	Physical	29	23	39	18	0.017**
Your friends will be upset with you	Social	44	25	71	18	<0.001**
You will get into trouble	Social	35	21	47	17	0.051**
Your performance in sports will get worse	Social	46	23	55	18	0.155
Perceived Benefits						
You'll feel high or buzzed	Physical	48	21	45	15	0.531
You will feel less hungry	Physical	29	23	31	16	0.852
You will feel less stressed	Physical	37	24	29	15	0.426
You will look cool	Social	20	18	14	13	0.072
You will look more mature	Social	15	18	9	12	0.243
You will have better concentration	Social	15	24	11	20	0.106
You will fit in with your peers	Social	12	18	10	12	0.339

*Responses may vary due to missing data

** A p-value ≤0.05 was used to determine statistical significance

users (used e-cigarettes more than 50 times in their lifetime) are reported to be more interested in the advanced generation devices, classified as "tanks," that have a large, high-powered battery and often a button to press before inhalation.^{23, 24}

Major reasons for e-cigarette use in this study included "I enjoy sampling different e-juice flavors with friends" and "I enjoy watching the exhaled vapor." These findings are consistent with those of Etter who reported that young adult and adult respondents used e-cigarettes because they liked the taste and the variety of flavors offered.²⁵ In contrast, Peters et al found that almost half of their college students who ever used e-cigarettes endorsed quitting or reducing smoking as their reasons for use.²⁶ In the Peters et al study, 32% also endorsed reasons for use related to curiosity/experimentation.²⁶

In this study, e-cigarettes were perceived to be the most socially acceptable of all products included in this survey, followed by marijuana and hookah, whereas cigarettes and cigars were perceived as not socially acceptable. Berg et al reported similar findings among college students, suggesting that the new culture of hookah and e-cigarette lounges

attracting young adults, supports the perception that hookah and e-cigarettes are being increasingly viewed as socially acceptable.²⁷ This social acceptance may have been initially due to the lack of regulation of these products at the federal and state level. In 2013, the Food and Drug Administration (FDA) issued a deeming rule, which has been finalized in 2016, giving the FDA authority to regulate the marketing, sale, and manufacturing of e-cigarettes, cigars, pipe tobacco, and hookah tobacco.²⁸ Previously, such restrictions were left to state and local governments. In California, where this sample was drawn, the sale of e-cigarettes to minors under 18 years of age has been banned since 2011.²⁹ Local ordinances enacted in the community in which this study was conducted have amended clean indoor air laws to prohibit e-cigarette use in public areas, such as restaurants and bars. Local regulatory action may also influence the perceived social acceptability of e-cigarettes, and therefore, the level of social acceptance measured in this study might differ from what would be measured in communities under different regulatory approaches.

The college students in this study who had never

Table V. Perceived Harmfulness of Various Tobacco Products, Devices, and Marijuana (N=55)

Products	Not at all % (n)	Slightly % (n)	Moderately % (n)	Extremely % (n)
Cigarettes	—	—	12 (7)	87 (48)
E-cigarettes	2 (1)	4 (14)	47 (26)	24 (13)
Cigars	—	2 (1)	7 (4)	89 (49)
Hookah	5 (3)	20 (11)	29 (16)	42 (23)
Smokeless Tobacco (Dip and Chew)	—	7 (4)	16 (9)	75 (41)
Marijuana	18 (10)	42 (23)	15 (8)	24 (13)

Table VI. Perceived Environmental Harm to Others (N=56)

Products	Not at all % (n)	Slightly % (n)	Moderately % (n)	Extremely % (n)
Cigarettes	2 (1)	9 (5)	21 (12)	66 (38)
E-cigarettes	16 (9)	34 (20)	30 (17)	16 (9)
Cigars	-	16 (9)	21 (12)	63 (35)
Hookah	11 (6)	43 (24)	20 (11)	23 (13)
Smokeless Tobacco (Dip and Chew)	43 (24)	14 (8)	9 (5)	32 (18)
Marijuana	30 (17)	34 (19)	13 (7)	21 (12)

Table VII. Perceived Social Acceptance by Products (N=56)*

Products	Strongly Disagree/Disagree** % (n)	Strongly Agree/Agree** % (n)
Cigarettes	70 (39)	30 (17)
E-cigarettes	39 (22)	61 (34)
Cigars	70 (38)	30 (16)
Hookah	29 (16)	71 (40)
Smokeless Tobacco (Dip and Chew)	75 (41)	22 (12)
Marijuana	30 (17)	70 (39)

*Percentages may vary due to missing data

**Respondents were given the statement "My friends think it's OK (socially acceptable) to use the following products." Social acceptance was measured on a 5 point Likert-scale ranging from "strongly disagree" to "strongly agree" or "don't know." In analyzing the 5-point Likert scale the bottom 2 categories and the top two categories were combined respectively to form two new categories of "Strongly Disagree/Disagree" and "Strongly Agree/Agree."

used e-cigarettes perceived a significantly higher percent chance of developing bad breath, feeling jittery and nervous, getting mouth sores, upsetting friends, and getting into trouble if they used e-cigarettes than college students who had ever used e-cigarettes. These findings are consistent with those of Halpern-Felsher and colleagues who reported that adolescent non-smokers estimated their chance of experiencing a smoking-related negative outcome as more likely than smokers.¹⁶ Chaffee

and colleagues also reported in a sample of adolescents that risk composite scores were inversely associated with e-cigarette ever-use and use intention.¹⁷ These findings can be explained by the Health Belief Model which posits that when the perceived risks of performing a behavior outweigh the perceived benefits, an individual tends not to adopt the behavior.³⁰

Respondents in this study perceived e-cigarettes, marijuana, and hookah use to be less harmful to their health and to cause less harm to others than the use of cigarettes. These findings are similar to those reported in a study of 2,002 students from two southeastern universities in the US that found students perceived marijuana, e-cigarettes, and hookah use to be less harmful to their health than use of cigarettes, cigar products, and smokeless tobacco.²⁷ In that study, the majority of college students also believed that e-cigarettes had fewer health risks than traditional cigarettes. This perception is of concern, because if e-cigarette use is viewed as having few health consequences, there may be relatively little hesitation among young people to try the product. While e-cigarette aerosol may contain fewer toxicants than cigarette smoke, scientific evidence has not yet been accumulated to evaluate the short-term and long-term health effects of e-cigarette use.³¹ Dental hygienists need to inform their clients of this lack of evidence, to stay abreast of e-cigarette-related research as it becomes available, and to incorporate such information into their client tobacco-related counseling.

In this study, college students reported receiving little or no counseling related to e-cigarette use from health professionals, including dental hygienists, although about a quarter of respondents reported receiving counseling regarding the adverse health effects associated with

cigarette use. These findings suggest a need for dental hygienists and other healthcare professionals to increase their awareness of e-cigarettes and their comfort level in discussing e-cigarettes and other tobacco products with their college-age clients. These findings are consistent with several studies evaluating self-reported tobacco education and cessation interventions by dental professionals. Such studies have reported that dental professionals, including dental hygienists, do not regularly ask about patients' tobacco use or implement the 5 A's,³²⁻³⁴ although evidence suggests that counseling from dental professionals can effectively reduce tobacco use when implemented.¹² These findings are also consistent with those of Foote et al who found that only 26% of college students in their study reported receiving tobacco-related counseling by physicians at their medical visit in the last year.¹⁴ In contrast, Sutfin et al found that 62% of North Carolina college students reported being screened for tobacco use at their student health center; and 50% of those students reported being advised to quit or reduce tobacco use.³⁵

Although there have been multiple comprehensive reports about the adverse health effects of cigarettes, to date there have been no such reports on e-cigarettes as this evidence is being collected currently.^{21,36-38} A 2013 study of Minnesota health care providers' awareness of e-cigarettes reported that although nearly all had heard of e-cigarettes, they knew little to nothing about e-cigarettes, and more than half were either somewhat or very uncomfortable talking to patients about e-cigarettes.³⁹ The findings in this study highlight the need to encourage dental hygienists and other healthcare professionals to screen every patient routinely for use of e-cigarettes, as well as use of other tobacco products and to provide a brief intervention for users.

This study has several limitations. The sample is a small, convenience sample of college students enrolled in humanities and science courses at a university in northern California. At the state level, California has strict cigarette and smokeless tobacco regulations, and local ordinances have extended clean indoor air laws to include e-cigarettes. These regulations may influence e-cigarette perceptions and limit the ability to generalize findings to all United States college students. The low response percentage increases the possibility of selection bias in that those who responded may have been more interested in e-cigarettes than those who did not respond. In addition, the data analysis focused on ever-users and never-users of e-cigarettes. Due to the small number of current-users in this sample (n=9), this group was not analyzed separately. Further research is needed to examine how patterns of current use, including total nicotine exposure, are related to attitudes and risk perceptions among e-cigarette users. In addition, some questionnaire

items were developed specifically for this study and further validity and reliability testing is warranted. Finally, this study focused only on e-cigarette use and did not assess use behaviors of other tobacco products. Consequently, our groups of ever-users, current-users and never-users may have been users of other tobacco products which may have confounded our results. Nevertheless, this study provides insights into the use of e-cigarettes among college students and factors associated with use to inform future studies.

Conclusion

The use of e-cigarettes is increasing in the US, especially among adolescents and young adults. Our findings demonstrate a high prevalence of e-cigarette use and experimentation among college students in our sample population. Participants' perceptions related to reduced harm of e-cigarettes may influence their willingness to use such products. Dental hygienists need to stay current with the scientific evidence related to e-cigarette use and incorporate this information into their tobacco-related education and cessation counseling. Such information will help their patients develop accurate perceptions about physical and social risks associated with e-cigarette use so that they can make informed decisions to protect their current and future health.

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