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Adolescents' Perceptions of Health Risks, Social Risks, and Benefits Differ Across Tobacco Products

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Abstract

Objective—This study assesses perceptions of overall harm, short-term health and social risks, long-term health risks, and benefits associated with various tobacco products including conventional cigarettes, e-cigarettes, cigars, chew, and hookah. This study also assesses whether and how perceptions differ by age, gender, race/ethnicity, and previous experience with tobacco.

Methods—A total of 722 high school students completed an online survey, answering questions about their use and perceptions of a variety of tobacco products. Differences in perceptions across products were assessed using a generalized estimation equation with an exchangeable correlation structure.

Results—Adolescents rated the various tobacco products as conferring significantly different levels of risks and benefits. Generally, adolescents rated cigarettes as most risky, followed by cigars and chew, with hookah and e-cigarettes rated as least risky. Adolescents rated hookah followed by cigarettes and e-cigarettes as most likely to make them look cool or fit in and cigars and chew as least likely to confer these benefits. There were interaction effects by age and use, with older adolescents and those with tobacco experience holding lower perceptions of risk. There were no significant interaction effects by race/ethnicity or gender.

Conclusion—Given the significant differences in adolescents' perceptions of risks and benefits of using different tobacco products and research showing the predictive relationship between perceptions and behavior, there is a need for comprehensive messaging that discusses risks of all tobacco products, particularly hookah and e-cigarettes. There is also a need to address perceived benefits of tobacco products, especially hookah and e-cigarettes.

Keywords

Tobacco use; Risk perceptions; Decision making

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More than 4.5 million adolescents initiate tobacco use [1], exposing them to harmful tobacco constituents [2]. The form in which tobacco use occurs, however, has changed, with rates of cigarette use decreasing and use of novel tobacco products increasing. Rates of ever cigarette use among adolescents went from 70.4% in 1997 to 41.1% in 2014; and current use decreased from 15.8% in 2011 to 9.2% in 2014 [3]. In contrast, e-cigarette use doubled from 1.5% in 2011 to 4.2% in 2013 [4] and tripled between 2013 and 2014 to 13.4% of high school students reporting past 30-day e-cigarette use [2]. Past 30-day hookah use increased between 2011 and 2014, from 4.1% to 9.4% [2]; cigar use decreased from 11.6% to 8.2%; and smokeless tobacco use remained fairly stable at about 5.5% [2]. Although negative health consequences of smoking cigarettes are well understood [1], using any tobacco product has negative health consequences [5–8]. Furthermore, nicotine alone negatively impacts cardiovascular health and the developing adolescent brain [9,10]. Understanding why this switch in tobacco product usage has occurred is critical to being able to develop public health messages and effective and comprehensive tobacco product prevention and intervention programs.

Perceptions of risks and benefits are key constructs in a number of health behavior theories [11,12], providing an explanatory basis for why individuals engage in risky behavior. There also exists a strong observable relationship between perceptions of tobacco-related risks and benefits and adolescents' initiation and continued tobacco use [13–16]. Adolescents with smoking experiences have higher perceptions of benefits and lower perceptions of risks compared to adolescents who have never smoked [4]. Furthermore, perceptions of low health and social risks and higher perceptions of benefits predict future cigarette use [15,16]. The relationship between perceptions of risks and use of hookah, cigars, and e-cigarettes has been also found among college students [17–19]. Studies assessing general perceptions of harm find a continuum of risk in which e-cigarettes, cigars, and hookah are viewed as less harmful than other tobacco products [20,21]. Qualitative studies show that adolescents are less certain about risks related to e-cigarettes versus cigarettes, and that youth experiment with e-cigarettes in part because they are viewed as less harmful than cigarettes [22,23]. Despite the importance of perceived risks and benefits in explaining adolescent tobacco use, few studies have examined adolescents' perceptions across tobacco products, including perceptions associated with newer products such as e-cigarettes, hookah, and chew, and fewer have queried about specific risks and benefits.

This study examines adolescents' perceptions of specific short- and long-term health and social risks and benefits concerning e-cigarettes, conventional cigarettes, cigars, chew, and hookah. Additionally, this study assesses whether and how these perceptions differ by age, gender, race/ethnicity, and previous experience with tobacco. Based on the changing landscape of tobacco use, we hypothesized: (1) adolescents will perceive the least amount of risk for e-cigarettes, and the most amount of risk for conventional cigarettes; (2) adolescents will perceive similar benefits across tobacco products; and (3) adolescents who have tried tobacco will perceive less harm and greater benefits in using these products.

Methods

Participants

Participants were recruited directly from 9th to 12th grade classrooms in Northern and Southern California to participate in an ongoing longitudinal study of tobacco perceptions, social norms, marketing, and patterns of tobacco use. Ten large schools with diverse populations with respect to race/ethnicity and socioeconomic status were recruited, with eight schools agreeing to participate. Researchers came to each class or to a school assembly, introduced the study, and invited all ninth and 12th graders to participate. Students received study information and consent forms and were asked to bring the materials home to share with their parents. Interested participants signed assent forms and parents signed consent forms. Students more than 18 years provided their own consent. Researchers returned to school a few days later, collected forms, and answered any questions.

Overall, 1,299 students were recruited and consented, of whom 722 completed the survey. Participants included 261 (36.1%) males and 453 (62.7%) females (mean age = 16.16 years, standard deviation = 1.6). Participants were ethnically diverse, with 193 (27.0%) white, 157 (21.9%) Asian/Pacific Islander, 213 (29.7%) Hispanic, and 153 (21.4%) other. Overall, 248 participants (34.7%) had ever tried any tobacco product, of whom 160 (22.4%) had ever tried hookah, 139 (19.5%) had ever tried e-cigarettes, 93 (13.0%) had ever tried cigarettes, 47 (6.5%) had ever tried cigars, and 19 (2.6%) had ever tried chew.

The study sample had more females, fewer males and a higher percentage of Asian students than schools from which we recruited. However, neither gender nor race/ethnicity had a significant main or interactive effect. Additionally, use rates and patterns for tobacco products among participants are consistent with rates of use for California youth [24]. The sample size was based on power analyses conducted as part of the grant application and was chosen based on relevant literature and data from our prior research with adolescents. The sample size was designed to assure reasonably sized standard errors of estimate and allow sufficient power (80%) to detect the contrasts of interest.

Procedures—Consented students received an email containing a link to the survey, administered through Qualtrics (Qualtrics Labs; Provo, UT). Participants were encouraged to complete the survey all at once, although they could return to the survey if needed. The survey was piloted on a small cohort of students before dissemination. The questions regarding perceptions of risks and benefits have been previously validated and used [13–16]. Adolescents received \$10 for completing the survey. All procedures were approved by our university's institutional review board.

Measures

Demographics—Participants provided demographic data including age, sex, and race/ethnicity. Age was combined into two categories: 13 through 15 and 16 through 19. Race/ethnicity included the categories of Latino, white, Asian, and other.

Perceptions of overall harm—Adolescents were asked to rate their perception of overall harm to their health if they used e-cigarettes, chew, cigarettes, cigars, and hookah two to

three times a day every day. They were also asked to rate the overall harm this would cause to a friend's health and to the environment. Responses were made on a five-point scale (1 = not at all to 5 = extremely).

Perceptions of short-term health risks, short-term social risks, and short-term benefits—Adolescents were asked to estimate their chance of experiencing short-term health risks, short-term social risks, and short-term social benefits from using e-cigarettes, conventional cigarettes, cigars, chew, and hookah. After reading the scenario, “Imagine that you just began using the following product [e-cigarettes, conventional cigarettes, cigars, chew, and hookah]. You use the product about two or three times each day. Sometimes you use the product alone and sometimes you use it with friends,” participants indicated the percent chance, from 0% to 100%, of getting short-term health risks (a bad cough, cold, trouble catching breath, mouth sores, and worse performance in sports), short-term social risks (friends will be upset with you, get in trouble, and bad breath), and short-term social benefits (look cool, look more mature, and fit in with your peers) [16–18].

Perceptions of long-term health risks—After reading the following scenarios, adolescents estimated their chance of experiencing long-term health risks (oral cancer, wrinkles, heart attack, lung cancer, another tobacco-related illness, and die from a tobacco-related illness) using any number from 0% to 100%: “Imagine now that you continue to use one of the products below two to three times a day for the rest of your life” and “Now imagine that you have never used any tobacco or related products” [13–16].

Never and ever use—Participants were asked: “During your entire life how many times have you ever used.[e-cigarettes, chew, cigarettes, cigars, and hookah].” Participants chose from a seven-point scale (never, 1–2 times, 3–10 times, 11–19 times, 20–30 times, 31–99 times, 100 or more times). Given that there was an unequal distribution of users across products and the primary focus of this study was to assess whether perceptions differed generally by ever and never use, data on the number of times the participants used each tobacco product were collapsed. Individuals who had ever used any of these products were labeled as “ever users,” and individuals who had never used any of these products were labeled as “never users.”

Analyses

To compare the mean ratings across the five products for the continuous variables (those assessing specific risks and benefits), we estimated and tested a general linear regression model with standard errors adjusted for clustering by school using a generalized estimation equation with an exchangeable correlation structure. Variables assessing overall harm had sufficient range so they were treated as continuous variables. Estimation was based on maximum likelihood so all available data were used but missing data were not imputed. Post hoc pairwise comparisons used the Tukey-Kramer method to control the type I error rate that could occur given the large number of comparisons being made. Age, ethnicity, sex, and tobacco use were included as covariates and interaction terms as these variables have been found relevant to perceptions of risks and benefits in previous studies [13–16]. Analyses

were performed using SAS version 9.4 (SAS Institute; Cary, NC) and SPSS version 23 (IBM Corp., Armonk, NY).

Results

For all analyses reported, age and tobacco use were included as between-subjects main effects and interaction terms. The variables of ethnicity and sex were also assessed but there were not consistent significant main or interaction effects. For example, the between-subjects effect of race in relationship to perceptions of “trouble catching breath” “get in trouble” and “look more mature” approached significance. For this reason, differences by race and sex variables were not included in these analyses and are not reported.

Comparison of perceived overall harm across tobacco products

There were significant differences in adolescents’ ratings across products of their overall perception of harm to their own health, their friend’s health and the environment. Adolescents perceived cigarettes as most likely to cause harm to their own health, followed by chew and cigars; hookah and e-cigarettes were seen as least likely to cause harm. For harm to others, adolescents thought that combustible products of cigarettes, cigars, and hookah would cause the most harm, followed by chew and e-cigarettes. Regarding harm to the environment, cigarettes were once again perceived as most harmful, followed by cigars, chew, hookah, and e-cigarettes (Table 1).

There was a significant interaction by age and perceptions of risk across products for the scenario of harm to friend’s health and harm to the environment, with older adolescents rating risks of chew, cigar and cigarettes as lower than younger adolescents. There were significant interactions by use and perceptions of risk across products for the scenario of harm to their friend’s health, with ever users rating these risks associated with e-cigarettes and hookah as lower than never users.

Short-term health risks—Adolescents believed there were significant differences in their chance of experiencing each short-term health risk from using each of the tobacco products assessed (Table 2), with e-cigarettes perceived as the least harmful, followed by chew or hookah, and then cigars and cigarettes. With the exception of the chance of getting mouth sores, in which adolescents perceived chew to be most risky, cigarettes and cigars were perceived to confer the greatest short-term health risks (Table 2).

There were significant interaction effects by age and product for most short-term health risks (Table 3). Older adolescents rated their likelihood of experiencing the short-term health risks of “getting a cold,” and “trouble catching breath” if using hookah, chew, or e-cigarettes as significantly lower than younger adolescents. There were also significant interactions by use and perceptions across products for short-term health risks, with ever users rating their likelihood of “bad cough” or “cold” as much less likely than never users for the scenarios of using chew, hookah, or e-cigarettes (Table 3).

Short-term social risks—Adolescents rated the tobacco products as conferring significantly different short-term social risks (Table 2). Adolescents perceived e-cigarettes as

least likely to result in “friends upset with you,” “get in trouble,” or “bad breath,” followed by use of hookah. Cigarettes and cigars were believed to be most socially risky.

There were significant interaction effects by age and product for the social risks of “friends upset with you” and “bad breath” but not for “get in trouble.” Older adolescents rated their likelihood of experiencing short-term social risks of “friends upset with you” and “bad breath” as lower than younger adolescents for all products; the difference was greatest between younger and older adolescents in the e-cigarette and hookah scenarios. There were also significant interaction effects by use and perceptions of risk across products. Ever users rated their likelihood of “get in trouble” or “friend upset with you” as much less likely than never users for the scenarios of using hookah or e-cigarettes (Table 3).

Short-term social benefits—There were significant differences in perceived social benefits across the tobacco products (Table 2). In general, compared to the other products, adolescents perceived chew as least likely to result in social benefits, including “look cool,” “mature,” and “fit in.” Adolescents reported believing that cigarettes and cigars would help them look more mature (with the exception of hookah compared to cigars and cigarettes based on post hoc analysis).

Significant interactions were seen by age and product for the social benefits of “look cool” and “fit in” but not for the benefit of “mature.” Older adolescents perceived the likelihood of experiencing the social benefit of “looking cool” as lower or similar to that of younger adolescents for all products except for hookah, which they rated as much higher than younger adolescents. Younger adolescents rated their likelihood of experiencing the social benefit of “fit in” as higher than older adolescents, given the scenario of using an e-cigarette, whereas older adolescents rated the likelihood of experiencing this social benefit as higher in the cases of cigar and hookah use. There were also significant interactions by use and perceptions across products for all social benefits. Ever users generally rated their likelihood of experiencing social benefits as higher than never users for all products, except for chew (Table 3).

Long-term health risks—There were significant differences in perceptions of all long-term health risks by product (see Table 2). For all products, adolescents reported a significant difference between experiencing a long-term health risk if using one of the tobacco products, compared to never having used any product. Adolescents believed they were significantly less likely to experience all six long-term health risks from using e-cigarettes, compared to the other tobacco products with the exception of the risk of experiencing lung cancer if using e-cigarettes versus chew. Adolescents believed chew was most likely to result in oral cancer, whereas they perceived cigarettes and cigars as most harmful for the other long-term health risks.

There were significant interactions by age and perceptions of risk across products for the long-term health risk of heart attack. Older adolescents reported their likelihood of experiencing these long-term health risks as lower than younger adolescents given the scenarios of having used cigars, cigarettes, chew, or e-cigarettes. There were significant interactions by use and product for all long-term risks tested. Ever users rated their

likelihood of experiencing lung cancer as lower than never users given the scenarios of using e-cigarettes or chew; ever users and never users rated their likelihood of getting lung cancer as similar given the scenario of having used cigarettes or having never used any tobacco product (Table 3).

Discussion

Adolescents perceived conventional cigarettes, cigars, chew, hookah, and e-cigarettes as conferring significantly different likelihoods of overall harm and short- and long-term health risks. As hypothesized, e-cigarettes were generally perceived as having the least amount of risk, followed by chew and hookah, cigars, and then cigarettes. For e-cigarettes, chew and hookah, ever users and older participants tended to report lower perceptions of risks than never users and younger participants, a finding that is consistent with other studies [14–16]. In contrast, regardless of behavioral experience, adolescents rated the short- and long-term risks of cigarettes and cigars as higher than that of emerging and novel tobacco products such as e-cigarettes and chew. This finding differed from our hypothesis that ever users would have lower perceptions of risk regardless of product. At least for the case of cigarettes, this may be reflective of the massive public health efforts to message on the negative health consequences and change social norms around cigarette use [2,25,26].

Counter to our hypothesis that adolescents would perceive similar benefits across products, our results showed chew was generally regarded as conferring the least amount of benefits, with hookah perceived as more likely to result in benefits, including “look cool” and “fit in.” E-cigarettes, cigars, and cigarettes generally did not differ from one another for these perceived benefits.

These findings show that adolescents perceive cigarettes as more risky than novel or emerging tobacco products, such as hookah and e-cigarettes. Indeed, tobacco products such as e-cigarettes and chew are marketed as less harmful than conventional cigarettes, and touted as an alternative to cessation for hard-core smokers [27,28]. There is still debate regarding the effectiveness of these strategies [8,29]; nevertheless, such strategies are meant for adult smokers who are having difficulty quitting conventional cigarettes. A concern regarding such a harm reduction perspective is that it may have the unintended consequence of spurring youth to initiate use of tobacco products that are viewed as less harmful than conventional cigarettes.

Our findings demonstrate that adolescents view use of hookah and e-cigarettes as most likely to help them fit in, and cigars and cigarettes as most likely to result in them appearing mature. Perceiving these products as less risky and more beneficial might be one of the factors explaining the large increase in rates of use of hookah and e-cigarettes between 2013 and 2014 [2]. Work by Amrock et al. [30] shows low perceptions of harm are associated with increased e-cigarette use.

A limitation to this study is that it took place with adolescents in California. Consistent with smoking rates in California, ever use tobacco rates were lower than the national average; thus the results may not be generalizable to other areas. Additionally, because of institutional

review board requirements and the desire to assure that students and parents understood and actively assented/consented to the study, the assent/consent procedures involved several steps, including requiring students to take home forms for parental signatures. It is possible that students who consented were those highly motivated to participate. That being said, this is one of the first studies to assess perceptions of risk across the gamut of products on the market today, and our findings regarding perceptions of risk and benefit do match other studies assessing perceptions related to specifically e-cigarette or cigarettes use [13–16,31].

There are a number of policy, public health, and prevention implications from these results. Although there are large national campaigns messaging on the harms of conventional cigarette use such as The Centers for Disease Control and Prevention’s TIPS campaign, Food and Drug Administration’s Real Cost campaign, and the “Truth” campaign [25,32,33], there are no national and limited state and local messages regarding e-cigarettes, hookah, or other tobacco products despite the growing literature regarding health effects of tobacco products. Emerging research regarding e-cigarettes has found chemical flavorants that, when inhaled, are known to cause respiratory diseases [34], and certain flavorants are cytotoxic [35]. Additionally, hookah use is associated with lung cancer and respiratory illness, and sharing a hookah may increase risk for infectious disease transmission [36]. Current evidence suggests that nicotine alone negatively impacts both cardiovascular health and the growing adolescent brain.

Messaging on the risks of conventional cigarettes without messaging on risks related to other tobacco products may be viewed by adolescents as implicitly condoning use of other tobacco products or conveying no or limited harm related to the use of these other products. This is particularly important in the case of e-cigarettes, which are not federally regulated yet are heavily marketed via a number of media sites, including television commercials [37]. Thus, there is a clear need to expand messaging campaigns to discuss the risks related to all tobacco products and not focus solely on risk of cigarettes alone. Although such messaging campaigns should continually be updated to reflect the current body of research, the public health community needs to actively start messaging on known risks related to all tobacco products now.

This study also has implications for clinical practice. The American Academy of Pediatrics statement on tobacco states that clinicians should, “Include tobacco in all discussions of substances of abuse and risky behaviors [38].” This recommendation is supported by evidence that physicians asking about patients’ smoking status promotes cessation [39]. Despite this recommendation, less than 30% of adolescents reported being asked by their clinician about or counseled on tobacco use [40]. There is a need for clinicians to discuss the risks and debunk myths of all tobacco products with their patients, not just cigarettes. As this study assessed how perceptions across products varied between ever and never users, future studies should assess how perceptions across tobacco products are related to degree and type of tobacco use.

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IMPLICATIONS AND CONTRIBUTION

This study shows that, along with shifting patterns of tobacco use among youth, youth perceive significant differences in the risks and benefits of using various tobacco products. This study highlights the need for clinicians and public health advocates to message on risks and debunk myths and perceived benefits across all tobacco products, not just cigarettes.

Table 1

Perceptions of overall harm across products

	E- <i>eig</i> \bar{x} (SD)	Chew \bar{x} (SD)	Cigarette \bar{x} (SD)	Cigar \bar{x} (SD)	Hookah \bar{x} (SD)	Variables tested	χ^2 (Wald)	<i>p</i>
Perceived harm to own health								
Age								
13–15	3.61 (1.26)	4.34 (.89)	4.68 (.59)	4.35 (.85)	3.88 (1.16)	Age	1.36	.2430
16–19	3.39 (1.26)	4.33 (.85)	4.67 (.65)	4.30 (.89)	3.60 (1.20)	Age × product	3.08	.5447
Use								
Never	3.57 (1.22)	4.34 (.87)	4.69 (.60)	4.34 (.87)	3.83 (1.14)	Use	7.43	.0064 ^a
Ever	3.27 (1.33)	4.32 (.87)	4.65 (.67)	4.28 (.89)	3.46 (1.25)	Use × product	6.81	.1461
Total	3.47 (1.26)	4.34 (.87)	4.67 (.63)	4.32 (.87)	3.71 (1.19)		817.45	<.0001 ^a
Perceived harm to friend's health								
Age								
13–15	3.13 (1.35)	3.11 (1.48)	4.20 (.85)	3.88 (1.04)	3.33 (1.27)	Age	11.85	.0006 ^a
16–19	2.94 (1.34)	2.82 (1.50)	4.13 (.94)	3.79 (1.05)	3.11 (1.25)	Age × product	20.46	.0004 ^a
Use								
Never	3.09 (1.35)	3.01 (1.50)	4.19 (.88)	3.87 (1.05)	3.32 (1.25)	Use	8.08	.0045 ^a
Ever	2.84 (1.34)	2.78 (1.49)	4.09 (.98)	3.74 (1.03)	2.95 (1.25)	Use × product	21.50	.0003 ^a
Total	3.01 (1.35)	2.93 (1.50)	4.16 (.91)	3.83 (1.05)	3.20 (1.26)		841.66	<.0001 ^a
Perceived harm to the environment								
Age								
13–15	3.14 (1.38)	3.45 (1.34)	4.27 (.93)	4.04 (1.03)	3.40 (1.28)	Age	1.08	.2998
16–19	2.99 (1.40)	3.34 (1.34)	4.12 (.99)	3.85 (1.06)	3.13 (1.35)	Age × product	16.87	.0020 ^a
Use								
Never	3.14 (1.37)	3.44 (1.32)	4.26 (.92)	3.99 (1.02)	3.34 (1.31)	Use	8.22	.0041 ^a
Ever	2.85 (1.41)	3.26 (1.37)	4.00 (1.05)	3.78 (1.09)	3.01 (1.34)	Use × product	7.05	.1335
Total	3.05 (1.39)	3.39 (1.34)	4.18 (.97)	3.92 (1.05)	3.23 (1.33)		976.34	<.0001 ^a

Test used was a general linear regression model; regression estimates and standard errors available on request. Responses to these questions were on a 1–5 scale with 1 representing “not at all harmful” and 5 “extremely harmful.” SD = standard deviation.

Significant at the $p < .01$ level.

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Table 2

Difference in risk and benefit perceptions across products

	E-cig \bar{x} (SD)	Chew \bar{x} (SD)	Cigarette \bar{x} (SD)	Cigar \bar{x} (SD)	Hookah \bar{x} (SD)	χ^2 (Wald)	p^a	Significant post hoc
Short-term health risks								
Bad cough	42.95 (31.93)	47.09 (31.74)	76.09 (25.14)	71.64 (26.42)	54.91 (34.03)	2,225.36	<.0001	b, c, d, e, f, g ^b , h, i, j
Cold	33.63 (30.12)	41.83 (30.48)	54.56 (31.57)	51.17 (31.06)	41.50 (32.45)	3,628.86	<.0001	a, b, c, d, e, f, h ^b , i, j
Trouble catching breath	48.44 (33.42)	50.70 (32.16)	77.87 (24.00)	73.53 (25.40)	56.31 (32.74)	1,866.35	<.0001	b, c, d ^b , e, f, h, i, j
Mouth sores	36.90 (31.50)	71.98 (28.15)	63.30 (29.74)	60.53 (29.72)	42.82 (34.02)	443.45	<.0001	a, b, c, d, e, f, g, h ^b , i, j
Worse at sports	50.56 (36.08)	59.66 (32.75)	75.38 (27.12)	71.69 (28.32)	58.94 (36.64)	2,087.99	<.0001	a, b, c, d ^b , e, f, h, i, j
Short-term social risks								
Friends upset	53.54 (37.59)	70.08 (32.34)	74.51 (31.34)	71.80 (32.12)	53.71 (40.65)	451.63	<.0001	a, b, c, e, g, h, i, j
Get in trouble	65.20 (37.94)	76.20 (32.23)	79.75 (30.49)	78.50 (31.22)	68.65 (36.18)	175.55	<.0001	a, b, c, e, f ^b , g, i, j
Bad Breath	56.48 (38.21)	85.20 (24.03)	88.46 (20.77)	86.35 (22.55)	60.14 (36.05)	1,693.33	<.0001	a, b, c, e, f ^b , g, h, i, j
Short-term benefits								
Look cool	15.32 (27.33)	10.58 (22.47)	15.80 (28.20)	15.24 (27.85)	20.37 (31.10)	252.93	<.0001	a, d, e, f, g, i, f ^b
Mature	12.86 (24.86)	12.17 (24.77)	17.32 (29.34)	17.51 (29.71)	15.35 (27.36)	65.36	<.0001	b, c, e, f, g ^b
Fit in	13.39 (25.94)	10.20 (23.50)	13.17 (25.80)	11.53 (24.31)	20.26 (31.57)	175.62	<.0001	a, d, e, f ^b , g, i, j
Never used \bar{x} (SD)								
Long-term health risks								
Oral cancer	53.41 (34.14)	81.27 (24.05)	78.99 (23.99)	75.87 (25.16)	15.56 (22.94)	5,618.83	<.0001	a, b, c, d, f, g, h, i, j
Wrinkles	58.38 (35.88)	72.27 (29.68)	83.64 (22.54)	79.99 (25.05)	43.66 (35.37)	1,161.58	<.0001	a, b, c, d, e, f, g, h, i, j
Heart attack	53.00 (34.25)	65.48 (29.42)	74.79 (26.18)	73.22 (26.18)	24.29 (23.91)	824.79	<.0001	a, b, c, d, e, f, g, i, j
Lung cancer	57.77 (34.07)	61.14 (33.44)	83.65 (21.12)	80.40 (22.31)	18.73 (23.28)	7,857.71	<.0001	b, c, d, e, f, g, h, i, j
Tobacco-related disease	58.49 (36.02)	77.25 (24.84)	83.91 (21.45)	81.00 (22.69)	11.46 (23.36)	15,122.99	<.0001	a, b, c, d, e, f ^b , g, h, i, j
Tobacco-related death	55.74 (35.67)	73.17 (27.18)	79.57 (24.08)	76.98 (25.04)	10.33 (22.80)	4,394.98	<.0001	a, b, c, d, e, f, g, h, i, j

a = E-cig × chew, b = E-cig × cigarettes, c = E-cig × cigars, d = E-cig × hookah/never, e = chew × cigarette, f = chew × cigars, g = hookah/never, h = cigarette × cigar, i = cigarette × hookah/never, j = cigar × hookah/never.

Test used was a general linear regression model; regression estimates and standard errors available on request.

Responses ranged from 0% to 100%.

SD = standard deviation.

^aSignificant at the $p < .001$ level.
^bSignificant at the $p < .05$ level.

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Table 3

Difference in risk and benefit perception across products by age and use

	E- <i>oig</i> \bar{x} (SD)	Chew \bar{x} (SD)	Cigarette \bar{x} (SD)	Cigar \bar{x} (SD)	Hookah \bar{x} (SD)	Variables tested	χ^2 (Wald)	<i>P</i>
Short-term health risks								
Bad cough								
Age								
13–15	47.68 (33.29)	55.38 (32.25)	75.94 (25.61)	72.34 (27.45)	58.74 (33.35)	Age	3.12	.0771
16–19	39.81 (30.65)	42.91 (30.77)	76.19 (24.86)	71.18 (25.74)	52.40 (34.23)	Age \times product	96.07	<.0001*
Use								
Never	44.21 (31.49)	50.06 (30.87)	75.98 (25.47)	72.36 (26.16)	57.89 (33.48)	Use	12.81	.0003*
Ever	39.88 (32.88)	39.75 (32.78)	76.36 (24.35)	69.87 (27.04)	47.31 (34.36)	Use \times product	25.28	<.0001*
Cold								
Age								
13–15	38.45 (31.05)	47.19 (31.62)	57.66 (30.80)	55.62 (31.20)	47.10 (33.31)	Age	4.08	.0435*
16–19	30.40 (29.08)	37.24 (29.20)	52.47 (31.96)	48.17 (30.65)	37.87 (31.40)	Age \times product	12.61	.0134*
Use								
Never	35.75 (30.12)	44.10 (30.41)	55.20 (31.39)	51.83 (31.00)	45.22 (32.78)	Use	5.01	.0252*
Ever	28.52 (29.59)	36.25 (30.00)	52.95 (32.07)	49.53 (31.27)	32.15 (29.67)	Use \times product	10.32	.0354*
Trouble catching breath								
Age								
13–15	51.86 (34.48)	55.35 (32.61)	77.55 (25.28)	73.87 (26.23)	56.65 (32.49)	Age	1.29	.2552
16–19	46.15 (32.54)	47.61 (31.54)	77.08 (23.16)	73.30 (24.87)	54.66 (32.85)	Age \times product	45.76	<.0001*
Use								
Never	51.11 (33.00)	53.06 (31.52)	77.81 (24.18)	73.39 (25.42)	59.10 (32.06)	Use	9.39	.0022*
Ever	41.89 (33.63)	44.76 (33.09)	78.01 (23.62)	73.88 (25.42)	49.19 (33.50)	Use \times product	25.14	<.0001*
Mouth sores								
Age								
13–15	42.49 (33.78)	73.56 (26.85)	66.50 (29.23)	64.91 (29.70)	52.37 (33.24)	Age	9.54	.0020*
16–19	32.18 (29.34)	70.93 (28.98)	61.18 (29.93)	57.60 (29.41)	36.63 (33.12)	Age \times product	15.74	.0034*

16–19	50.92 (34.56)	81.08 (24.52)	77.40 (25.24)	74.08 (26.40)	15.01 (22.61)	Age × product	5.50	.2393
Use								
Never	57.69 (32.55)	82.38 (22.41)	80.42 (23.01)	77.74 (23.48)	14.38 (21.31)	Use	13.67	.0002*
Ever	42.77 (35.76)	78.44 (27.65)	75.36 (26.05)	71.12 (28.53)	18.52 (26.44)	Use × product	331.81	<.0001*
Wrinkles								
Age								
13–15	61.25 (35.36)	73.79 (27.33)	83.85 (22.12)	81.25 (23.91)	43.01 (35.31)	Age	.10	.7564
16–19	56.53 (36.21)	71.29 (31.10)	83.50 (22.85)	79.16 (25.77)	44.08 (35.47)	Age × product	2.61	.6243
Use								
Never	61.86 (34.17)	74.24 (27.48)	84.07 (21.45)	81.03 (23.58)	42.00 (34.94)	Use	5.44	.0197*
Ever	49.65 (38.61)	67.27 (34.38)	82.53 (25.16)	77.36 (28.33)	47.78 (36.21)	Use × product	41.61	<.0001*
Heart attack								
Age								
13–15	57.01 (33.74)	68.14 (27.55)	76.52 (25.11)	76.11 (24.09)	25.81 (24.54)	Age	3.95	.0468*
16–19	50.43 (34.38)	63.78 (30.49)	73.66 (26.85)	71.35 (27.34)	23.32 (23.50)	Age × product	20.97	.0003*
Use								
Never	56.84 (32.62)	68.06 (27.81)	76.39 (24.62)	74.71 (24.49)	23.34 (23.30)	Use	20.67	<.0001*
Ever	43.39 (36.40)	58.96 (32.34)	70.72 (29.49)	69.43 (29.86)	26.63 (25.29)	Use × product	93.17	<.0001*
Lung cancer								
Age								
13–15	61.37 (34.35)	66.00 (31.48)	85.62 (18.52)	82.33 (20.41)	20.04 (23.98)	Age	8.24	.0041*
16–19	55.48 (33.74)	58.03 (34.32)	82.38 (22.58)	79.18 (23.40)	17.88 (22.81)	Age × product	5.98	.2010
Use								
Never	60.46 (32.93)	64.00 (32.15)	84.45 (20.43)	81.90 (20.75)	17.00 (21.36)	Use	2.45	.1173
Ever	51.10 (35.99)	53.86 (35.59)	81.63 (22.71)	76.63 (25.52)	22.99 (27.03)	Use × product	44.19	<.0001*
Tobacco-related disease								
Age								
13–15	61.91 (35.72)	79.32 (23.51)	85.27 (19.82)	81.98 (21.40)	12.19 (23.44)	Age	1.52	.2176
16–19	56.32 (36.09)	77.56 (25.66)	83.04 (22.42)	80.37 (23.50)	11.00 (23.33)	Age × product	1.49	.8285
Use								

Never	61.97 (34.62)	79.60 (24.00)	85.01 (20.19)	82.42 (21.38)	10.23 (21.48)	Use	4.36	.0369 *
Ever	49.84 (38.02)	74.79 (26.61)	81.11 (24.22)	77.42 (25.42)	14.54 (27.31)	Use × product	40.52	<.0001 *
Tobacco-related death								
Age								
13–15	56.69 (35.71)	73.05 (26.71)	78.61 (24.18)	75.95 (24.96)	10.60 (22.87)	Age	.26	.6306
16–19	55.14 (35.68)	73.24 (27.51)	80.18 (24.92)	77.63 (25.12)	10.15 (22.80)	Age × product	7.84	.0976
Use								
Never	57.96 (34.59)	74.29 (26.56)	79.94 (23.44)	77.81 (24.02)	9.24 (21.15)	Use	2.20	.1379
Ever	50.22 (37.78)	70.34 (28.95)	78.62 (25.66)	74.86 (27.44)	13.03 (26.35)	Use × product	24.60	.0223 *

Test used was a general linear regression model; regression estimates and standard errors available on request. Responses ranged from 0% to 100%. SD = standard deviation.

* Significant at the $p < .05$ level.