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**Perceptions about Levels of Harmful Chemicals in E-cigarettes Relative to Cigarettes,
and Associations with Relative E-cigarette Harm Perceptions, E-cigarette Use and
Interest**

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ABSTRACT

Background and aims. Exposure to chemicals contributes to harm from nicotine products, and e-cigarette communications often refer to chemicals. However, while e-cigarette studies commonly measure perceived harmfulness of e-cigarettes relative to cigarettes, few have assessed comparative perceptions about chemicals. This study measured perceived levels of harmful chemicals in e-cigarettes compared with cigarettes, and associations with e-cigarette/cigarette relative harm perceptions, e-cigarette use, and interest.

Design and setting. Online cross-sectional survey of adults/young adults from a nationally representative research panel in the United States conducted in January 2021.

Participants. Independent samples of 1018 adults who smoked cigarettes and 1051 young adult non-smokers (ages 18-29).

Measurements. Participants were asked their perceptions of the level of harmful chemicals in e-cigarettes versus cigarettes (fewer/about the same/more/don't know), perceived harmfulness of using e-cigarette versus cigarettes (less/about the same/more/don't know), and their current e-cigarette use and use interest.

Findings. About 20% of all participants believed e-cigarettes contain fewer harmful chemicals than cigarettes, while 36% of adult smokers and 25% of young adult non-smokers responded "don't know". Participants more frequently reported "don't know" to the chemicals item than the harm item. About half (51–55.7%) of those who believed e-cigarettes contain fewer harmful chemicals also believed e-cigarettes are less harmful than cigarettes. Both beliefs were associated with higher odds of interest in using e-cigarettes (less harmful belief, odds ratio [OR]=5.53, 95% confidence interval [CI] 2.93–10.43; fewer chemicals belief, OR=2.45, 95% CI 1.40–4.29) and past 30-day e-cigarette use (less harmful belief, OR=2.53, 95% CI 1.17–5.44; fewer chemicals belief, OR=5.09, 95% CI 2.31–11.19) for adults who smoke, but not young adult non-smokers.

Conclusions. In the United States, most adults who smoke cigarettes and young adult non-smokers do not appear to think that e-cigarettes have fewer harmful chemicals than cigarettes, and many are uncertain about how these levels compare.

INTRODUCTION

Nicotine-based electronic cigarettes (“e-cigarettes”) and vaping products are not safe products, but current evidence suggests that they expose users to fewer types and lower levels of harmful chemicals than combusted tobacco cigarettes and may therefore be less harmful to a user’s health and pose lower risks for major smoking-related diseases (1–3). However, whether people use e-cigarettes may depend, in part, on whether or not they believe e-cigarettes are less harmful to health than cigarettes. As such, study of e-cigarette harm perceptions has been an active area of inquiry (4,5), and major national health/tobacco surveys in the United States (e.g., PATH and HINTS studies) and elsewhere (3) include a broad survey question to measure the perceived harm of e-cigarettes relative to cigarettes (3, 6–9). This type of e-cigarette comparative harm measure has been shown to predict e-cigarette use in longitudinal and measurement studies, with e-cigarette use more likely among those who perceive e-cigarettes to be less harmful than smoking (3, 10–12). However, large survey studies of e-cigarettes have not typically included a question about the perceived exposure to or level of harmful *chemicals* in e-cigarettes relative to cigarettes, and there is generally a lack of data from quantitative studies on such perceptions. These types of beliefs may be relevant to measure given that lower exposure/levels of harmful chemicals in e-cigarettes is a reason why they may pose lower harm than tobacco cigarettes (1–3), and measures of perceived harmful chemical exposure may provide context to understanding people’s beliefs about e-cigarette harms (13,14).

Measuring comparative perceptions of e-cigarette/cigarette chemical exposure may also be important because e-cigarette communications often directly refer to chemicals in some way. For example, vaping prevention messages have referred to the presence and types of chemicals found in e-cigarettes, (e.g. formaldehyde) (15–18), which may directly or

indirectly impact perceptions about harmful chemicals in e-cigarettes relative to cigarettes, as well as relative product harm perceptions. Other e-cigarette communications, including potential future “modified risk tobacco product” (MRTP) claims, may refer to reduced levels of exposure to harmful or potentially harmful chemicals in e-cigarettes, which may then impact risk beliefs (13, 19–21). In the US, tobacco companies can apply to the US Food and Drug Administration (FDA) to make MRTP claims about reduced risks to health or reduced exposure to constituents, and FDA has already authorized use of MRTP messaging for IQOS, a heated tobacco product (22). This includes authorized claims that switching from cigarettes to IQOS can reduce one’s exposure to harmful or potentially harmful chemicals (22). Future US MRTP applications making reduced chemical claims could come from e-cigarettes that receive FDA authorization for sale, which requires meeting a standard of being “appropriate for the protection of public health”. Notably, FDA sale authorizations received by e-cigarette products thus far have been based in large part on the rationale that switching from cigarettes to these products could reduce one’s exposure to harmful chemicals (23–25).

Thus, given the potential relevance of measuring chemical-related beliefs in e-cigarette research, the overall goal of this study was to examine responses to a measure about current perceived levels of harmful chemicals in e-cigarettes compared to cigarettes, and to explore associations between responses to this item and a measure assessing perceptions about the relative harm from e-cigarettes compared to cigarettes. We also evaluated which of these measures is more strongly associated with current e-cigarette use and future use interest. We examined these topics using data from a survey conducted with two priority audiences for e-cigarette research and MRTP perception studies (26,27) 1) adults who smoke cigarettes, for whom e-cigarettes may serve as a harm-reduction alternative, and 2) young adults (YA) who do not smoke cigarettes, for whom e-cigarette appeal and initiation may constitute unintended consequences, such as addiction and harms to health.

METHODS

Participants and data source

Between January – February 2021, we conducted an online survey with two independent samples recruited from the Ipsos KnowledgePanel, a large probability-based research panel that is selected to be representative of the entire US population: 1,018 adults (ages 18 and older) who have smoked at least 100 cigarettes in their lifetime and currently smoke cigarettes daily or some days (i.e., current established smoking); and 1,051 young adults (ages 18–29) who do not currently smoke and have never established cigarette smoking (i.e., never smoked 100 cigarettes in their lifetime). *KnowledgePanel* members are recruited through probability-based sampling of addresses via the US Postal Service’s Delivery Sequence File, and surveys are weighted to produce nationally representative estimates (28).

Measures

As part of a broader survey, we assessed perceived harm from e-cigarettes relative to cigarettes using an item (with associated response categories) similar to ones used on large US national surveys (7,8): “As far as you know, is using e-cigarettes or other electronic nicotine vaping products less harmful, about the same, or more harmful to a person’s health than smoking cigarettes?”, with response options “Less harmful,” “About the same,” “More harmful,” and “I don’t know.” Next, on two separate pages participants were asked three items about whether they had ever heard and seen messages/ads that e-cigarettes are less harmful than smoking, regardless of what they personally believed about e-cigarettes.

On a separate survey page, we assessed perceptions about harmful chemicals from e-cigarettes relative to cigarettes by asking an item we developed to be similar in format to the relative harm perception measure - “As far as you know, do e-cigarettes or other electronic nicotine vaping products contain fewer harmful chemicals, about the same amount, or more

harmful chemicals than cigarettes?” Response options were: “Fewer harmful chemicals,” “About the same amount,” “More harmful chemicals,” and “I don’t know.” For both items, we treated responses of “about the same” as the reference category in regression analysis.

We assessed interest in using e-cigarettes by asking, “How interested, if at all, are you in using an e-cigarette or other electronic nicotine vaping product in the next 6 months?” (1= Not at all interested – 5= Extremely interested). Any response other than “not at all interested” was classified as “any interest” in using e-cigarettes in the next six months for analysis. We defined current e-cigarette use as having used an e-cigarette or nicotine vaping product in the past 30 days.

Analyses

Since they were drawn and weighted independently, we analyzed the adult smoking and young adult never-smoking samples separately, applying weights to each to yield results that are representative to all US adults who smoke (adult smoking sample) and all US young adults who have never established smoking (YA never smoking sample), and estimated variance using Taylor series linearization to account for the complex sampling design. We used descriptive statistics to characterize the populations, then compared chemical perceptions to harm perceptions within each population. Ninety-five percent confidence intervals (95% CI) were calculated for all point estimates, and prevalence estimates were considered statistically different if the intervals did not overlap. We used Spearman’s rho to assess the correlation between the e-cigarette harm and chemicals perceptions, and multivariable logistic regression models. We separately modeled the associations between e-cigarette harm perceptions relative to cigarettes (reference: about as harmful) and having any interest in using e-cigarettes in the next 6 months and the association between e-cigarette harmful chemical perceptions relative to cigarettes (reference: about the same amount) and having any interest in using e-cigarettes. Both models were adjusted for continuous age, sex,

race/ethnicity, and education (high school or less vs. at least some college), and were conducted among the overall populations (additionally adjusted for past 30-day e-cigarette use [yes vs. no]) and then among only those who had not used e-cigarettes in the past 30 days. Covariates were selected a priori given that they may predict both e-cigarette perceptions as well as e-cigarette use behavior and intentions (6, 9-11). We similarly assessed the associations between e-cigarette perceptions and past 30-day use of e-cigarettes. For both regression model sets, we compared strength of odds ratios and model fit criteria (Akaike Information Criterion [AIC]) to explore which perception—chemical or harm—was a better indicator of e-cigarette use intentions and use. Fewer than 10 participants in each sample had missing data for some variables of interest and were excluded. Analyses were not pre-registered and thus results may be considered exploratory.

RESULTS

The adult cigarette smoking population tended to be non-Hispanic white (70.7%), not have a college degree (87.9%), smoke every day (79.1%), and have either no plans to quit in the next 6 months (32.0%) or ever (37.2%; Table 1). Fifty-five percent had ever tried e-cigarettes and 10.5% had used e-cigarettes in the past 30-days. The young adult (YA) non-smoking population was more ethnically diverse, with about half (52%) identifying as non-Hispanic white and 23.4% as Hispanic, and about 23.6% had a college degree. About 1 in 5 (21.5%) had ever smoked a cigarette, 24.8% had ever tried an e-cigarette, and 5.1% had used e-cigarettes in the past 30-days.

Prevalence of beliefs about e-cigarette harmfulness and level of harmful chemicals

Among adults who smoke cigarettes, 12.3%, 40%, and 22% believed that e-cigarettes are less harmful, about the same, and more harmful than smoking, respectively, with the remaining 25.6% being unsure (Table 1). About 18% of young adults who never established cigarette smoking believed e-cigarettes to be less harmful than smoking, while 16.6%

believed them to be more harmful (16.6%), about the same (54.6%) or were unsure (11.3%). With respect to chemical perceptions, 18.1%, 27.9%, and 18.5% of adults who smoke believed e-cigarettes contain fewer, about the same amount, and higher amounts (“more”) of harmful chemicals, respectively. Among young adult non-smokers, 21.0%, 35.8%, and 18.2% held these beliefs (fewer; same, more, respectively); 35.6% of smoking adults and 24.9% of never-smoking young adults were unsure.

Correlation of e-cigarette harm and chemical beliefs

Chemical and harm perceptions were correlated but not fully concordant (Spearman's $R = 0.54$, $p < .0001$ for adult smokers; Spearman's $R = 0.46$, $p < .0001$ for YA non-smokers, see Table 2). For example, among adults who smoke cigarettes, about half (51%) who believed e-cigarettes have fewer harmful chemicals also believed they are less harmful than cigarettes; 37.3% believed they are about as harmful, 1.2% believed they are more harmful, and 10.5% were unsure. Meanwhile, most but not all (73.9%) who believed e-cigarettes have more harmful chemicals also believed they are more harmful than cigarettes; none believed they are less harmful. Among young adults who never established smoking, 55.7% who believed e-cigarettes have fewer chemicals also believed they are less harmful.

Associations between e-cigarette harm and chemical beliefs and use interest

Among adults who smoke, odds of interest in e-cigarette use were significantly higher among those who perceive them to be less harmful than smoking (OR 5.53, 95% CI 2.93–10.43) relative to those who perceive them to be equally harmful (Table 3). The belief that e-cigarettes have fewer harmful chemicals than cigarettes was also significantly associated with increased odds of interest relative to those who perceive them to have equal amounts, though the associations were less strong (OR 2.45, 95% CI 1.40–4.29 overall; OR 2.32, 95% CI 1.30–4.12 among e-cigarette nonusers). Both perceiving e-cigarettes to be more harmful and perceiving them to have more harmful chemicals were associated with significantly lower

odds of e-cigarette interest among adults who smoke. The relative harm perception measure yielded better model fit (as indicated by lower AIC) than including the relative chemical perception measure when modeling odds of e-cigarette interest among adult smokers. Neither measure was significantly associated with e-cigarette interest among the YA never-smokers.

The models for e-cigarette use (Table 4) found that both beliefs about less harm and fewer chemicals in e-cigarettes were significantly associated with increased odds of e-cigarette use for adults who smoke, but in contrast to the e-cigarette interest models, the associations were stronger for the fewer harmful chemicals belief, (OR 5.09, 95% CI 2.31–11.19) than the less harmful belief (OR 2.53, 95% CI 1.17–5.44). Comparisons between those who responded “don’t know” relative to those responding “same or more” were not significant in any model. For adults who smoke, model fit for the e-cigarette use models were better when including the e-cigarette chemical perception variable than when including e-cigarette harm perception variable; however, the opposite was true for young adults who do not smoke (i.e., the use model with the harm measure showed better fit), although neither harm perception nor chemical perception was significantly associated with e-cigarette use in this population.

Consistent with differences in model fit, when including *both* harm and chemical perception measures in the same model (versus separate models), only the less harmful perception (not fewer chemical perception) was significantly associated with e-cigarette interest (OR 4.77, 95% CI 2.30–9.90) and only the fewer chemical perceptions was significantly associated with e-cigarette use (OR 4.74, 95% CI 2.00–11.24) among adult smokers (Supplemental Tables).

DISCUSSION

To our knowledge this is the first study to report the prevalence of perceived amount of harmful chemicals in e-cigarettes relative to cigarettes using national samples of adults

who smoke cigarettes and young adult non-smokers in the US, and to compare this perception with that of perceived harm to health from e-cigarettes compared to cigarettes. Consistent with results from large national surveys and recent reviews (3, 7,8, 10) we found that a minority of participants overall (~12–18%) perceived e-cigarettes to be less harmful to health than cigarettes. This study adds to the literature by also finding that a minority of adults who smoke cigarettes and young adult non-smokers (~18–21%) believe e-cigarettes contain fewer harmful chemicals than cigarettes. Although both measures were associated with current e-cigarette use and future use interest among adults who smoke, the relative harm measure was more strongly associated with interest in *future* use of e-cigarettes, including among those who were not already using e-cigarettes, while the chemicals measure was more strongly associated with current use. We also found that while the relative chemicals and relative harm measures were associated with each other, consistent with findings in previous studies (13,14), people’s responses to these items were not as consistent as one might imagine, with only about half of adult smokers who thought e-cigarettes contain fewer harmful chemicals also thinking that e-cigarettes are less harmful to health than tobacco cigarettes. Collectively, these results may suggest that addressing beliefs about harmful chemicals from e-cigarettes compared to cigarettes may be important for any potential public health efforts aimed at encouraging switching to e-cigarettes as a harm reduction vehicle for adults who smoke cigarettes.

As noted, only about one-fifth of participants reported thinking that e-cigarettes contain fewer harmful chemicals than cigarettes. This is consistent with previous research exploring reactions to modified risk messages, including about reduced chemicals, and finding significant skepticism of such claims (19–21, 29). This skepticism may be related to perceptions that tobacco cigarettes are more “natural” while e-cigarettes are man-made, with e-liquids created synthetically with chemicals (21). This may also be related to a lack of

knowledge that the majority of chemicals from cigarettes come from the burning of tobacco, rather than from added chemicals (30). If the public does not understand the role of combustion in development and exposure to chemicals, they may be unlikely to perceive that e-cigarettes expose users to fewer chemicals (because of the lack of combustion).

Previous qualitative research may also suggest reasons for some of the observed discordance between the beliefs that e-cigarettes have fewer harmful chemicals but are not less harmful to health (19–21). This may include beliefs that even if e-cigarettes contain fewer harmful chemicals than cigarettes, the type (e.g., formaldehyde) or level of harmful chemicals that are present are still sufficient to cause the same types of harms or health risks as cigarettes. People may also believe that e-cigarettes contain new or unique chemicals that are harmful (31), even if the overall level of chemicals is lower. Our results may also be related to people's knowledge or beliefs that both product types contain nicotine, the chemical in tobacco products that is the most familiar and well known by the public (32), but which is also widely misperceived as being one of the main causes of cancer from smoking cigarettes (33,34). Indeed, e-cigarette ads and packaging carry prominent warnings that they contain nicotine, and e-cigarette prevention and educational messages have included comparative nicotine statements, for example noting that one vaping pod contains as much nicotine as a pack of cigarettes (15,18). As such, people may think that even if e-cigarettes contain fewer chemicals overall, if both products contain nicotine and nicotine is harmful, then both products would be similarly harmful (20,21). Relatedly, people may also consider addiction when they think about product "harm", and thus may consider products to be about equally harmful if they are both perceived as addictive.

Results also showed that adults who smoke and young adult non-smokers both more frequently reported that they *did not know* how the amount of harmful chemicals in e-cigarettes compared to cigarettes than reported not knowing how cigarettes and e-cigarettes

compared in terms of harm to health. Previous studies have stated that the public, particularly adult cigarette smokers who may benefit from switching, should be better informed about the lower relative harm of e-cigarettes versus cigarettes (1,3,7, 8), and research has begun examining methods/interventions for doing so, such as written communications, informational/education campaigns and videos, and relative harm labels (3; 35-39). Findings from this study suggest that these types of interventions may need to include information and education about relative exposure to harmful or potentially harmful chemicals from e-cigarettes versus cigarettes (and the reason for this difference, i.e., lack of tobacco and tobacco combustion), as this may be important to understanding why and how e-cigarettes may be less harmful to health.

Despite some discordance with the relative harm perception item and a large percentage of “don’t know” responses, we did find that the relative chemicals item lined up with current e-cigarette use and interest in future e-cigarette use in the expected/same direction as the relative harm item (i.e., perceptions of fewer chemicals was positively associated with e-cigarette use and interest) among adults who smoke. Given this, as well as the fact that both e-cigarette MRTP and prevention messages may make comparative statements about chemicals in cigarettes and e-cigarettes, e-cigarette research studies may benefit from including measurement items about this construct. Furthermore, since not all chemicals are inherently harmful, such a measure should specifically address perceived levels of/exposure to “harmful” or “potentially harmful” chemicals.

Although our study provides new information on this topic, results are limited to two types of populations (adults who smoke cigarettes and young adults who do not smoke cigarettes) and do not include the full general population nor other subgroups of potential interest, such as youth. As well, we could not directly evaluate the moderating effect of cigarette smoking, since the smoking and nonsmoking samples were drawn and weighted

separately. In addition, although our study was conducted with participants drawn from a nationally representative research panel, the complex sample design resulted in some wide confidence intervals around our estimates, even with our relatively large sample sizes. Also, since the e-cigarette interest outcome was common (>10%), the odds ratios likely overestimate the prevalence ratios. There is potential for misclassification of e-cigarette use and intention, since these were self-reported, and low prevalence of e-cigarette use prohibited examination of more refined use categories (e.g., daily vs frequent vs occasional). Our results and estimates may also be impacted to some extent by survey order effects, as the order of the relative harm and relative chemicals perception questions were not randomized in our survey. However, the items were presented on separate survey pages to promote answering questions independently, and our order was consistent with guidance on conducting tobacco perception studies which recommends asking a more general perception question before more specific related perception questions (27). Nevertheless, future studies that utilize larger samples, include different subgroups, and use randomized question order may be useful to replicate our findings and to track these perceptions and associations over time, as well as identify demographic correlates of knowledge about e-cigarette constituents. In addition, although our chemicals item tracked with e-cigarette use and interest in the expected direction, it should be noted that we asked about the amount of harmful chemicals *contained* in vaping products and cigarettes, rather than perceptions about a users' relative level of *exposure* to harmful chemicals from e-cigarettes versus cigarettes, which is ultimately the more important issue from a health perspective, though potentially a more difficult concept to assess via a survey question. Future research could further examine approaches to best assess this construct.

CONCLUSION

Overall, this study found that the majority of adults who smoke cigarettes and young adult non-smokers do not think e-cigarettes have fewer harmful chemicals than cigarettes and

do not think e-cigarettes are less harmful than cigarettes. These measures were only moderately correlated, indicating that beliefs about fewer harmful chemicals do not automatically translate to lower relative harm beliefs. Both items were associated with e-cigarette use among adults who smoke cigarettes, a group who could potentially benefit from switching to an MRTP. Future surveys should consider including measures to track beliefs about relative exposure to harmful chemicals, given the association of these beliefs with product interest and use, and that various e-cigarette communications may influence these beliefs.

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Table 1. Sample Characteristics and Prevalence of Perceptions about E-cigarette Harmfulness and Level of Harmful Chemicals relative to Cigarettes, among Adults who Currently Smoke Cigarettes (N=1,018) and Young Adults who Do Not Currently Smoke (N=1,051)

Demographics	Adult Smokers ^a			Young Adult Nonsmokers ^b		
	N	%	(95% CI)	N	%	(95% CI)
Sex						
Male	532	52.7	(49.1, 56.4)	599	48.7	(44.7, 52.8)
Female	486	47.3	(43.6, 50.9)	452	51.3	(47.2, 55.3)
Missing	0			0	0.0	
Age, years						
18-29	63	17.3	(13.2, 21.3)	1051	100.0	---
30-44	271	29.6	(26.4, 32.9)	0	0.0	---
45-59	326	29.8	(26.7, 33)	0	0.0	---
60+	358	23.3	(20.7, 25.8)	0	0.0	---
Missing	0			0		
Race/Ethnicity						
White, Non-Hispanic	734	70.7	(67.4, 74.1)	681	52.0	(47.9, 56.1)
Black, Non-Hispanic	123	12.4	(10.1, 14.7)	97	14.3	(11.1, 17.4)
Other, Non-Hispanic	30	5.1	(3.1, 7)	65	8.2	(5.8, 10.7)
Hispanic	97	10.5	(8.2, 12.8)	164	23.4	(19.7, 27.1)
2 or More Races, Non-Hispanic	34	1.3	(0.8, 1.7)	44	2.1	(1.3, 3)
Missing	0			0		
Education						
Less than high school	117	17.9	(14.7, 21.1)	28	8.4	(5.2, 11.5)
High school	371	38.4	(34.8, 42.1)	180	28.7	(24.7, 32.7)
Some college	383	31.6	(28.3, 34.9)	359	39.3	(35.4, 43.2)
Bachelor's degree or higher	147	12.1	(9.7, 14.4)	484	23.6	(21, 26.2)
Missing	0			0		
Sexual Orientation						
Gay or lesbian	36	1.3	(0.8, 1.7)	44	1.7	(1, 2.4)
Straight	905	95.7	(94.6, 96.8)	793	93.2	(91.7, 94.7)
Bisexual	47	2.3	(1.5, 3.1)	62	3.1	(2.1, 4)
Something else	13	0.8	(0.2, 1.4)	39	2.0	(1.2, 2.9)
Missing	17			113		
Tobacco Use/History						
Ever Smoked a Cigarette						
Yes	1018	100.0	---	262	21.5	---
Missing	0			0		
Current Cigarette Smoking Frequency						
Every Day	823	79.1	(76, 82.2)	---	---	---
Some Days	195	20.9	(17.8, 24)	---	---	---
Missing	0					
Cigarette Quitting Plans						
No plans to quit smoking	367	37.2	(33.6, 40.9)	---	---	---
Planning to quit in next 30 days	127	11.4	(9.3, 13.6)	---	---	---
Planning to quit in next 6 mo.	192	19.3	(16.3, 22.3)	---	---	---
Planning to quit in future/beyond 6 mo.	328	32.0	(28.6, 35.4)	---	---	---
Missing	4					
Ever Tried an E-Cigarette						
Yes	546	55.7	(52, 59.3)	259	24.8	(21.3, 28.3)
Missing	5			6		
Used an E-Cigarette in Past 30 Days						
Yes	86	10.5	(7.9, 13.1)	48	5.1	(3.2, 7)
Missing	9			7		
E-Cigarette Perceptions						
E-Cigarette Harm Perceptions^c						

Less harmful than smoking	128	12.3	(9.8, 14.8)	217	17.6	(14.6, 20.5)
About as harmful as smoking	390	40.0	(36.4, 43.7)	564	54.6	(50.5, 58.6)
More harmful than smoking	236	22.0	(19.1, 24.9)	152	16.6	(13.4, 19.7)
Don't know	259	25.6	(22.4, 28.9)	109	11.3	(8.7, 13.9)
Missing	5			9		
E-Cigarette Chemical Perceptions^d						
Fewer harmful chemicals than cigarettes	182	18.1	(15.1, 21)	260	21.0	(17.9, 24.1)
About the same as cigarettes	267	27.9	(24.4, 31.3)	378	35.8	(31.9, 39.7)
More harmful chemicals than cigarettes	192	18.5	(15.7, 21.2)	149	18.2	(14.9, 21.6)
Don't know	373	35.6	(32.1, 39.1)	257	24.9	(21.4, 28.5)
Missing	4			7		
^a Ages 18 years or older, currently smoke cigarettes, and have smoked at least 100 cigarettes in lifetime						
^b Ages 18 to 29 years, do not currently smoke cigarettes and have not smoked at least 100 cigarettes in lifetime						
^c As far as you know, is using e-cigarettes or other electronic nicotine vaping products less harmful, about the same, or more harmful to a person's health than smoking cigarettes?						
^d As far as you know, do e-cigarettes or other electronic nicotine vaping products contain fewer harmful chemicals, about the same amount, or more harmful chemicals than cigarettes?						
NOTE: Table reports unweighted frequencies and weighted percentages						

Table 2: Cross-tabulation of E-cigarette Harm Perceptions by E-Cigarette Chemical Perceptions among Adults who Currently Smoke^a and Young Adults who Do Not Smoke^b

	E-Cig Harm Perceptions ^c											
	Less harmful than smoking			About as harmful as smoking			More harmful than smoking			Don't know		
	N	%	(95% CI)	N	%	(95% CI)	N	%	(95% CI)	N	%	(95% CI)
Adult Current Smokers (N=1,018)												
E-Cigarette Chemical Perceptions ^d												
Fewer harmful chemicals than cigarettes	99	51.0	(41.9, 60.1)	58	37.3	(28.1, 46.4)	4	1.2	(0.0, 2.4)	21	10.5	(5.9, 15.2)
About the same as cigarettes	10	3.0	(1.0, 5.0)	20	77.1	(71.7, 83.5)	31	9.7	(6.0, 13.5)	24	9.7	(5.1, 14.3)
More harmful chemicals than cigarettes	0	---	-----	36	18.8	(12.3, 25.3)	13	73.9	(66.9, 80.9)	17	7.3	(3.7, 10.8)
Don't know	19	6.4	(2.6, 10.2)	95	23.2	(18.4, 28.1)	61	14.9	(11.0, 18.8)	19	55.6	(49.5, 61.5)
Young Adult Nonsmokers (N=1,051)												
E-Cigarette Chemical Perceptions ^d												
Fewer harmful chemicals than cigarettes	156	55.7	(47.7, 63.8)	76	33.4	(25.6, 41.1)	9	3.3	(0.9, 5.7)	18	7.6	(3.2, 12.1)
About the same as cigarettes	23	6.0	(3.1, 8.9)	31	84.3	(80.2, 89.2)	34	7.7	(4.3, 11.0)	8	1.6	(0.3, 3.0)
More harmful chemicals than cigarettes	7	6.2	(0.7, 11.7)	49	29.0	(20.4, 37.6)	89	62.2	(52.6, 71.9)	3	2.5	(0.0, 5.7)
Don't know	31	10.5	(5.5, 15.5)	12	47.5	(39.0, 55.5)	20	7.1	(3.5, 10.8)	80	35.1	(27.1, 43.1)

^a Ages 18 years or older, currently smoke cigarettes, and have smoked at least 100 cigarettes in lifetime

^b Ages 18 to 29 years, do not currently smoke cigarettes and have not smoked at least 100 cigarettes in lifetime

^c As far as you know, is using e-cigarettes or other electronic nicotine vaping products less harmful, about the same, or more harmful to a person's health than smoking cigarettes?

^d As far as you know, do e-cigarettes or other electronic nicotine vaping products contain fewer harmful chemicals, about the same amount, or more harmful chemicals than cigarettes?

Unweighted frequencies, weighted percentages

Spearman's rho: Among adult smokers, 0.54 ($p < .001$) or 0.76 ($p < .001$) excluding "don't know" responses; Among young adult nonsmokers, 0.46 ($p < .001$) or 0.65 ($p < .001$) excluding "don't know" responses

Table 3: Prevalence and Odds of Having Any Interest^a in Using E-Cigarettes in the Next Six Months among Adults who Currently Smoke and Young Adults who Do Not Smoke^c

	Overall					Currently Do Not Use E-Cigarettes				
	N	%	(95% CI)	aOR	(95% CI)	N	%	(95% CI)	aOR	(95% CI)
Adult Current Smokers										
E-Cigarette Harm Perceptions ^d										
Less harmful than smoking	90	72.2	(62.2, 82.2)	5.53	(2.93, 10.43)	57	62.3	(49.7, 75)	5.47	(2.85, 10.13)
As harmful as smoking	123	34.5	(28.5, 40.6)	Ref		88	25.1	(19.5, 30.8)	Ref	
More harmful than smoking	24	13.0	(7.7, 18.4)	0.38	(0.21, 0.7)	21	11.4	(6.3, 16.4)	0.41	(0.23, 0.7)
Don't know	71	29.8	(23, 36.7)	1.05	(0.67, 1.65)	57	25.0	(18.5, 31.5)	1.03	(0.65, 1.65)
AIC					969.564					927.892
E-Cigarette Chemical Perceptions ^e										
Fewer harmful chemicals than cigarettes	106	59.9	(51.1, 68.8)	2.45	(1.4, 4.29)	59	43.5	(33.1, 53.8)	2.32	(1.4, 4.29)
About the same harmful chemicals than cigarettes	82	33.5	(26.3, 40.6)	Ref		62	27.1	(19.9, 34.2)	Ref	
More harmful chemicals than cigarettes	21	10.9	(6, 15.9)	0.27	(0.14, 0.52)	16	8.0	(3.7, 12.2)	0.26	(0.13, 0.52)
Don't know	100	31.1	(25.2, 37.1)	1.10	(0.69, 1.75)	87	27.2	(21.6, 32.9)	1.09	(0.68, 1.75)
AIC					997.56					954.528
Young Adult Nonsmokers										
E-Cigarette Harm Perceptions ^d										
Less harmful than smoking	38	18.4	(11.8, 25.1)	1.70	(0.8, 3.61)	20	11.3	(5.5, 17.1)	1.68	(0.78, 3.61)
As harmful as smoking	54	11.9	(7.9, 15.8)	Ref		34	7.2	(4, 10.4)	Ref	
More harmful than smoking	13	9.4	(2.7, 16)	0.95	(0.34, 2.63)	11	7.1	(1.3, 12.9)	0.94	(0.33, 2.63)
Don't know	10	6.0	(1.8, 10.3)	0.54	(0.19, 1.58)	7	4.2	(0.6, 7.7)	0.53	(0.18, 1.58)
AIC					547.454					531.922
E-Cigarette Chemical Perceptions ^e										
Fewer harmful chemicals than cigarettes	39	16.8	(10.7, 23)	1.08	(0.49, 2.37)	21	9.4	(4.4, 14.3)	1.11	(0.51, 2.37)
About the same harmful chemicals than cigarettes	36	13.3	(7.9, 18.7)	Ref		24	9.0	(4.3, 13.7)	Ref	
More harmful chemicals than cigarettes	13	9.5	(3.7, 15.3)	0.72	(0.27, 1.91)	10	6.8	(1.9, 11.6)	0.71	(0.26, 1.91)
Don't know	28	8.6	(4.8, 12.4)	0.48	(0.21, 1.13)	17	4.5	(2, 7)	0.47	(0.19, 1.13)
AIC					547.615					531.154

^a Any interest defined by a response of "extremely," "very," "somewhat," or "not very" interested in using an e-cigarette or other electronic vaping product in the next 6 months (as opposed to "not at all interested")

^b Ages 18 years or older, currently smoke cigarettes, and have smoked at least 100 cigarettes in lifetime (N=1,018, including 923 who currently do not use cigarettes)

^c Ages 18 to 29 years, do not currently smoke cigarettes and have not smoked at least 100 cigarettes in lifetime (N=1,051, including 994 who currently do not use cigarettes)

^d As far as you know, is using e-cigarettes or other electronic nicotine vaping products less harmful, about the same, or more harmful to person's health than smoking cigarettes?

^e As far as you know, do e-cigarettes or other electronic nicotine vaping products contain fewer harmful chemicals, about the same amount, or more harmful chemicals than cigarettes?

NOTES: All models adjusted for age (continuous), sex, race/ethnicity (non-Hispanic Black, Hispanic, non-Hispanic other/multiple race vs. non-Hispanic white), and education (high school or less vs. at least some college). Models among overall samples are additionally adjusted for past 30-day use of e-cigarettes (yes vs. no). Separate models for harm perceptions and chemical perceptions, not included simultaneously. Bolded AIC numbers represent the lower AIC numbers and models with better fit.

Table 4: Prevalence and Odds of Using E-Cigarettes in the past 30 days among Adults who Currently Smoke^a and Young Adults who Do Not Smoke^b					
	N	%	(95% CI)	aOR	(95% CI)
Adult Current Smokers (N=1,018)					
E-Cigarette Harm Perceptions ^c					
Less harmful than smoking	32	25.6	(16.1, 35.1)	2.53	(1.17, 5.44)
As harmful as smoking	36	12.8	(8, 17.6)	Ref	
More harmful than smoking	5	3.1	(0.3, 5.8)	0.21	(0.07, 0.59)
Don't know	13	6.2	(1.9, 10.4)	0.52	(0.22, 1.21)
AIC				594.5	
E-Cigarette Chemical Perceptions ^d					
Fewer harmful chemicals than cigarettes	46	28.8	(20.1, 37.5)	5.09	(2.31, 11.19)
About the same harmful chemicals as cigarettes	21	9.2	(4.7, 13.7)	Ref	
More harmful chemicals than cigarettes	6	4.0	(0.7, 7.4)	0.48	(0.17, 1.38)
Don't know	13	5.6	(1.9, 9.4)	0.78	(0.31, 1.92)
AIC				573.5	
Young Adult Nonsmokers (N=1,051)					
E-Cigarette Harm Perceptions ^c					
Less harmful than smoking	20	8.2	(3.8, 12.6)	1.68	(0.73, 3.85)
As harmful as smoking	23	5.3	(2.5, 8)	Ref	
More harmful than smoking	2	2.4	(0, 6.2)	0.48	(0.09, 2.62)
Don't know	3	1.5	(0, 3.8)	0.30	(0.05, 1.71)
AIC				404.7	
E-Cigarette Chemical Perceptions ^d					
Fewer harmful chemicals than cigarettes	21	9.1	(4.2, 13.9)	2.22	(0.89, 5.5)
About the same harmful chemicals as cigarettes	14	4.8	(1.4, 8.3)	Ref	
More harmful chemicals than cigarettes	3	3.0	(0, 6.6)	0.63	(0.14, 2.79)
Don't know	10	4.0	(1, 6.9)	0.82	(0.3, 2.28)
AIC				420.7	

^a Ages 18 years or older, currently smoke cigarettes, and have smoked at least 100 cigarettes in lifetime

^b Ages 18 to 29 years, do not currently smoke cigarettes and have not smoked at least 100 cigarettes in lifetime

^c As far as you know, is using e-cigarettes or other electronic nicotine vaping products less harmful, about the same, or more harmful to a person's health than smoking cigarettes?

^d As far as you know, do e-cigarettes or other electronic nicotine vaping products contain fewer harmful chemicals, about the same amount, or more harmful chemicals than cigarettes?

NOTES: All models adjusted for age (continuous), sex, race/ethnicity (non-Hispanic Black, Hispanic, non-Hispanic other/multiple race vs. non-Hispanic white), and education (high school or less vs. at least some college). Separate models for harm perceptions and chemical perceptions, not included simultaneously. Bolded AIC numbers represent the lower AIC numbers and models with better fit.