Original investigation

Knowledge About E-Cigarette Constituents and Regulation: Results From a National Survey of U.S. Young Adults

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Abstract

Objectives: To examine young adults' knowledge of e-cigarette constituents and regulation and its association with product use and self-reported exposure to marketing.

Methods: Young adults (18–34 years, $N = 1,247$) from a U.S. web panel were surveyed in March 2014. Using multinomial logistic regressions, self-reported exposure to marketing was examined as a predictor of whether participants responded correctly (reference category), incorrectly, or “don't know” to four knowledge items—whether e-cigarettes contain nicotine, contain toxic chemicals, are regulated by government for safety, and are regulated for use as a cessation aid. Analyses adjusted for demographics and smoking status and were weighted to match the U.S. young adult population.

Results: Most respondents did not know if e-cigarettes, contain toxic chemicals (48%), are regulated for safety (61%), and are regulated as cessation aids (68%); fewer than 37% answered all of these items correctly. Current users of e-cigarettes (past 30 days) had a lower likelihood of being incorrect about safety testing ($p = .006$) and being regulated as a cessation aid ($p = .017$). Higher exposure to e-cigarette marketing was associated with a lower likelihood of responding “don't know” than being correct, and with a higher likelihood of being incorrect as opposed to correct about e-cigarettes containing nicotine.

Conclusions: Knowledge about e-cigarette constituents and regulation was low among young adults, who are the largest consumer group for these products. Interventions, such as warning labels or information campaigns, may be necessary to educate and correct misinformation about these products.

Introduction

Although much research about e-cigarettes has focused on consumer awareness and use of these products,^{1–4} too little is known about consumer knowledge of e-cigarette constituents and federal regulation. The U.S. Food and Drug Administration (FDA) addresses

concerns about consumer knowledge in its proposed rule to regulate e-cigarettes and other electronic nicotine delivery systems under the Family Smoking Prevention and Tobacco Control Act (Tobacco Control Act).⁵ The proposed rule states: “Many consumers believe that e-cigarettes are ‘safe’ tobacco products or are ‘safer’ than

cigarettes. FDA has not made such a determination and conclusive research is not available.”⁵ Indeed, there is growing evidence that e-cigarettes contain many of the toxic substances contained in traditional combustible cigarettes⁶ and many also contain nicotine.⁷ Examples of toxic chemicals contained in e-cigarettes include formaldehyde, acetaldehyde, carbonyls, volatile organic compounds,⁶ and others (see Pisinger and Dossing⁸ for a review). Research on public knowledge about e-cigarettes is urgently needed to inform FDA’s policymaking process.

False beliefs about product regulation—that is, believing that a product is regulated when it is not—can lead people to infer the products are safer.^{9–11} Conversely, accurate beliefs about product regulation may be associated with improved understanding of product risks. For example, smokers who responded that FDA does not regulate cigarettes for safety before they are sold to consumers were more knowledgeable than smokers who thought the FDA regulates cigarettes for safety; the former were less likely to endorse myths that milder, low-tar, or additive-free cigarettes were less dangerous.¹¹

E-cigarette marketing is a source of product information for many consumers¹² and is increasing rapidly.^{4,13–16} Previous research has found that exposure to tobacco marketing can result in public misinformation about the risks of tobacco use^{17,18} and incorrect beliefs.^{19,20} Consumers may believe that e-cigarettes are safer than cigarettes partly due to the marketing messaging, which make e-cigarettes look more appealing and less harmful than combustible tobacco cigarettes.

While print and other mass media advertisements have targeted Whites,²¹ e-cigarette advertisements also appear on websites that are popular among Blacks and Hispanics¹⁶ and at stores located in minority neighborhoods.²² If there is demographic targeting, different demographic groups may diverge in having accurate knowledge about e-cigarettes depending on their level of exposure to e-cigarette marketing.

This study aims to examine young adults’ knowledge of e-cigarette constituents and regulation and its association with product use and self-reported exposure to marketing. We further assessed if knowledge differed by demographic characteristics. The study focuses on young adults because this age group has the highest prevalence of experimentation and use of e-cigarettes in the United States.^{1,4,23} We included nonusers and nonsmokers because their understanding of these products may affect their opinions about regulatory policies, such as regulating marketing or use, and would affect the information available from nonusers and nonsmokers to smokers who are trying to quit.²⁴

Methods

Data Collection

Data for this study was collected in March 2014 (about 2 months prior to the announcement of FDA’s proposed deeming rule). Young adults were surveyed about tobacco use, e-cigarette use, perceived risk of e-cigarettes, support for e-cigarette use restrictions and combustible cigarette use restrictions in public places and a number of items on political orientation and trust in government and individuals. Surveys took place in March 2014 by GfK, Inc. (formerly Knowledge Networks) using a nationally representative web-based panel of U.S. households that was recruited using address-based sampling and random digit dialing. Participants were 1,247 young adults (age 18–34 years), including an oversample of Blacks and Hispanics. Of the panelists who were contacted initially, 95.6% of

participants met inclusion criteria for age and race/ethnicity and the completion rate was 44.7% among eligible participants. This response rate is comparable to those found in Internet surveys of U.S. young adults.^{25,26} The median time to complete the survey was 13 min and compensation was \$10. The study was approved by the Stanford University Institutional Review Board (protocol #25358).

Dependent Variables

Knowledge items about product constituents were based on prior research.^{27–31} The two statements were: (a) “Some e-cigarettes contain nicotine” and (b) “E-cigarettes do not contain any of the toxic chemicals that can be found in combustible cigarettes.” Participants were asked to respond true, false, or don’t know. The correct response for the statement about some e-cigarettes containing nicotine was “true” while the correct response for the other item was “false.” In addition, participants were asked to respond to two statements about regulation: (a) “The federal government requires product safety testing for e-cigarettes” and (b) “The federal government regulates e-cigarettes as smoking cessation aids.” The correct response for these two items about e-cigarette regulations was “false.” Responses were coded as correct, incorrect and “don’t know.” Between 1.3% and 2.6% of respondents refused to answer and were coded as “don’t know.” We did not combine incorrect and “don’t know” because those who possess inaccurate information or false beliefs about e-cigarettes may require different types of communication messages than those who possess no information or opinion (“don’t know”).^{32,33} Both responses suggest the need for some form of communication intervention, but replacing or correcting misinformation may be more difficult than simply informing someone who has not yet received information.³⁴

Self-Reported Exposure to E-Cigarette Marketing

Self-reported exposure was measured using four items: “In the past 30 days, how often did you see advertisements for e-cigarettes (a) when you went to a convenience store, liquor store, or gas station, (b) when you used social media such as Facebook, Twitter, or YouTube, (c) when watching television or cable shows, and (d) when reading newspapers or magazines?” Each item was on a four-point scale (don’t know/never [0], once or twice [1], three or four times [2], five or more times [3]). The items were summed in a scale with a single-factor solution (Cronbach’s $\alpha = .78$; Mean = 1.61, SD = 2.10). Sensitivity analyses using self-reported exposure to e-cigarette marketing variables as separate predictors did not significantly improve model fit (analyses are available on request).

Tobacco Use

E-cigarette use was categorized as “never user,” “ever user but not in the past 30 days,” and “current user” (any use in the past 30 days). Smoking status was categorized as “nonsmoker (less than 100 cigarettes in their lifetime),” “former smoker (smoked at least 100 cigarettes in their lifetime but none in the past 30 days),” “non-daily smoker,” and “daily smoker” based on the number of days smoked in the past 30 days.

Sociodemographics

Variables were age, gender, race/ethnicity (non-Hispanic White, non-Hispanic Black, Other non-Hispanic, and Hispanic), level of education (less than high school, high school, some college, Bachelor’s degree or higher) and household income (<\$10,000,

\$10,000–\$24,999, \$25,000–\$49,999, \$50,000–\$74,999, and \$75,000 or more).

Analyses

Multinomial logistic regression analyses were adjusted using post-stratification weights to match the study population to the U.S. young adult population. The following variables were used for post-stratification weighting: gender, age, race/ethnicity, education, Census region, household income, home ownership status, metropolitan area (yes/no), and internet access (yes/no). All analyses were completed in Stata/MP Version 13. Using the `mlogit` command, four multinomial logistic regression models were fitted to predict knowledge about product constituents and regulation as a function of e-cigarette use, self-reported exposure to e-cigarette marketing, and other demographic variables. We fitted the models to predict “don’t know” or incorrect with correct as the reference category and reported relative risk ratios (RRR), 95% CI and *p* values. “Correct” was assigned as the reference category because all others are the most likely targets for future intervention. Although examining responses to knowledge as three categories (rather than combining “incorrect” with “don’t know”) is more common in political science and political communication, there are also relevant public health examples.³⁵

Results

Participants

Mean age of the sample was 26.8 years (*SD* = 4.7). Slightly more than half of the respondents were non-Hispanic White (54%), 20% were non-Hispanic Black, and 19.2% were Hispanic. Further description of participant demographics can be found in Table 1. Approximately one in five respondents (21.7%) were current smokers, including 12.6% who were non-daily smokers and 9.1% who were daily smokers. Although the prevalence of current smoking was slightly higher than that reported for adults in the National Health Interview Survey (17.8%),³⁶ young adults typically smoke at higher rates, particularly non-Hispanic Blacks and non-Hispanic Whites.³⁷

One in four respondents (25.3%) had ever used e-cigarettes and 7.9% used them in the past 30 days. Of the 98 respondents who used e-cigarettes in the past 30 days, 18.3% were non-smokers, 63.3% were current smokers, and 18.4% were former smokers.

Knowledge of E-Cigarette Constituents and Regulation

The modal response for all four knowledge items was “don’t know.” Though most respondents (57.3%) did know that some e-cigarettes contain nicotine, respondents were primarily incorrect or responded don’t know for the other items. (Table 2). Being incorrect about toxic chemicals was more common: 31.5% of young adults believed

that e-cigarettes contain none of the toxic chemicals that can be found in combustible cigarettes. Compared to knowledge about product constituents, even fewer young adults were knowledgeable about regulation (Table 2). Only 12.5% correctly answered that the federal government does not require safety testing for e-cigarettes and 16.1% correctly answered that the federal government does not regulate e-cigarettes as cessation aids.

The level of correct knowledge to each of the four knowledge items by demographic characteristics, tobacco use, and marketing exposure is available in online [Supplementary Table 1](#). Results suggest that Blacks were less likely to answer these knowledge items correctly than other groups. A lower proportion of nonsmokers and daily smokers were correct on items about regulation compared with former smokers and non-daily smokers. Never users of e-cigarettes were less likely to respond correctly to items about regulation than ever or current users. Those with higher marketing exposure were less likely to be correct about product constituents and less likely

Table 1. Sample Descriptive Statistics for U.S. Young Adults

	Unweighted		Weighted
	<i>n</i>	%	%
Gender			
Male	633	50.8	50.7
Female	614	49.2	49.2
Race/ethnicity			
White non-Hispanic	673	54.0	52.7
Black non-Hispanic	249	20.0	20.0
Hispanic	239	19.2	19.2
Other non-Hispanic	86	6.9	8.1
Education (categorical)			
Less than high school	112	9.0	12.2
High school	302	24.2	27.5
Some college	428	34.3	35.9
Bachelor’s degree or more	405	32.5	24.4
Income			
<\$10,000	218	17.5	16.5
\$10,000–\$24,999	191	15.3	10.5
\$25,000–\$49,999	197	15.8	15.6
\$50,000–\$74,999	229	18.4	19.5
≥\$75,000	412	33.0	37.9
Smoking status			
Nonsmoker	843	67.6	66.7
Former smoker	133	10.7	10.9
Non-daily smoker	157	12.6	12.9
Daily smoker	114	9.1	9.5
E-cigarette use			
Never use	931	74.7	74.1
Ever use	218	17.5	18.0
Past 30 days	98	7.9	7.9

Table 2. Knowledge About E-Cigarette Constituents and Regulation: U.S. Young Adults (*n* = 1,247)

	% Incorrect	% Don’t know/refused	% Correct
Some contain nicotine	5.8	37.0	57.3
Do NOT contain any toxic chemicals	31.5	48.4	20.1
Federal government requires safety testing	26.9	60.6	12.5
Federal government regulates e-cigarettes as cessation aids	16.4	67.5	16.1

Refused responses were between 1.28% and 2.57%. We performed Stuart-Maxwell tests comparing each pair of knowledge items to test whether the proportions of informed = correct and misinformed = incorrect were significantly differently between items (all *ps* ≤ .00005).

to be respond “don’t know” about regulation items than those with lower marketing exposure.

Multinomial Logistic Regression Results for Product Constituents

Table 3 summarizes the adjusted RRRs predicting being incorrect and “don’t know” versus correct (the reference category). Compared with never users of e-cigarettes, ever users (not in the past 30 days) ($RRR = 0.44, p < .001$) and current users (any use in the past 30 days) ($RRR = 0.35, p < .001$) of e-cigarettes had lower likelihood of responding they did not know that some e-cigarettes contain nicotine. Daily smokers were more likely than nonsmokers to respond “don’t know” to the item about e-cigarettes containing toxic chemicals ($RRR = 1.78, p = .047$). Reporting more frequent exposure to e-cigarette marketing was associated with a lower likelihood of responding “don’t know” to knowledge items about nicotine ($RRR = 0.81, p < .001$) and toxic chemicals ($RRR = 0.85, p < .001$). However, reporting more frequent exposure to e-cigarette marketing was also associated with higher likelihood of responding incorrectly to the item about nicotine ($RRR = 1.12, p = .031$).

Several participant demographics were associated with product knowledge. Specifically, Black non-Hispanics had higher likelihood of being incorrect or responding “don’t know” to both items about product knowledge. Other non-Hispanics and Hispanics had higher likelihood of answering “don’t know” or incorrectly about e-cigarettes containing nicotine but there was no ethnic difference on knowledge about toxic chemicals. Those with a Bachelor’s degree or higher had lower likelihood of responding “don’t know” and incorrect than correct to questions about e-cigarettes containing nicotine. There were no significant effects for income and a small but statistically significant effect of age such that older individuals were more likely to respond “don’t know”.

Multinomial Logistic Regression Results for Federal Regulation

Table 4 summarizes the adjusted RRRs predicting being less likely to respond incorrect and “don’t know” versus being correct (the reference category). Current (past 30 day) users of e-cigarettes were less likely to be incorrect about safety testing ($RRR = 0.34, p = .006$) and being regulated as a cessation aid ($RRR = 0.39, p = .017$). They also had a lower likelihood of responding “don’t know” ($RRR = 0.44, p = .007$) versus being correct for the question about regulating e-cigarettes as a cessation aid. Greater self-reported exposure to e-cigarette marketing was associated with lower likelihood of responding “don’t know” to the question about safety testing ($RRR = 0.77, p < .001$) and regulation for cessation ($RRR = 0.78, p < .001$). Non-Hispanic Blacks had a greater likelihood of responding “don’t know” or incorrectly than non-Hispanic Whites to both items about regulation. Other non-Hispanics were more likely to respond “don’t know” to the item about e-cigarettes as a cessation aid.

Discussion

This population-based survey of U.S. young adults found that many were either uninformed or incorrect about e-cigarette constituents. A majority of young adults were also either incorrect or answered “don’t know” about e-cigarette regulations. This is less surprising, given that the survey was conducted before FDA announced its proposed deeming rule, and is likely to change with increasing media

coverage about public comments and rule making. However, lack of knowledge or interest about regulation and safety testing raises concerns about young adults’ ability to assess the relative harm of unregulated and regulated products.

There is very little association between combustible cigarette use and knowledge about e-cigarettes. However, current users of e-cigarettes were more likely to have correct knowledge about e-cigarette regulation, but e-cigarette users in general were more likely to respond “don’t know” than to be correct about e-cigarettes containing nicotine. This may suggest the need for ingredient labels on e-cigarette packaging about e-cigarettes containing nicotine.

This study also suggests that e-cigarette marketing may serve as a source of information, both accurate and inaccurate, about e-cigarette constituents and regulations. Exposure to marketing may help young adults to feel more informed since more frequent self-reported exposure to marketing was associated with a reduced likelihood of responding “don’t know” for three of the four knowledge items (the exception being the item about whether e-cigarettes are regulated as a cessation aid). However, greater self-reported exposure to marketing also was associated with a greater likelihood of being incorrect about e-cigarettes containing nicotine. The study findings suggest a need for additional sources of information about e-cigarettes that can inform people about e-cigarettes and their benefits and risks. These sources of information could include public awareness campaigns, or other health education interventions, as well as warning labels on packaging or in advertising. However, efforts aimed at informing the public may need to address two audiences—those who “don’t know” and those who think they do, but actually hold incorrect beliefs. Communicators seeking to inform audiences may need to consider whether segmentation strategies are necessary and pretest messages to effectively communicate to both groups.

The current study found that compared to other racial/ethnic groups, non-Hispanic Blacks had a higher likelihood of responding “don’t know” and incorrectly about e-cigarettes. Thus, non-Hispanic Blacks were both more uncertain of their knowledge and also less correct. We are unable to ascertain from this analysis if uncertainty is in part due to lack of interest in e-cigarettes, although rates of e-cigarette use have increased among non-Hispanic Blacks as they have in other population groups.³⁸ However, these results suggest evidence of a knowledge gap among race/ethnic minorities and indicate that they may benefit from additional information. Although the cause of this knowledge gap is unknown, it is possible that targeted marketing toward non-Hispanic Whites may be increasing their accurate knowledge of e-cigarettes and producing informational differences across race/ethnicity.

As marketing evolves and public health campaigns are implemented, similar questions should be included in longitudinal research to monitor trends in young adults’ exposure to e-cigarette marketing and their knowledge about e-cigarette constituents and regulation. Further, it would be important to understand how these trends are associated with consumer risk perceptions and behaviors related to e-cigarettes.

Limitations

The main limitation is that a cross-sectional survey cannot disentangle the directional effect of self-reported exposure to marketing on knowledge of e-cigarette constituents and regulation. This study cannot detect differences between exposure to different marketing channels because, exposure across channels was highly correlated.

Table 3. Correlates of Knowledge About E-Cigarette Constituents Among U.S. Young Adults Using Multinomial Logistic Regression Analysis (Reference Category is Correct Knowledge) (*n* = 1,247)

	Contains nicotine				Contains toxic chemicals			
	Don't know		Incorrect		Don't know		Incorrect	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
E-cigarette use (reference never use)								
Ever user, not in past 30 days	0.44**	0.29, 0.67	1.09	0.54, 2.20	0.77	0.51, 1.18	1.33	0.82, 2.15
Current user (past 30 days)	0.25***	0.13, 0.48	0.84	0.33, 2.14	0.76	0.42, 1.36	1.61	0.86, 3.01
Smoking (reference nonsmoker)								
Former smoker	0.80	0.51, 1.27	1.25	0.56, 2.79	0.96	0.60, 1.54	1.41	0.81, 2.44
Non-daily smoker	0.72	0.44, 1.18	0.87	0.38, 1.97	1.09	0.67, 1.78	1.18	0.67, 2.07
Daily smoker	1.16	0.70, 1.91	0.45	0.14, 1.44	1.78*	1.01, 3.14	1.34	0.68, 2.65
Exposure to e-cigarette marketing	0.81***	0.76, 0.87	1.12*	1.01, 1.25	0.85***	0.79, 0.91	1.05	0.98, 1.13
Female	1.04	0.81, 1.34	1.29	0.77, 2.15	0.87	0.67, 1.13	0.66*	0.47, 0.91
Race (reference White non-Hispanic)								
Black non-Hispanic	2.97***	2.11, 4.17	3.26***	1.62, 6.56	2.48***	1.67, 3.71	2.92***	1.82, 4.68
Other non-Hispanic	1.75**	1.24, 2.47	2.36*	1.21, 4.58	0.97	0.68, 1.40	1.18	0.76, 1.83
Hispanic	1.92*	1.16, 3.20	3.42**	1.39, 8.41	1.19	0.70, 2.02	1.45	0.76, 2.75
Education (less than high school)								
High school	0.74	0.45, 1.22	1.02	0.45, 2.31	0.95	0.55, 1.65	1.03	0.54, 1.94
Some college	0.67	0.41, 1.09	0.48	0.20, 1.12	0.90	0.53, 1.54	0.80	0.43, 1.49
Bachelor's degree or higher	0.44**	0.26, 0.74	0.24**	0.09, 0.67	0.56*	0.32, 1.00	0.69	0.35, 1.35
Income (reference <\$10,000)								
\$10,000–\$24,999	1.02	0.66, 1.57	0.96	0.42, 2.24	1.40	0.85, 2.30	1.15	0.63, 2.07
\$25,000–\$49,999	0.75	0.48, 1.16	0.75	0.31, 1.82	0.77	0.48, 1.22	0.77	0.44, 1.36
\$50,000–\$74,999	0.67	0.43, 1.03	1.12	0.46, 2.69	0.85	0.54, 1.35	0.69	0.39, 1.23
>\$75,000	0.91	0.62, 1.34	1.40	0.64, 3.10	0.90	0.59, 1.36	0.99	0.59, 1.65
Age	1.03*	1.00, 1.06	0.98	0.92, 1.04	1.05**	1.01, 1.08	1.00	0.96, 1.04
Constant	0.67	0.28, 1.59	0.12*	0.02, 0.66	0.72	0.28, 1.82	0.60	0.19, 1.84

CI = confidence interval; RRR = relative risk ratio.

p* < .05; *p* < .01; ****p* < .001.

Table 4. Correlates of Knowledge About E-Cigarette Regulation Among U.S. Young Adults Using Multinomial Logistic Regression Analysis (Reference Category is Correct Knowledge) (*n* = 1,247)

	Safety testing				Cessation aid			
	Don't know		Incorrect		Don't know		Incorrect	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
E-cigarette use (reference never use)								
Ever user, not in past 30 days	0.77	0.45, 1.31	0.68	0.38, 1.21	0.68	0.42, 1.10	0.92	0.52, 1.64
Current user (past 30 days)	0.69	0.35, 1.36	0.34**	0.16, 0.74	0.44**	0.24, 0.80	0.39*	0.18, 0.85
Smoking (reference nonsmoker)								
Former smoker	0.93	0.52, 1.67	0.86	0.44, 1.66	1.29	0.72, 2.30	1.06	0.51, 2.20
Non-daily smoker	0.74	0.40, 1.37	1.34	0.70, 2.56	0.62	0.36, 1.06	0.99	0.52, 1.88
Daily smoker	1.56	0.74, 3.28	1.41	0.62, 3.19	1.24	0.64, 2.40	1.38	0.63, 3.02
Exposure to e-cigarette marketing	0.77***	0.71, 0.84	1.02	0.93, 1.11	0.78***	0.72, 0.84	1.01	0.93, 1.10
Female	1.07	0.74, 1.53	0.92	0.62, 1.36	0.96	0.69, 1.34	0.82	0.55, 1.23
Race (reference White non-Hispanic)								
Black non-Hispanic	1.95*	1.13, 3.38	1.89*	1.05, 3.39	2.17**	1.32, 3.55	1.98*	1.11, 3.52
Other non-Hispanic	1.29	0.79, 2.11	1.39	0.82, 2.36	1.81*	1.13, 2.90	1.57	0.90, 2.76
Hispanic	1.11	0.54, 2.29	1.61	0.76, 3.43	1.33	0.70, 2.51	1.13	0.50, 2.52
Education (less than high school)								
High school	0.89	0.44, 1.81	1.18	0.55, 2.56	1.07	0.56, 2.04	1.19	0.55, 2.55
Some college	1.13	0.56, 2.26	1.31	0.61, 2.82	1.18	0.63, 2.22	0.90	0.42, 1.91
Bachelor's degree or higher	1.05	0.50, 2.23	1.99	0.87, 4.52	1.05	0.53, 2.07	1.03	0.45, 2.33
Income (reference <\$10,000)								
\$10,000–\$24,999	1.19	0.60, 2.38	1.59	0.76, 3.34	1.30	0.69, 2.46	1.19	0.56, 2.54
\$25,000–\$49,999	0.76	0.40, 1.43	1.08	0.55, 2.14	0.62	0.35, 1.11	0.78	0.39, 1.56
\$50,000–\$74,999	0.82	0.44, 1.52	0.64	0.32, 1.28	0.90	0.50, 1.62	1.04	0.51, 2.12
>\$75,000	0.77	0.43, 1.37	0.84	0.45, 1.57	0.65	0.39, 1.10	0.69	0.37, 1.32
Age	0.99	0.95, 1.03	0.97	0.93, 1.01	1.01	0.97, 1.05	1.00	0.96, 1.05
Constant	11.14***	3.21, 38.70	3.36	0.86, 13.09	5.41**	1.77, 16.55	0.98	0.25, 3.84

CI = confidence interval; RRR = relative risk ratio.

p* < .05; *p* < .01; ****p* < .001.

However, both channel and source factors likely contribute to the extent to which marketing claims contain more or less accurate information about e-cigarettes.³⁹ The study did not assess the contents of e-cigarette marketing that participants were exposed to or their motives for using e-cigarettes, which may moderate the association between self-reported marketing exposure and product knowledge.

The type of information in marketing varies by brand and there is variability in whether e-cigarettes are marketed as containing nicotine.⁴⁰ The knowledge item on nicotine reflected the fact that some e-cigarettes (but not all) contain nicotine. As a result, choosing “false” for this item was coded as incorrect, but it may be ambiguous as to whether the respondent believed all or no e-cigarettes contain nicotine. As with most surveys, there is some uncertainty in whether answering “don’t know” to the knowledge items reflects actual lack of knowledge versus disinterest in answering the survey items (i.e., satisficing on the part of the respondent).

Future research should endeavor to tease out the effects of different marketing and communication channels and content on knowledge about e-cigarettes, and the impact of self-reported exposure to e-cigarette marketing on change in knowledge about constituents and regulation. The response rate was fairly low but consistent with other web panel surveys of young adults. Although Hispanics and non-Hispanic Blacks were oversampled, there are still important U.S. racial/ethnic subpopulations that were not adequately represented. Larger population-based surveys are needed to track the possibility of knowledge gaps regarding e-cigarette constituents and regulation, particularly among population subgroups that are targets of e-cigarette marketing.

Implications

Most U.S. young adults do not know about e-cigarettes constituents or regulations and sometimes what “knowledge” they have is incorrect. Conducted just months before FDA announced its proposed deeming rule, the study results provide some baseline information about young adults’ knowledge about e-cigarettes for comparison with future studies following the implementation of federal regulations.

The results from this study also identify important misconceptions about e-cigarettes among young adults that are amenable to public communication interventions. Interventions such as warning labels and public health campaigns may be helpful in counteracting misinformation that people are exposed to in the mediated environment and increasing awareness of e-cigarette constituents and regulations. Further research that explores effective strategies to communicate with young adults’ about e-cigarette constituents and regulations is recommended.

Supplementary Material

Supplementary Table 1 can be found online at <http://www.ntr.oxfordjournals.org>

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Declaration of Interests

None declared.

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