

E-Cigarette Awareness and Perceived Harmfulness

Prevalence and Associations with Smoking-Cessation Outcomes

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Background: Electronic cigarettes, or e-cigarettes, are increasingly advertised as replacements for regular cigarettes or cessation aids for smokers.

Purpose: To describe the prevalence and correlates of e-cigarette awareness and perceived harmfulness among U.S. adults and analyze whether these variables are associated with smokers' past-year quit attempts and intention to quit.

Methods: Data were obtained from the Health Information National Trends Survey (HINTS 4 Cycle 2), conducted from October 2012 to January 2013. Data analyses were performed from June to August 2013.

Results: Overall, 77% of respondents were aware of e-cigarettes. Of these, 51% believed e-cigarettes were less harmful than cigarettes. Younger, white (compared with Hispanic), more educated respondents and current or former smokers (compared with non-smokers) were more likely to be aware of e-cigarettes. Among those who were aware of e-cigarettes, younger, more educated respondents and current smokers (compared with former and non-smokers) were more likely to believe that e-cigarettes were less harmful. Awareness and perceived harm were not associated with smokers' past year quit attempts or intention to quit.

Conclusions: Overall e-cigarette awareness increased whereas the proportion of smokers who perceived less harm of e-cigarettes declined compared with earlier surveys. However, awareness and perceived harm of e-cigarettes did not show evidence of promoting smoking cessation at the population level.

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Introduction

Electronic cigarettes, also known as e-cigarettes, are defined as “battery-operated products designed to deliver nicotine, flavor, and other chemicals.”¹ E-cigarettes are marketed through various media channels,² sports or music events,^{3,4} and outdoor or in-store displays.^{2,5} E-cigarettes have been portrayed in the media as competing products to traditional cigarettes and a

cessation aid. For instance, some online marketing strategies communicate that e-cigarettes are safer alternatives to regular cigarettes.⁶

Increasingly, e-cigarette use is appearing in news stories and entertainment media.^{2,7} Some YouTube videos, for example, feature e-cigarettes use on entertainment shows by celebrities who claim that e-cigarettes are safer than regular cigarettes.^{8,9} Other videos misrepresent e-cigarettes as medical products and smoking-cessation aids.^{8,9} The products are not currently approved by the U.S. Food and Drug Administration (FDA) for smoking cessation.¹⁰

As awareness of e-cigarettes and their potential competitive advantages to traditional cigarettes increases because of marketing and publicity, it is possible that use of traditional cigarettes will decline. Prior research on the marketing of nicotine replacement therapies and other established cessation aids suggest a link between advertising exposure and cessation intentions and behaviors. Avery

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and colleagues,¹¹ for example, found that increased exposure to magazine advertisements of cessation products (e.g., Habitrol, Nicoderm patch, Nicorette Gum, Nicotrol, Pro-step patch, and Zyban) was associated with an increased likelihood of attempted and successful quitting.

In a study among smokers, increased recall of cessation methods—the most frequently recalled methods being the nicotine patch, nicotine gum, and Zyban or prescription medications—and perceived effectiveness of cessation aids were significantly associated with intentions to quit.¹² These studies suggest that advertising exposure and recall of cessation products could influence smokers' quit intentions and successful quitting.

Of course, awareness is a necessary but not always sufficient condition for adoption of new technologies or behaviors.^{13,14} Diffusion of innovation and behavior change theories offer frameworks that help explain how awareness of e-cigarettes and beliefs about their harmfulness could influence cessation-related psychosocial factors (e.g., outcome expectancies, subjective norms, and self-efficacy to use e-cigarettes to quit smoking) and ultimately cessation behavior.¹³⁻¹⁶

For example, adoption of alternatives to traditional cigarette smoking such as e-cigarettes and other cessation products appear to be driven in part by perceptions of reduced harm as a relative advantage.^{17,18} However, there is an ongoing debate within the public health community about whether e-cigarettes are a viable alternative for harm reduction, and whether smokers are merely supplementing or truly replacing their smoking with e-cigarettes and achieving smoking cessation.

Although e-cigarettes are characterized as replacements for regular cigarettes or cessation aids for smokers,² the evidence on the harm-reduction potential of e-cigarettes as cessation products is mixed. For instance, clinical trials showed that e-cigarettes could help some smokers who are trying to quit to achieve abstinence rates comparable to those using nicotine patches.¹⁹⁻²¹ A national survey found that current e-cigarette users were more likely to have attempted to quit smoking in the previous year and tried to quit for longer than 24 hours compared with those who were not current e-cigarette users.²²

Other studies suggest that e-cigarette use might interfere with successful quitting. One study reported that current smokers who tried using e-cigarettes did not differ from those who never tried e-cigarettes in their quit intentions or attempts in the past year.²³ In another survey, smokers who used e-cigarettes were more likely to reduce cigarette consumption, but the rates of successful quitting were not different from those who did not use e-cigarettes.²⁴ State quitline clients who had used e-cigarettes were significantly less likely to be tobacco-abstinent at follow-up compared with non-users.²⁵

Study Objectives

If e-cigarettes are in fact being viewed as a competitor or replacement for smoking cigarettes owing to a comparative advantage with regard to reduced harmfulness, then awareness and perceived harmfulness of e-cigarettes may be associated with cessation intentions or quit attempts among current smokers. Several national surveys indicate a steady increase in awareness of e-cigarettes between 2009 and 2012 among the general U.S. population.^{22-24,26-28}

Given the rapidly evolving landscape in advertising and media coverage of e-cigarettes, the first objective of this study is to describe the prevalence of awareness and perceived harmfulness of e-cigarettes compared with regular cigarettes using a nationally representative survey of U.S. adults conducted between late 2012 and early 2013. There is also a gap in the literature regarding the impact of increased publicity and awareness about the purported harm-reduction potential of e-cigarettes on cessation outcomes. Therefore, the second objective of this study is to examine whether the awareness and perceived harmfulness of e-cigarettes are associated with quit attempts or intentions to quit among smokers.

Methods

Data Source

Data were obtained from the most recent round of the Health Information National Trends Survey (HINTS 4 Cycle 2) conducted between October 2012 and January 2013 by the National Cancer Institute.²⁹

Sample

The sampling frame included U.S. adults aged ≥ 18 years. For the first stage of the stratified sampling procedure, a sample of addresses was randomly selected from three strata: areas with high concentrations of minorities, areas with low concentrations of minorities, and counties comprising Central Appalachia. In the second stage, one adult was selected within each sampled household using the next birthday method. Minority respondents (Hispanics and African Americans) were oversampled.

Data were collected using mailed self-administered questionnaires following a modified Dillman approach.³⁰ In this survey, 3,630 respondents completed the questionnaire, yielding an overall response rate of 39.97%, as computed using the RR2 formula from the American Association of Public Opinion Research.³¹ This response rate is comparable with previous HINTS iterations using address-based sampling strategies.³² Additional details of the survey design and administration are available elsewhere.³³

Measures

The survey asked the following question: *New types of cigarettes are now available called electronic cigarettes (also known as e-cigarettes or personal vaporizers). These products deliver nicotine through a vapor. Compared to smoking cigarettes, would you say that electronic cigarettes are...much less harmful/less harmful/just as*

harmful/more harmful/much more harmful/I've never heard of electronic cigarettes?

Respondents who answered they have never heard of electronic cigarettes were coded as being unaware of e-cigarettes and all other responses were coded as being aware. Item non-response, multiple responses, and missing values were coded as missing ($n=143$). Perceived harmfulness among those who were aware of e-cigarettes was dichotomized into less harmful versus equally or more harmful because of the skewed distribution of the responses (<3% of respondents answered more harmful or much more harmful).

Smoking status was based on self-reported smoking, consistent with other research.^{23,26,27} Respondents who have never smoked up to 100 cigarettes in their lives were classified as non-smokers. Those who smoked at least 100 cigarettes in their lives but were currently not smoking at all were classified as former smokers. Those who smoked at least 100 cigarettes in their lives and were smoking daily or on some days were classified as current smokers.

Current smokers were asked if in the past year they have stopped smoking for 1 day or longer because they were trying to quit (past year quit attempt) and if they are seriously considering quitting smoking in the next 6 months (intention to quit). Potential confounders included demographic variables (i.e., age, gender, race/ethnicity, and education level), health status, Census region, and household income.

Statistical Analyses

Data were analyzed between June and August 2013 with Stata, version 13 (StataCorp LP, College Station TX), using descriptive statistics and multiple logistic regression models. Prevalence and predictors of awareness of e-cigarettes were analyzed among the overall sample. For the distribution and predictors of perceived harmfulness of e-cigarettes, the analysis was restricted to respondents who were aware of e-cigarettes.

To evaluate the harm-reduction potential of e-cigarettes, multiple logistic regression models assessed whether awareness and perceived harmfulness of e-cigarettes were associated with reporting past-year quit attempts and the intention to quit among current smokers. All logistic regression models controlled for the aforementioned potential confounders and were weighted to the U.S. general adult population using full sample and replicate weights provided in the HINTS data set.³³

These weights were necessary to adjust for the stratified sampling design, oversampling of certain subpopulations, and correction for non-response and non-coverage biases in order to ensure valid inferences from the responding sample to the general population.³³ Missing values on dependent variables were excluded from the analyses. To reduce potential bias, missing values for each predictor variable were treated as a separate category in the logistic regression models.³²

Results

Table 1 summarizes the sample characteristics (weighted to the general U.S. adult population). Most respondents were white, had some college or higher education, reported annual household income <\$75,000, were in good to excellent health, and did not smoke currently.

Prevalence and Correlates of E-Cigarette Awareness

Figure 1 shows that a steady increase in the awareness of e-cigarettes based on earlier national surveys among U.S. adults occurred from 16.4% in 2009 to 77.1% in the current study.^{23,26,27} In the multivariate analysis, older participants aged 65–74 years and those aged ≥ 75 years had 62% and 82% lower odds of being aware of e-cigarettes, respectively, compared with young adults aged 18–34 years.

Hispanic respondents had 62% lower odds of e-cigarette awareness than white respondents. Respondents with a college or higher education level had 1.75-fold increased odds of being aware than those with high school or lower education. Current and former smokers had 3.37- and 1.62-fold higher odds of being aware of e-cigarettes, respectively, than non-smokers (Table 2).

Prevalence and Correlates of Perceptions of E-Cigarette Harmfulness

Figure 2 shows that a slight decline in the proportion of current smokers who were aware of e-cigarettes and believed that e-cigarettes are less harmful than smoking regular cigarettes occurred from 84.7% in 2010 to 65.0% in the current study. Data for non-smokers and former smokers were not available from these earlier surveys for comparison with the current study.

Table 2 presents the multivariate analyses predicting beliefs about e-cigarette harms versus regular cigarettes. Older respondents had 38%–72% lower odds of believing that e-cigarettes are less harmful than regular cigarettes compared with those aged 18–34 years. Those who had college or higher education had 2.06-fold higher odds than participants with high school or lower education of believing e-cigarettes were less harmful. Current smokers in the study had 2.53-fold higher odds of holding this belief compared with non-smokers.

Associations with Past Year Quit Attempts and Intention to Quit

Awareness was not associated with current smokers' quit attempts in the past year or their intention to quit in the next 6 months. Similarly, among those who were aware of e-cigarettes, perceived harmfulness of e-cigarettes compared with regular cigarettes was not associated with current smokers' quit attempts or intention to quit (Tables 3 and 4).

Discussion

Compared with earlier national surveys among U.S. adults, this study found a notable increase in public

Table 1. Characteristics of study sample: unweighted sample size and weighted percentages

| | n (weighted %) |
|-------------------------------------|----------------|
| Age (years) | |
| 18-34 | 529 (29.8) |
| 35-49 | 845 (25.8) |
| 50-64 | 1,168 (25.0) |
| 65-74 | 555 (9.2) |
| ≥ 75 | 414 (7.8) |
| Missing | 119 (2.6) |
| Gender | |
| Male | 1,390 (47.7) |
| Female | 2,172 (50.5) |
| Missing | 68 (1.8) |
| Race/ethnicity | |
| White | 2,043 (61.6) |
| African-American | 496 (10.0) |
| Hispanic | 511 (13.7) |
| Other ^a | 208 (6.5) |
| Missing | 372 (8.2) |
| Education | |
| High school or below | 329 (13.2) |
| Completed high school | 775 (19.9) |
| Some college | 1,057 (36.8) |
| College graduate or higher | 1,380 (28.1) |
| Missing | 89 (1.9) |
| Annual household income (\$) | |
| <20,000 | 837 (21.3) |
| 20,000-34,999 | 550 (14.5) |
| 35,000-49,999 | 51 (15.2) |
| 50,000-74,999 | 570 (16.1) |
| ≥ 75,000 | 1,043 (30.2) |
| Missing | 119 (2.6) |
| Health status | |
| Excellent | 382 (11.2) |
| Very good | 1,232 (35.9) |
| Good | 1,277 (34.1) |
| Fair | 509 (12.9) |
| | (continued) |

Table 1. (continued)

| | n (weighted %) |
|-----------------------------------|----------------|
| Poor | 123 (3.0) |
| Missing | 107 (2.9) |
| U.S. Census region | |
| Northeast | 561 (18.2) |
| Midwest | 684 (21.5) |
| South | 1,542 (37.1) |
| West | 843 (23.1) |
| Smoking status^b | |
| Non-smoker | 2,052 (58.1) |
| Current | 586 (18.5) |
| Former | 939 (22.4) |
| Missing | 53 (1.0) |

^aParticipants who were categorized as "other" were those who identified as non-Hispanic American Indian or Alaskan, Asian, Native Hawaiian or other Pacific Islander, or multiple races. Smoking status was based on self-reported smoking consistent with other research.

^bRespondents who have never smoked up to 100 cigarettes in their lives were classified as non-smokers. Current smokers were those who smoked at least 100 cigarettes in their lives and were smoking daily or on some days. Former smokers were those who smoked at least 100 cigarettes in their lives but were currently not smoking at all.

awareness of e-cigarettes since 2009. In the beginning of 2013, more than three in four respondents were aware of this novel product. The rise in awareness of e-cigarettes could reflect sharp increases in advertising expenditures by manufacturers, availability in retail stores across the country, and presence in popular media in the time between the national surveys.² This trend suggests that e-cigarette awareness is increasingly prevalent and could be almost universal among U.S. adults in the near future.

However, it is worth noting that there were differences in awareness across certain socioeconomic factors. Consistent with previous research, older respondents, those with lower education, and some minorities were not as aware of e-cigarettes.^{22,23,26,27} These persistent disparities in awareness may be consequential for tobacco control efforts among vulnerable populations depending on whether e-cigarettes turn out to be, on balance, helpful or harmful regarding smoking uptake and cessation efforts.

The implications of increasingly widespread awareness of e-cigarettes in the general population are presently unclear. Despite the high levels of awareness, only 6% of U.S. adults reported ever using e-cigarettes.²⁷ Among smokers, ever use of e-cigarettes was estimated at 32% in

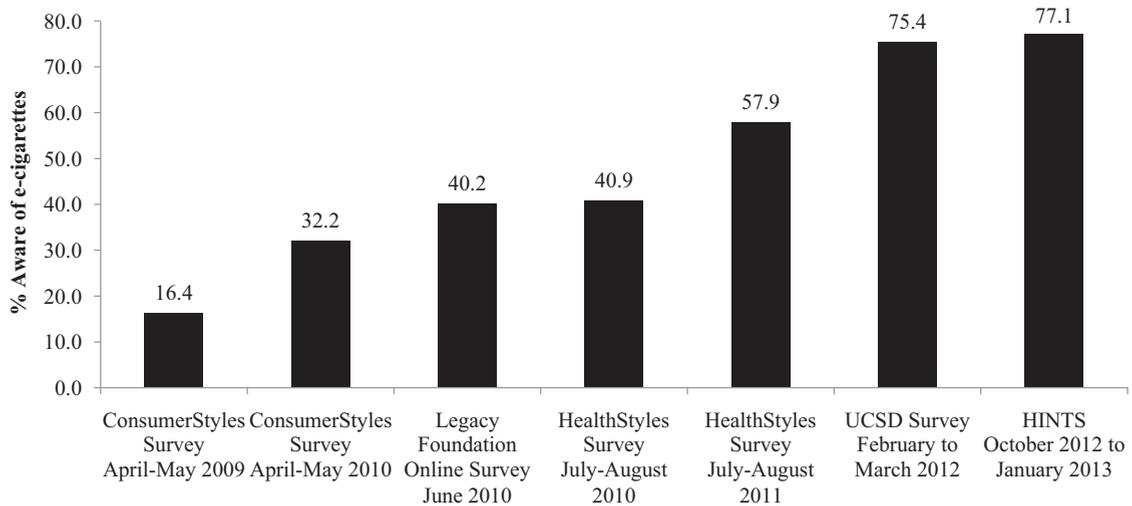


Figure 1. Population awareness of e-cigarettes, 2009–2013

Note: Population awareness data from 2009 to 2011 were obtained from separate national surveys.^{23,26,27}

2012, but current e-cigarette use is relatively low at only 6%.²² Although one recent news report predicted that e-cigarette sales would soon reach \$1.7 billion,³⁴ this impressive figure represents only 1% of current regular cigarette sales in the U.S.

The low usage levels do not presently support fears that e-cigarettes pose a serious public health threat that could unravel decades of tobacco control programs to denormalize smoking. At the same time, claims that e-cigarettes are currently a major force in reducing harm from regular cigarette use at the population level also appear premature.

We compared current smokers' perceptions of reduced harm of e-cigarettes with earlier surveys and found a gradual decline in this belief from 84% in 2010 to 65% in 2013.²⁶ A formal analysis of this trend was not possible because of differences in study sampling. This apparent decline in smokers' beliefs about reduced harm of e-cigarettes compared with regular cigarettes is perplexing against the background of advertising and media messages touting e-cigarettes as safer alternatives and cessation aids.

One possible explanation is that the increased media attention over the lack of FDA approval and regulation of this emerging tobacco product,^{34–36} injuries arising from e-cigarette-induced fires,^{37,38} and health concerns from toxic chemicals in e-cigarettes^{39–41} in recent years may have conveyed conflicting information about the relative safety of e-cigarette use.

In this study, we found that fewer former (50%) and never smokers (46%) were convinced that e-cigarettes are less harmful than regular cigarettes compared with current smokers (65%). These differences could be due to smokers being more exposed to marketing materials that frame the benefits and reduced harm of e-cigarettes because they are

the target audience of e-cigarette marketing, or they could reflect greater attention to the topic among smokers because it has more personal relevance.

However, we recommend continued monitoring of perceptions of e-cigarette harms among former and non-smokers for a few reasons. First, a qualitative study suggested that non-smokers who have no intention to initiate smoking may nevertheless be open to trying e-cigarettes, which could serve as a gateway to other tobacco products including cigarettes.⁴² Second, young adult former smokers in a community survey believed that e-cigarettes are less addictive than cigarettes; this may tempt former smokers to resume their smoking habits and result in relapse.⁴³

The current analyses showed that there were no significant associations between e-cigarette awareness or perceived harmfulness and smokers' intentions to quit or past-year quit attempts. These null findings suggest several possibilities. One potential interpretation is that adult smokers have not yet accepted e-cigarettes as a means to quit smoking. Even if they are aware of e-cigarettes and believe that they are less harmful, it is not sufficient to prompt them to consider quitting or try to quit smoking.

For example, this relationship may be mediated through greater perceived efficacy of the product and moderated by perceived efficacy to quit smoking. A recent study reported that smokers in Hawaii who used e-cigarettes for quitting were more likely to have higher motivation and self-efficacy to quit and to achieve longer recent quit durations than non-users of e-cigarettes.⁴⁴

An alternative interpretation of the null associations is that it could be an artifact of the cross-sectional analyses. For example, it may be that there was insufficient time lag between smokers becoming aware of e-cigarettes and

Table 2. Point estimates and AORs for predicting e-cigarette awareness and perceived harmfulness

| Predictor variables | Awareness of e-cigarettes (n=3,487) ^a | | Believe e-cigarettes are less harmful (n=2,609) ^b | |
|-------------------------------------|--|-----------------------------|--|-----------------------------|
| | % (95% CI) | AOR (95% CI) ^c | % (95% CI) | AOR (95% CI) ^c |
| Overall | 77.1 (74.5, 79.7) | — | 50.7 (47.8, 53.7) | — |
| Age (years) | | | | |
| 18–34 (ref) | 81.5 (74.7, 88.3) | 1.00 | 60.1 (53.4, 66.8) | 1.00 |
| 35–49 | 83.5 (80.3, 86.7) | 1.00 (0.56, 1.79) | 51.2 (45.5, 56.9) | 0.62* (0.41, 0.94) |
| 50–64 | 78.6 (74.4, 82.8) | 0.73 (0.41, 1.29) | 47.3 (43.4, 51.1) | 0.55** (0.38, 0.81) |
| 65–74 | 67.8 (61.9, 73.7) | 0.38** (0.21, 0.69) | 42.5 (36.0, 49.0) | 0.48** (0.30, 0.79) |
| ≥ 75 | 46.6 (40.1, 53.2) | 0.18*** (0.10, 0.31) | 27.5 (19.7, 35.3) | 0.28*** (0.16, 0.47) |
| Gender | | | | |
| Male (ref) | 79.6 (76.0, 83.2) | 1.00 | 58.4 (53.4, 63.4) | 1.00 |
| Female | 75.6 (72.3, 78.8) | 0.82 (0.65, 1.02) | 42.9 (39.2, 46.5) | 0.84 (0.50, 1.40) |
| Race/ethnicity | | | | |
| White (ref) | 81.3 (78.7, 84.0) | 1.00 | 53.8 (50.1, 57.5) | 1.00 |
| African American | 78.1 (73.1, 83.0) | 0.82 (0.52, 1.29) | 42.2 (32.0, 52.4) | 0.61 (0.35, 1.07) |
| Hispanic | 64.3 (54.9, 73.8) | 0.38*** (0.24, 0.62) | 53.5 (44.1, 63.0) | 0.95 (0.64, 1.41) |
| Other | 72.3 (53.2, 91.4) | 0.60 (0.21, 1.73) | 42.9 (30.8, 54.9) | 0.57 (0.31, 1.08) |
| Education | | | | |
| High school or below (ref) | 65.0 (56.7, 73.2) | 1.00 | 41.0 (28.2, 53.9) | 1.00 |
| Completed high school | 72.8 (67.3, 78.3) | 1.15 (0.69, 1.93) | 45.9 (37.8, 54.0) | 1.23 (0.65, 2.34) |
| Some college | 80.3 (75.9, 84.8) | 1.54 (0.90, 2.62) | 51.4 (46.5, 56.3) | 1.42 (0.77, 2.65) |
| College graduate or higher | 81.8 (79.3, 84.2) | 1.75* (1.07, 2.87) | 57.1 (52.2, 62.0) | 2.06* (1.06, 4.02) |
| Annual household income (\$) | | | | |
| < 20,000 (ref) | 72.3 (65.4, 79.3) | 47.1 (38.3, 55.9) | 1.00 | |
| 20,000–34,999 | 76.5 (69.6, 83.3) | 1.31 (0.83, 2.06) | 49.7 (42.8, 56.7) | 1.22 (0.77, 1.91) |
| 35,000–49,999 | 72.4 (66.2, 78.7) | 0.93 (0.54, 1.59) | 48.0 (38.5, 57.4) | 1.04 (0.63, 1.70) |
| 50,000–74,999 | 82.5 (78.4, 86.5) | 1.26 (0.73, 2.19) | 52.6 (46.0, 59.3) | 1.18 (0.74, 1.89) |
| ≥ 75,000 | 81.2 (78.1, 84.3) | 1.10 (0.64, 1.91) | 54.2 (48.8, 59.6) | 1.29 (0.83, 2.00) |
| Health status | | | | |
| Excellent (ref) | 75.2 (66.2, 84.2) | 1.00 | 49.4 (37.3, 61.6) | 1.00 |
| Very good | 81.2 (77.7, 84.7) | 1.38 (0.79, 2.42) | 52.4 (46.9, 58.0) | 1.21 (0.67, 2.19) |
| Good | 77.4 (73.7, 81.1) | 1.24 (0.72, 2.11) | 47.7 (42.6, 52.7) | 1.07 (0.58, 1.98) |
| Fair | 65.2 (53.7, 76.7) | 0.76 (0.33, 1.76) | 53.7 (43.5, 63.8) | 1.75 (0.89, 3.44) |
| Poor | 78.2 (66.8, 89.7) | 1.28 (0.54, 3.03) | 44.5 (20.5, 68.6) | 0.96 (0.20, 4.56) |
| U.S. Census region | | | | |
| Northeast (ref) | 75.9 (70.1, 81.7) | 1.00 | 51.2 (43.0, 59.3) | 1.00 |
| Midwest | 79.6 (74.4, 84.7) | 1.15 (0.72, 1.81) | 48.7 (41.2, 56.3) | 0.86 (0.55, 1.35) |

(continued on next page)

Table 2. (continued)

| Predictor variables | Awareness of e-cigarettes (n=3,487) ^a | | Believe e-cigarettes are less harmful (n=2,609) ^b | |
|-----------------------|--|-----------------------------|--|-----------------------------|
| | % (95% CI) | AOR (95% CI) ^c | % (95% CI) | AOR (95% CI) ^c |
| South | 78.1 (74.7, 81.6) | 1.19 (0.77, 1.87) | 52.4 (47.0, 57.9) | 1.06 (0.73, 1.52) |
| West | 74.2 (67.9, 80.4) | 1.04 (0.67, 1.62) | 49.6 (42.1, 57.0) | 0.85 (0.54, 1.34) |
| Smoking status | | | | |
| Non-smoker (ref) | 73.0 (68.6, 77.3) | 1.00 | 45.9 (42.1, 49.6) | 1.00 |
| Current | 88.6 (84.4, 92.8) | 3.37*** (2.02, 5.63) | 65.0 (57.6, 72.4) | 2.53*** (1.72, 3.72) |
| Former | 78.3 (74.3, 82.3) | 1.62** (1.16, 2.26) | 49.5 (43.6, 55.3) | 1.33 (0.99, 1.78) |

Note: Boldface indicates statistical significance.

^aMissing cases for awareness of e-cigarettes variable (n=143) were excluded from analysis.

^bThe model predicting belief that e-cigarettes are less harmful included only respondents who are aware of e-cigarettes.

^cORs are adjusted for all other covariates in the model.

*p<0.05, **p<0.01, ***p<0.00005

reduced harm and their decisions to try to quit smoking. It is also possible that there has not been enough exposure to information about e-cigarettes or related persuasive content that would influence smokers' cessation intentions or behaviors at this point in time.

The null findings underscore the importance of further research to track smokers' exposure to e-cigarette information and their cessation behaviors over time, which could help to rule out these alternate explanations about insufficient time lag, lack of cumulative exposure to e-cigarette information, or lack of exposure to specific messages to use e-cigarettes for smoking cessation.

Study Limitations

There are several limitations to this study. First, the e-cigarette awareness measure did not directly ask if respondents were aware of e-cigarettes. However, the results from this study are in line with the trend of

increasing e-cigarette awareness across various studies over time as shown in Figure 1.

Currently, there is no standardized measure of e-cigarette awareness; prior surveys have all measured awareness using different survey items.^{22-24,26,27} Second, owing to the cross-sectional nature of the survey design, it is not possible to draw causal inferences. The study sample may not represent the U.S. adult population because of the low response rate. However, steps were taken to adjust for survey non-response and to weight the study sample to the general population.

This study did not assess exposure to e-cigarette information in the media, the content of such exposures, e-cigarette usage, and other quit behaviors (e.g., reducing the number of cigarettes smoked per day) because these were not measured in the HINTS questionnaire. Future rounds of HINTS could consider including these items. We recommend further population-based research to assess smokers' beliefs and attitudes toward e-cigarettes as cessation aid devices, quit attempts, smoking reduction, and successful tobacco cessation among e-cigarette users in the U.S. In particular, it may be that as population-level e-cigarette use increases, a relationship among awareness, perceived harm, e-cigarette use, and smoking cessation could emerge.

Conclusions

This study found that awareness of e-cigarettes among U.S. adults increased over

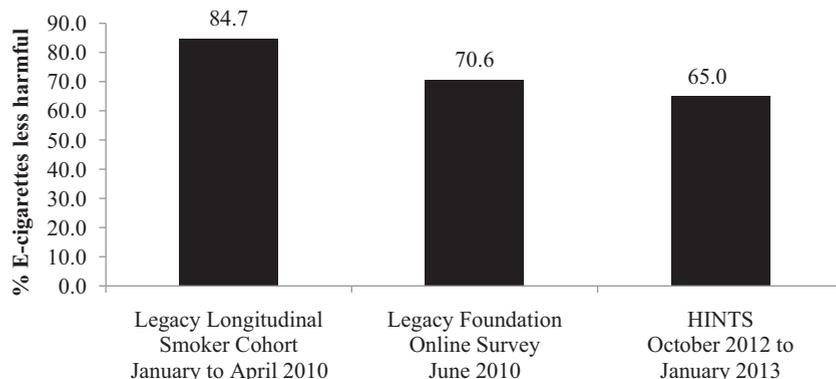


Figure 2. Perceptions that e-cigarettes are less harmful than regular cigarettes among current smokers aware of e-cigarettes, 2010 and 2013

Note: Perceptions of e-cigarette harm for 2010 were obtained from separate national surveys.²⁶

Table 3. Predicting past-year quit attempt and intention to quit with e-cigarette awareness^a

| Predictor variable | Past-year quit attempt ^b | | Intention to quit ^c | |
|-----------------------------------|-------------------------------------|---------------------------|--------------------------------|---------------------------|
| | % (95% CI) | AOR (95% CI) ^d | % (95% CI) | AOR (95% CI) ^d |
| Awareness of e-cigarettes | | | | |
| Never heard of e-cigarettes (ref) | 43.0 (33.9, 52.1) | 1.00 | 68.0 (50.5, 85.6) | 1.00 |
| Aware of e-cigarettes | 47.4 (42.7, 52.1) | 1.25 (0.54, 2.91) | 66.4 (58.9, 74.0) | 0.96 (0.32, 2.92) |

^aThese analyses included only current smokers.

^bMissing cases for quit attempt in the past year ($n=217$) are excluded from these analyses.

^cMissing cases for intention to quit ($n=8$) are excluded from these analyses.

^dORs are adjusted for gender, race/ethnicity, education level, household income, health status, and Census region.

Table 4. Predicting past-year quit attempt and intention to quit with perceived e-cigarette harmfulness^a

| Predictor variable | Past-year quit attempt ^b | | Intention to quit ^c | |
|---|-------------------------------------|---------------------------|--------------------------------|---------------------------|
| | % (95% CI) | AOR (95% CI) ^d | % (95% CI) | AOR (95% CI) ^d |
| Perceived harmfulness | | | | |
| Equally or more harmful than cigarettes (ref) | 47.0 (39.8, 54.2) | 1.00 | 69.4 (56.5, 82.3) | 1.00 |
| Less harmful than cigarettes | 47.7 (41.0, 54.5) | 0.48 (0.21, 1.09) | 64.9 (54.9, 74.8) | 0.95 (0.42, 2.12) |

^aThese analyses included only current smokers who are aware of e-cigarettes.

^bMissing cases for quit attempt in the past year ($n=131$) are excluded from these analyses.

^cMissing cases for intention to quit ($n=3$) are excluded from these analyses.

^dORs are adjusted for gender, race/ethnicity, education level, household income, health status, and Census region.

time compared with earlier surveys. It is uncertain whether increased population e-cigarette awareness and perceptions about reduced harm might play a role in encouraging smoking-cessation behaviors. However, public health professionals should systematically scrutinize the nature of marketing activities and media coverage of e-cigarettes, their impact on population awareness and perceptions of e-cigarettes, and how these factors may influence e-cigarette use and smoking prevalence in the U.S. population.

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