Reasons for current *E*-cigarette use among U.S. adults

Deesha Patel, MPH[a,*], **Kevin C. Davis, MA**[b], **Shanna Cox, MSPH**[a], **Brian Bradfield, BA**[b], **Brian A. King, PhD**[a], **Paul Shafer, MA**[b,c], **Ralph Caraballo, PhD**[a], and **Rebecca Bunnell, ScD**[a]

[a]Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, GA, United States

[b]Center for Health Policy Science and Tobacco Research, RTI International, Research Triangle Park, NC, United States

[c]Department of Health Policy and Management, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

Abstract

E-cigarette use has increased rapidly among U.S. adults. However, reasons for use among adults are unclear. We assessed reasons for e-cigarette use among a national sample of U.S. adults. Data were collected via online surveys among U.S. adults aged 18 or older from April through June 2014. Descriptive and multivariate regression analyses were conducted to assess reasons for e-cigarette use among 2448 current e-cigarette users, by sociodemographic characteristics and product type. Assessed reasons included cessation/health, consideration of others, convenience, cost, curiosity, flavoring, and simulation of conventional cigarettes. Among current e-cigarette users, 93% were also current cigarette smokers. The most common reasons for e-cigarette use were cessation/health (84.5%), consideration of others (71.5%), and convenience (56.7%). The prevalence of citing convenience (adjusted prevalence ratio [aPR] = 1.49) and curiosity (aPR = 1.54) as reasons for e-cigarette use were greater among current cigarette smokers than nonsmokers ($P < 0.05$). The prevalence of citing flavoring as a reason for use was greater among adults aged 18 to 24 (aPR = 2.02) than 55 or older ($P < 0.05$). Tank use was associated with greater prevalence of citing every assessed reason except convenience and curiosity. Cessation- and health-related factors are primary reasons cited for e-cigarette use among adults, and flavorings are more commonly cited by younger adults. Efforts are warranted to provide consumers with accurate information on the health effects of e-cigarettes and to ensure that flavoring and other unregulated features do not promote nicotine addiction, particularly among young adults.

Keywords

Electronic cigarettes; Adult; Nicotine

[*]Corresponding author at: Division of HIV/AIDS Prevention, Centers for Disease Control and Prevention, Corporate Boulevard, MS E59, Atlanta, GA 30329, United States. dpatel3@cdc.gov (D. Patel). .

1. Introduction

Electronic nicotine delivery systems (ENDS), including e-cigarettes, are a rapidly emerging product in the United States. ENDS are battery-powered devices that heat a liquid-containing cartridge to produce an aerosol that is inhaled by the user (Grana et al., 2014). One of the most common types of ENDS is e-cigarettes, which typically contain nicotine, flavoring, and a humectant (e.g., propylene glycol) to produce the aerosol. However, in addition to nicotine, ENDS aerosols can contain other harmful and potentially harmful constituents, including heavy metals, ultrafine particulate, and volatile organic compounds (Goniewicz et al., 2014). Several different types of ENDS are currently available on the U.S. market, including those that are disposable, those that use cartridges, and "tank" systems or "mods" (Grana et al., 2014). In May 2016, the U.S. Food and Drug Administration (FDA) issued a rule to deem all products made or derived from tobacco—including ENDS, dissolvables, and novel and future products—subject to FDA jurisdiction (Food and Drug Administration, 2016).

Prevalence of e-cigarette use among U.S. youth and adults has increased rapidly in recent years. From 2011 to 2014, past 30-day use of e-cigarettes increased from 1.5% to 13.4% among high school students and from 0.6% to 3.9% among middle school students (Arrazola et al., 2015). During 2010–2013, past 30-day use increased from 1.0% to 2.6% among adults (King et al., 2015); past 30-day ENDS use was 4.8% in 2014 (Caraballo et al., 2015). In 2012/2013, 76.8% of past 30-day adult e-cigarette users were current smokers (King et al., 2015). However, despite the increasing prevalence of use, there is limited evidence on the general safety and long-term public health impact of e-cigarettes, especially with regard to their efficacy as a method for quitting conventional cigarette smoking and the potential for their use to lead to subsequent initiation of conventional tobacco product use among youth and young adults (Leventhal et al., 2015; Primack et al., 2015).

Given this limited evidence and the fact that e-cigarettes are still relatively new in the U.S. marketplace, reasons for e-cigarette use are not yet well understood. A few prior studies that have examined reasons for use have done so only among certain subpopulations. Among pregnant women who had ever used e-cigarettes, the most common reasons for use were the perception of less harm than traditional cigarettes (74%) and help with smoking cessation (72%) (Mark et al., 2015). Among opioid-dependent cigarette smokers in a clinical setting, the most common reasons for last e-cigarette use were curiosity (41.4%), followed by wanting to quit all nicotine (26%) (Stein et al., 2015); whereas almost half endorsed quitting or reducing cigarette smoking and 32% endorsed curiosity/experimentation as reasons for use among ever e-cigarette users in an outpatient substance use treatment program (Peters et al., 2015). From the 2013 Montana Adult Tobacco Survey, Schmidt et al. (2014) found that the most common reasons cited by ever e-cigarette users were "trying something new" (64%) or "trying to quit or reduce cigarette use" (56%) (Schmidt et al., 2014). Of the studies that examined broader U.S. adult populations, one assessed potential reasons to switch to ENDS among cigarette smokers only and found more interest in using e-cigarettes for cessation-related reasons (i.e., to reduce health risk, to cut down on the number of cigarettes, and to quit smoking) (Berg et al., 2015). Two additional studies have assessed reasons

among smokers and nonsmokers; Zhu et al. (2013) found that reasons related to curiosity (68.3%) and cessation (54.9%) were most commonly reported. In the study by Pepper et al. (2014), the most common reasons stated were curiosity (53%); because a friend or family member used, gave, or offered e-cigarettes (34%); and quitting or reducing smoking (30%) (Pepper et al., 2014). However, these studies assessed reasons among ever e-cigarette users; thus, it was not possible to disaggregate reasons for use between one-time experimenters and more frequent users (Zhu et al., 2013; Pepper et al., 2014).

Understanding the reasons for use in a large population study, including by sociodemographic and product characteristics, among current e-cigarette users could help inform public health policy, planning, and practice. To address this gap in the scientific literature, this study assessed reasons for current e-cigarette use among current e-cigarette users drawn from a national online sample of U.S. adults by sociodemographic characteristics, cigarette smoking status, and e-cigarette product characteristics.

2. Methods

2.1. Data and sample

Data came from Internet surveys of U.S. adult conventional cigarette smokers and nonsmokers that were designed to be nationally representative of each of these separate populations. Survey participants were recruited from a probability-based sample of residential mailing addresses derived from the U.S. Postal Services Delivery Sequence File. Sampled households received survey invitation letters containing a website link and survey password. Interested participants completed a brief screening instrument to determine their study eligibility.

All surveys were administered online by GfK Custom Research, which recruits custom probability-based samples for online surveys. Participants who did not already have Internet access when recruited were provided additional study incentive payments to obtain public Internet access, such as library locations or other points of access outside their homes. On the basis of these recruitment procedures, participants could not volunteer for study enrollment, and all sampled households had a known probability of selection. Recruitment procedures followed the methods used in GfK's KnowledgePanel (Chang and Krosnick, 2009; Yeager et al., 2011). All survey protocols and recruitment procedures were reviewed and approved by the sanctioned institutional review board (IRB) of RTI International.

Data collection was conducted from April 12 to June 30, 2014. All data were analyzed from July 2014 to March 2016. The sample consisted of 10,181 current cigarette smokers and 3123 nonsmokers aged 18 or older. The overall sample response rate was 22.8% among all invited households. Current cigarette smokers were defined as persons who had smoked at least 100 conventional cigarettes in their lifetime and currently smoked either "some days" or "every day" at the time of the survey. Nonsmokers were defined as persons who reported smoking "not at all" at the time of the survey, regardless of lifetime number of conventional cigarettes smoked.

2.2. Measures

2.2.1. Current E-cigarette use

—Current e-cigarette users were defined as those who responded "every day" or "some days" to the question, "Do you now use e-cigarettes every day, some days, or not all?"

2.2.2. Reasons for E-cigarette use

—Current e-cigarette users were asked to indicate their reasons for use by the question, "Are any of the following a reason why you currently use electronic cigarettes/e-cigarettes?" Respondents could select multiple choices from 14 responses, which included reasons such as cost, flavors, consideration of others, and use as a cigarette cessation aid, among others (Table 1). Previous research has developed and refined the reasons constructs we used through in-person cognitive testing and online item pretesting (Pepper et al., 2014). These responses were presented in random order to survey participants. On the basis of item correlation analysis, the reasons for e-cigarette use were then grouped into categories. The categories cited by at least 25% of current e-cigarette users were included in this analysis: cigarette cessation and health ("cessation/health"), consideration of others, convenience of e-cigarettes ("convenience"), cost, curiosity, flavors, and simulation of conventional cigarettes ("simulation of cigarettes"). Advertising was cited by less than 25% of current e-cigarette users; due to sample size limitations, it was excluded from the analysis.

2.2.3. Respondent characteristics

—Characteristics that were assessed included age (18–24, 25–34, 35–54, 55 years), sex (male or female), race/ethnicity (non-Hispanic white, non-Hispanic African American, Hispanic, or other), educational attainment (less than high school, high school graduate, some college, or college graduate or higher), household income (<$20,000, $20,000–$49,999, $50,000–$99,999, or $100,000), U.S. Census region (Northeast, Midwest, South, or West), presence of children younger than 18 years of age in the household (yes or no), conventional cigarette smoking (current smoker or nonsmoker), and cigarettes smoked per day (0, 1–10, 11–19, or 20). Respondents were also asked about type of e-cigarette product used by the question, "Do you usually use disposable electronic cigarettes/e-cigarettes, an electronic cigarette/e-cigarette that uses cartridges, or an electronic cigarette/e-cigarette that uses tanks?" The device types were presented in random order across respondent surveys.

2.3. Analysis

The final analytic sample was restricted to the 2448 respondents who reported current e-cigarette use (2295 cigarette smokers and 153 nonsmokers). Descriptive statistics were used to calculate reasons for e-cigarette use among current e-cigarette users, both overall and by sociodemographic characteristics, cigarettes smoking status, and e-cigarette product type. Wald tests were used to assess statistically signifi-cant ($P < 0.05$) differences across respondent characteristics.

Multivariate Poisson regressions were used to assess the relationship between each reason for using e-cigarettes and respondent characteristics ($P < 0.05$) among current e-cigarette users; a separate regression model for each reason category was performed. Poisson regressions were used because of the high prevalence for many of the study outcomes. All

regression coefficients were converted to prevalence ratios for ease of interpretation. These models controlled for the aforementioned respondent characteristics, with the exception of cigarettes smoked per day because of its collinearity with current cigarette smoking status.

Because the sample of current e-cigarette users was compiled by pooling separate large samples of smokers and nonsmokers, weighting adjustments were used to correct for overrepresentation of smokers in the pooled sample. All analyses were weighted to reflect national demographic distributions of current e-cigarette users. Benchmarks for demographic distributions of current e-cigarette users by age, sex, race/ethnicity, and educational attainment were derived from samples of current e-cigarette users in the 2013–2014 National Adult Tobacco Survey (NATS) (Centers for Disease Control and Prevention, 2015). A weight raking procedure was performed with the demographic variables noted above to yield weighted demographic distributions that match those of the NATS. All analyses were conducted using Stata 13.1 (StataCorp, 2013).

3. Results

3.1. Characteristics of current E-cigarette users

Approximately 71% of current e-cigarette users were non-Hispanic white. Current e-cigarette users were also more likely to be aged 35 to 54 years; female; have a high school diploma or attended some college; have an annual household income less than $100,000; have no children in the household; and live in the South. The most commonly used e-cigarette device was cartridges (40.2%), followed by tanks (35.0%) and disposables (24.8%).

Most current e-cigarette users (92.6%) were also current cigarette smokers. Nearly 48% of current e-cigarette users reported smoking 1 to 10 cigarettes per day, 18.6% of current e-cigarette users smoked 11 to 19 cigarettes per day, and 26.3% smoked 20 or more cigarettes per day. Among current e-cigarette users, 5.2% were former cigarette smokers and 2.2% were never cigarette smokers.

3.2. Reasons for E-cigarette use among current E-cigarette users

Among all current e-cigarette users, 89.2% reported more than one reason for e-cigarette use. The most commonly reported reasons for using e-cigarettes among current users were cessation/health (84.5%), consideration of others (71.5%), and convenience (56.7%), followed by curiosity (45.2%), flavoring (34.4%), cost (34.3%), and simulation of cigarettes (27.8%) (Table 2).

Citing cessation/health as a reason for use varied across respondent characteristics, including age, race/ethnicity, education, household income, cigarette smoking status, and product type. Citing consideration of others as a reason for use varied by education, cigarettes per day, and product type, whereas citing convenience varied by race/ethnicity, household income, smoking status, and cigarettes per day (see Table 2). Citing flavoring as a reason for use differed by age, U.S. region, cigarettes per day, and device type. Citing simulation of cigarettes as a reason for use varied by cigarettes per day and device type. Citing cost as a

reason for use varied by device type, whereas citing curiosity differed by cigarette smoking status (see Table 2).

3.3. Prevalence ratios for reasons for use among current E-cigarette users

Current e-cigarette users aged 18 to 24 years (adjusted prevalence ratio [aPR] = 2.02, 95% confidence interval [CI]: 1.60–2.55), 25 to 34 years (aPR = 1.61, 95% CI: 1.30–2.01), and 35 to 54 years (aPR = 1.29, 95% CI: 1.08–1.54) were more likely to cite flavoring as a reason for use than those aged 55 years or older (Table 3). The prevalence of citing flavoring as a reason for use was greater among current e-cigarette users living in the South than those in the Northeast (aPR = 1.36, 95% CI: 1.01–1.83).

Consideration of others as a reason for use was higher among those with some college education (aPR = 1.20, 95% CI: 1.02–1.42) or a college degree or higher (aPR = 1.22, 95% CI: 1.03–1.45) compared to those with less than a high school education. *E*-cigarette users with an annual income of $20,000 to $49,999 were less likely than those with incomes of less than $20,000 to report cost as a reason for e-cigarette use (aPR = 0.81, 95% CI: 0.67–0.99). Similarly, e-cigarette users with annual incomes of $100,000 or greater were less likely to cite cost as a reason for use compared with those making less than $20,000 per year (aPR = 0.71, 95% CI: 0.53–0.94).

Compared with nonsmokers, e-cigarette users who were current cigarette smokers were more likely to cite convenience (aPR = 1.49, 95% CI: 1.09–2.04) and curiosity (aPR = 1.54, 95% CI: 1.18–3.53) as reasons for use; citing cessation/health as a reason for use was not statistically significant (aOR = 1.91, 95% CI: 0.93–2.93). Compared with current e-cigarette users who used disposables the most, tank users had a greater odds of citing cost (aOR = 2.67, 95% CI: 2.08–3.42) and flavoring (aPR = 2.55, 95% CI: 1.97–3.32) as reasons for use. Tank users were more likely than disposable users to cite cessation/health (aPR = 1.12, 95% CI: 1.04–1.21), consideration of others (aPR = 1.17, 95% CI: 1.05–1.31), and simulation of cigarettes (aPR = 1.46, 95% CI: 1.14–1.86) as reasons for use.

4. Discussion

Among current e-cigarette users drawn from a national online sample of U.S. adults, a majority of respondents reported more than one reason for current e-cigarette use. The most cited reasons for current e-cigarette use were cessation or health, consideration of others, and convenience, followed by curiosity, flavoring, cost, and simulation of cigarettes. These results are relatively similar to previous studies examining reasons for e-cigarette use among specific subpopulations (Mark et al., 2015; Stein et al., 2015; Peters et al., 2015; Schmidt et al., 2014) and broader U.S. populations (Berg et al., 2015; Zhu et al., 2013; Pepper et al., 2014). However, this study assessed reasons for current e-cigarette use (versus ever e-cigarette use), thus differentiating between experimenters and more consistent users. Furthermore, this study showed that reasons reported for current e-cigarette use varied by sociodemographic and user characteristics and by e-cigarette product type. These findings suggest that efforts are warranted to provide consumers with accurate information on e-cigarettes, particularly around their nicotine content and efficacy for cessation from

conventional cigarettes, and to ensure that flavorings and other unregulated e-cigarette features do not promote nicotine addiction, particularly among young adults.

Flavoring was more likely to be cited as a reason for current e-cigarette use in younger age groups (18 to 24, 25 to 34, and 35 to 54 years) compared with those aged 55 years or older, with the greatest magnitude among those aged 18 to 24 years. Flavored tobacco products have been marketed to appeal to youth (Carpenter et al., 2005; Legacy, 2014; U.S. Department of Health and Human Services, 2012), with previous research finding that the majority of tobacco products used by adolescents are flavored (Ambrose et al., 2015; Corey et al., 2015); this preference may continue into young adulthood. There is growing concern that widely marketed varieties of new and existing flavored tobacco products, including e-cigarettes, might appeal to youth and young adults and could be contributing to recent increases in e-cigarette use among these population groups (Corey et al., 2015). Nicotine exposure may harm brain development, which continues into young adulthood (England et al., 2015), and earlier use of nicotine-containing products can lead to greater nicotine dependence and sustained tobacco use, which may result in more difficulty quitting and increased risk of health consequences (U.S. Department of Health and Human Services, 2012; Kendler et al., 2013).

The present study also revealed variations in reasons for use by product type, including greater likelihood of citing cessation/health among tank users compared with disposable users. Research suggests that tank systems may deliver more nicotine than disposable e-cigarettes (Farsalinos et al., 2014a) and that some e-cigarette users find disposable varieties less satisfying than tank systems (Dawkins et al., 2015). This aligns with research showing that e-cigarette users who use tanks are more likely to be former smokers than those who use disposable or cartridge style e-cigarettes (Farsalinos et al., 2014b), and that daily tank users are more likely to have quit cigarette smoking than those who reported no e-cigarette use, while daily disposable users are no more or less likely to have quit (Hitchman et al., 2015). Further research is critical to better understand the patterns of use, particularly with regard to conventional cigarette cessation, by type of e-cigarette device used.

Compared with nonsmokers, current cigarette smokers were more likely to cite convenience and curiosity as reasons for use. Research suggests that current cigarette smokers may be using e-cigarettes as a replacement in places where cigarette smoking is not allowed (Peters et al., 2015; Berg et al., 2015; Zhu et al., 2013). Current cigarette smokers were also more likely than nonsmokers to cite cessation/health as a reason for use in bivariate analysis; however, this result was not statistically significant in multivariate analysis. This could have been due to the fact that there were more former smokers than never smokers in the nonsmoker sample, thus diminishing the magnitude of effect of cessation/health as a reason for e-cigarette use between smokers and non-smokers. ENDS are not an FDA-approved cessation aid, and, to date, there is insufficient evidence to conclude that ENDS are effective for long-term smoking cessation (U.S. Preventive Services Task Force, 2015). For adult smokers to derive a benefit from ENDS, they must completely quit conventional tobacco use, as smoking even a few cigarettes per day is dangerous to health (U.S. Department of Health and Human Services (USDHHS), 2014).

This study has at least four limitations. First, the study includes a pooled sample of current e-cigarette users taken from separate nationally representative samples of smokers and nonsmokers. Although the subsample of e-cigarette users was weighted to reflect national demographic benchmarks for this population, this sample design may limit generalizability of findings to the e-cigarette user population as a whole. Moreover, although the original samples were drawn from a national probability frame of U.S. residential mailing addresses, the sampling frame may have underrepresented some populations (e.g., rural respondents). Furthermore, the overall sample response rate among invited households was low, but our analytic sample was weighted to the demographic distributions of current e-cigarette users in 2013–2014 NATS to address this limitation. Second, limited sample size prevented the assessment of reasons for use by categories of nonsmokers, including former and never cigarette smokers. Third, although each category of reasons for use was constructed based on item correlations between each of the possible categories, we cannot rule out respondent misclassification, as some categories of reasons for use may have multiple interpretations or meanings. However, we note that the constructs we used have been previously tested and refined through in-person cognitive testing and other quantitative assessments (Pepper et al., 2014). Fourth, this study specifically asked respondents about the use of "e-cigarettes"; therefore, it is possible that users of other types of ENDS (e.g., electronic hookahs) or those who do not consider the products they use to be e-cigarettes (e.g., vape pens), may not have answered affirmatively to this question.

5. Conclusions

In conclusion, this study found that cessation and health-related factors are primary reasons for e-cigarette use among adult users, and flavoring as a reason for use was most common among younger adults. Additionally, reasons for use vary by type of e-cigarette product used. These findings underscore the importance of public health efforts to provide consumers with accurate information on e-cigarettes, particularly around their potential utility for cessation among adult smokers, and to ensure that flavoring and other unregulated e-cigarette features do not promote nicotine addiction, particularly among young adults.

Acknowledgements

Abbreviations

aPR	adjusted prevalence ratio
ENDS	electronic nicotine delivery system
FDA	Food and Drug Administration
IRB	institutional review board

NATS National Adult Tobacco Survey

References

Ambrose BK, Day HR, Rostron B, et al. Flavored tobacco product use among US youth aged 12–17 years, 2013–2014. JAMA. 2015; 314(17):1871–1873. http://dx.doi.org/10.1001/jama.2015.13802. [PubMed: 26502219]

Arrazola RA, Singh T, Corey CG, et al. Tobacco use among middle and high school students—United States, 2011–2014. Morb. Mortal. Wkly Rep. 2015; 64(14):381–385.

Berg CJ, Haardoerfer R, Escoffery C, et al. Cigarette users' interest in using or switching to electronic nicotine delivery systems for smokeless tobacco for harm reduction, cessation, or novelty: a cross-sectional survey of US adults. Nicotine Tob. Res. 2015; 17(2):245–255. http://dx.doi.org/10.1093/ntr/ntu103. [PubMed: 24951496]

Caraballo RS, Jamal A, Nguyen KH, et al. Electronic nicotine delivery system use among U.S. adults, 2014. Am. J. Prev. Med. 2015 http://dx.doi.org/10.1016/j.amepre.2015.09.013.

Carpenter CM, Wayne GF, Pauly JL, et al. New cigarette brands with flavors that appeal to youth: tobacco marketing strategies. Health Aff. 2005; 24(6):1601–1610. http://dx.doi.org/10.1377/hlthaff.24.6.1601.

Centers for Disease Control and Prevention. 2013–2014 National Adult Tobacco Survey (NATS). 2015. Available at http://www.cdc.gov/tobacco/data_statistics/surveys/nats/index.htm

Chang L, Krosnick JA. National surveys via RDD telephone interviewing versus the internet. Public Opin. Q. 2009; 73(4):641–678. http://dx.doi.org/10.1093/Poq/Nfp075.

Corey CG, Ambrose BK, Apelberg BJ, et al. Flavored tobacco product use among middle and high school students–United States, 2014. Morb. Mortal. Wkly. Rep. 2015; 64(38):1066–1070. http://dx.doi.org/10.15585/mmwr.mm6438a2.

Dawkins L, Kimber C, Puwanesarasa Y, et al. First- versus second-generation electronic cigarettes: predictors of choice and effects on urge to smoke and withdrawal symptoms. Addiction. 2015; 110(4):669–677. http://dx.doi.org/10.1111/add.12807. [PubMed: 25407505]

England LJ, Bunnell RE, Pechacek TF, et al. Nicotine and the developing human: a neglected element in the electronic cigarette debate. Am. J. Prev. Med. 2015; 49(2):286–293. http://dx.doi.org/10.1016/j.amepre.2015.01.015. [PubMed: 25794473]

Farsalinos KE, Romagna G, Tsiapras D, et al. Characteristics, perceived side effects and benefits of electronic cigarette use: a worldwide survey of >19,000 consumers. Int. J. Environ. Res. Public Health. 2014b; 11(4):4356–4373. http://dx.doi.org/10.3390/ijerph110404356. [PubMed: 24758891]

Farsalinos KE, Spyrou A, Tsimopoulou K, et al. Nicotine absorption from electronic cigarette use: comparison between first and new-generation devices. Sci. Rep. 2014a; 4:4133. http://dx.doi.org/10.1038/srep04133. [PubMed: 24569565]

Food and Drug Administration. Deeming tobacco products to be subject to the Federal Food, Drug, and Cosmetic Act, as amended by the Family Smoking Prevention and Tobacco Control Act; restrictions on the sale and distribution of tobacco products and required warning statements for tobacco products. Fed. Regist. 2016; 81:28973, 28973–29106. https://www.federalregister.gov/articles/2016/05/10/2016-10685/deeming-tobacco-products-to-be-subject-to-the-federal-food-drug-and-cosmetic-act-as-amended-by-the. [PubMed: 27192730]

Goniewicz ML, Knysak J, Gawron M, et al. Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. Tob. Control. 2014; 23(2):133–139. http://dx.doi.org/10.1136/tobaccocontrol-2012-050859. [PubMed: 23467656]

Grana R, Benowitz N, Glantz SA. E-cigarettes: a scientific review. Circulation. 2014; 129(19):1972–1986. http://dx.doi.org/10.1161/CIRCULATIONAHA.114.007667. [PubMed: 24821826]

Hitchman SC, Brose LS, Brown J, et al. Associations between e-cigarette type, frequency of use, and quitting smoking: findings from a longitudinal online panel survey in Great Britain. Nicotine Tob. Res. 2015; 17(10):1187–1194. http://dx.doi.org/10.1093/ntr/ntv078. [PubMed: 25896067]

Kendler KS, Myers J, Damaj MI, et al. Early smoking onset and risk for subsequent nicotine dependence: a monozygotic co-twin control study. Am. J. Psychiatry. 2013; 170(4):408–413. http://dx.doi.org/10.1176/appi.ajp.2012.12030321. [PubMed: 23318372]

King BA, Patel R, Nguyen KH, et al. Trends in awareness and use of electronic cigarettes among US adults, 2010–2013. Nicotine Tob. Res. 2015; 17(2):219–227. http://dx.doi.org/10.1093/ntr/ntu191. [PubMed: 25239961]

Legacy. Vaporized: *E*-cigarettes, Advertising, and Youth. 2014. Available at http://legacyforhealth.org/content/download/4542/63436/version/1/file/LEG-Vaporized-E-cig_Report-May2014.pdf

Leventhal AM, Strong DR, Kirkpatrick MG, et al. Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. JAMA. 2015; 314(7):700–707. http://dx.doi.org/10.1001/jama.2015.8950. [PubMed: 26284721]

Mark KS, Farquhar B, Chisolm MS, et al. Knowledge, attitudes, and practice of electronic cigarette use among pregnant women. J Addict Med. 2015; 9(4):266–272. http://dx.doi.org/10.1097/ADM.0000000000000128. [PubMed: 25974378]

Pepper JK, Ribisl KM, Emery SL, et al. Reasons for starting and stopping electronic cigarette use. Int. J. Environ. Res. Public Health. 2014; 11(10):10345–10361. http://dx.doi.org/10.3390/ijerph111010345. [PubMed: 25286168]

Peters EN, Harrell PT, Hendricks PS, et al. Electronic cigarettes in adults in outpatient substance use treatment: awareness, perceptions, use, and reasons for use. Am. J. Addict. 2015; 24(3):233–239. http://dx.doi.org/10.1111/ajad.12206. [PubMed: 25809200]

Primack BA, Soneji S, Stoolmiller M, et al. Progression to traditional cigarette smoking after electronic cigarette use among US adolescents and young adults. JAMA Pediatr. 2015; 169(11):1018–1023. http://dx.doi.org/10.1001/jamapediatrics.2015.1742. [PubMed: 26348249]

Schmidt L, Reidmohr A, Harwell TS, et al. Prevalence and reasons for initiating use of electronic cigarettes among adults in Montana, 2013. Prev. Chronic Dis. 2014; 11(E204) http://dx.doi.org/10.5888/pcd11.140283.

StataCorp. Stata Statistical Software: Release 13. StataCorp LP; College Station, TX: 2013.

Stein MD, Caviness CM, Grimone K, et al. *E*-cigarette knowledge, attitudes, and use in opioid dependent smokers. J. Subst. Abus. Treat. 2015; 52:73–77. http://dx.doi.org/10.1016/j.jsat.2014.11.002.

U.S. Department of Health and Human Services. Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General Atlanta. Centers for Disease Control and Prevention; GA: 2012. Reports of the Surgeon General.

U.S. Department of Health and Human Services (USDHHS). The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General Atlanta. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; GA: Jan. 2014 Available from http://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.htm

U.S. Preventive Services Task Force. [Accessed March 3, 2016] Draft Recommendation Statement. Tobacco Smoking Cessation in Adults and Pregnant Women: Behavioral and Pharmacotherapy Interventions. 2015. Available at http://www.uspreventiveservicestaskforce.org/Page/Document/draft-recommendation-statement147/tobacco-use-in-adults-and-pregnant-women-counseling-and-interventions1

Yeager DS, Krosnick JA, Chang L, et al. Comparing the accuracy of RDD telephone surveys and internet surveys conducted with probability and non-probability samples. Public Opin. Q. 2011; 75(4):709–747. http://dx.doi.org/10.1093/Poq/Nfr020.

Zhu SH, Gamst A, Lee M, et al. The use and perception of electronic cigarettes and snus among the U.S. population. PLoS One. 2013; 8(10):e79332. http://dx.doi.org/10.1371/journal.pone.0079332. [PubMed: 24250756]

Table 1

Categorization of responses about reasons for *E*-cigarette use, National Online Sample of U.S. Adults (2014).

Reason	Cessation or health	Consideration	Convenience	Cost	Curiosity	Flavor	Simulation of cigarettes
They cost less than other forms of tobacco				X			
They can be used in places where smoking cigarettes isn't allowed			X				
They might be less harmful to me than regular cigarettes	X						
They might be less harmful to people around me than regular cigarettes		X					
E-cigarettes come in flavors I like						X	
E-cigarettes can help me quit smoking regular cigarettes	X						
E-cigarettes can help me reduce the number of regular cigarettes	X						
E-cigarettes don't smell		X					
Using an e-cigarette feels like smoking a regular cigarette							X
E-cigarettes don't bother people who don't use tobacco		X					
The advertising for e-cigarettes appeals to me							
They help me deal with cravings to smoke	X						
I have a friend or family member who suggested I use e-cigarettes to help me quit	X						
I was curious about e-cigarettes					X		

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 2

Reasons[a] for using *E*-cigarettes by sociodemographic characteristics among current *E*-cigarette users,[b] National Online Sample of U.S. adults (2014).

Sociodemographic characteristic	n	Weighted point estimates [95% Confidence Interval] (*N* = 2442)						
		Cessation/ Health	Consideration of others	Convenience	Cost	Curiosity	Flavoring	Simulation of cigarettes
Overall	2442	84.5% [82.1–86.8]	71.5% [68.8–74.1]	56.7% [53.8–59.5]	34.3% [31.6–37.0]	45.2% [42.3–48.0]	34.4% [31.6–37.2]	27.8% [25.3–30.2]
Age		*P* = 0.001 [c]	*P* = 0.152	*P* = 0.175	*P* = 0.058	*P* = 0.718	*P* < 0.001	*P* = 0.067
18–24	138	72.5% [64.1–80.8]	64.6% [55.5–73.6]	54.7% [45.5–64.0]	32.1% [23.7–40.5]	45.4% [36.3–54.6]	45.5% [36.4–54.6]	21.6% [14.5–28.8]
25–34	315	84.7% [79.9–89.6]	75.2% [69.8–80.7]	54.9% [48.6–61.2]	41.1% [34.9–47.3]	47.2% [40.8–53.5]	40.2% [34.0–46.5]	27.1% [21.6–32.6]
35–54	968	88.7% [86.4–91.0]	72.9% [69.7–76.2]	59.8% [56.3–63.3]	31.9% [28.5–35.2]	44.5% [41.0–48.1]	29.8% [26.5–33.1]	29.7% [26.4–33.0]
55	1021	88.8% [86.7–91.0]	70.3% [67.1–73.5]	54.5% [51.1–58.0]	31.8% [28.6–35.0]	43.1% [39.7–46.5]	22.5% [19.6–25.4]	31.7% [28.5–35.0]
Sex		*P* = 0.805	*P* = 0.407	*P* = 0.418	*P* = 0.168	*P* = 0.199	*P* = 0.198	*P* = 0.739
Female	966	84.2% [80.7–87.7]	70.5% [66.5–74.6]	57.7% [53.4–62.0]	35.9% [31.8–39.9]	46.7% [42.4–51.0]	35.9% [31.7–40.1]	27.4% [23.7–31.1]
Male	1476	84.8% [82.0–87.6]	72.7% [69.5–75.8]	55.4% [52.0–58.8]	32.2% [29.0–35.4]	43.1% [39.8–46.5]	32.4% [29.2–35.7]	28.2% [25.3–31.2]
Race/Ethnicity		*P* = 0.018	*P* = 0.275	*P* = 0.047	*P* = 0.132	*P* = 0.964	*P* = 0.371	*P* = 0.086
White	1987	87.1% [84.8–89.4]	72.6% [69.8–75.4]	59.3% [56.3–62.4]	36.1% [33.1–39.2]	45.0% [41.9–48.1]	35.7% [32.6–38.9]	29.8% [27.0–32.6]
Black	140	73.2% [61.8–84.5]	65.6% [54.5–76.6]	48.6% [37.3–59.9]	33.4% [22.3–44.5]	44.4% [33.3–55.6]	27.4% [17.0–37.8]	24.9% [15.6–34.2]
Hispanic	165	82.3% [73.6–91.0]	64.9% [54.7–75.0]	46.9% [36.7–57.1]	25.8% [17.4–34.1]	44.6% [34.3–54.9]	30.4% [21.1–39.8]	22.4% [14.2–30.6]
Other	150	76.6% [66.9–86.4]	75.5% [65.9–85.2]	55.7% [45.0–66.3]	31.9% [22.3–41.5]	47.8% [37.2–58.4]	34.9% [24.6–45.1]	21.7% [14.3–29.2]
Education		*P* = 0.040	*P* = 0.004	*P* = 0.352	*P* = 0.453	*P* = 0.326	*P* = 0.419	*P* = 0.106
Less than high school	157	78.4% [69.3–87.4]	61.6% [51.6–71.6]	56.0% [45.8–66.1]	28.8% [19.9–37.7]	43.0% [32.9–53.1]	33.6% [24.2–42.9]	28.1% [19.5–36.7]
High school graduate	616	82.5% [78.3–86.8]	69.0% [64.1–73.9]	54.2% [49.0–59.4]	33.8% [28.9–38.8]	44.1% [39.0–49.3]	34.6% [29.4–39.7]	24.9% [20.6–29.1]
Some college	1154	88.3% [85.6–91.1]	75.5% [72.2–78.8]	59.6% [55.9–63.3]	36.4% [32.7–40.1]	45.6% [41.8–49.4]	35.7% [31.9–39.5]	29.1% [25.7–32.6]
College graduate or higher	512	85.1% [80.5–89.7]	78.0% [73.3–82.6]	55.5% [49.9–61.1]	35.5% [30.1–40.8]	50.6% [45.0–56.1]	30.2% [25.0–35.4]	33.3% [28.0–38.5]
Household Income		*P* = 0.005	*P* = 0.096	*P* = 0.027	*P* = 0.468	*P* = 0.515	*P* = 0.200	*P* = 0.871
<$20,000	471	82.2% [76.8–87.6]	67.3% [61.3–73.3]	58.4% [52.1–64.6]	36.9% [30.8–43.0]	47.9% [41.6–54.2]	34.7% [28.6–40.7]	28.4% [22.9–34.0]
$20,000–49,999	809	82.1% [77.5–86.6]	70.0% [65.3–74.7]	50.7% [45.8–55.6]	32.7% [28.3–37.1]	43.3% [38.4–48.1]	30.2% [25.9–34.6]	26.8% [22.9–30.8]
$50,000–99,999	802	90.0% [86.9–93.1]	74.8% [70.2–79.5]	59.7% [54.7–64.7]	35.4% [30.5–40.3]	44.0% [38.9–49.2]	37.6% [32.3–42.8]	28.6% [24.1–33.0]
$100,000	278	81.2% [74.2–88.3]	76.8% [70.0–83.6]	62.2% [54.2–70.1]	30.1% [22.7–37.6]	48.9% [40.7–57.0]	34.6% [26.5–42.8]	30.1% [22.5–37.8]
Region		*P* = 0.676	*P* = 0.504	*P* = 0.627	*P* = 0.458	*P* = 0.279	*P* = 0.002	*P* = 0.578

Sociodemographic characteristic	n	Weighted point estimates [95% Confidence Interval] (N = 2442)						
		Cessation/ Health	Consideration of others	Convenience	Cost	Curiosity	Flavoring	Simulation of cigarettes
Northeast	377	84.6% [78.7–90.5]	73.1% [66.6–79.5]	57.5% [50.5–64.4]	29.6% [22.9–36.3]	51.6% [44.5–58.7]	24.6% [18.8–30.4]	31.9% [25.1–38.6]
Midwest	680	85.5% [81.1–89.9]	71.1% [66.2–76.1]	55.2% [49.8–60.6]	33.6% [28.6–38.6]	43.2% [37.9–48.5]	33.3% [28.1–38.6]	26.1% [21.7–30.6]
South	932	85.5% [82.0–89.0]	73.3% [69.2–77.4]	58.8% [54.3–63.3]	35.9% [31.5–40.3]	44.7% [40.2–49.3]	38.9% [34.3–43.5]	27.3% [23.4–31.2]
West	449	81.3% [75.1–87.4]	67.3% [60.4–74.2]	54.0% [47.0–61.0]	35.5% [29.0–42.0]	43.7% [36.8–50.5]	34.4% [27.7–41.0]	27.5% [21.8–33.2]
Children in household		P = 0.405	P = 0.458	P = 0.611	P = 0.186	P = 0.786	P = 0.096	P = 0.086
No	1736	85.3% [82.5–88.1]	70.5% [67.3–73.8]	57.2% [53.8–60.7]	35.7% [32.3–39.0]	44.8% [41.4–48.2]	32.3% [28.9–35.7]	29.3% [26.3–32.4]
Yes	698	83.2% [79.1–87.3]	72.6% [68.1–77.2]	55.7% [50.8–60.5]	31.9% [27.5–36.4]	45.6% [40.7–50.5]	37.2% [32.5–41.9]	24.9% [20.9–28.9]
Smoking status		P = 0.036	P = 0.121	P = 0.002	P = 0.918	P = 0.020	P = 0.835	P = 0.596
Nonsmoker	153	72.5% [60.5–84.4]	62.0% [49.3–74.7]	39.2% [27.3–51.0]	34.8% [23.6–46.1]	32.3% [20.9–43.7]	33.3% [22.8–43.9]	25.4% [16.3–34.5]
Current smoker	2289	85.4% [83.1–87.8]	72.2% [69.5–74.9]	58.1% [55.2–61.0]	34.2% [31.5–37.0]	46.2% [43.3–49.1]	34.5% [31.6–37.4]	28.0% [25.4–30.5]
Cigarettes per day		P = 0.155	P = 0.019	P < 0.001	P = 0.050	P = 0.145	P = 0.009	P = 0.006
0 cigarettes	153	72.5% [60.5–84.4]	62.0% [49.3–74.7]	39.2% [27.3–51.0]	34.8% [23.6–46.1]	32.3% [20.9–43.7]	33.3% [22.8–43.9]	25.4% [16.3–34.5]
1–10 cigarettes	1023	86.5% [83.2–89.9]	75.1% [71.3–79.0]	53.3% [49.0–57.7]	38.1% [33.9–42.3]	46.5% [42.2–50.9]	39.3% [34.9–43.6]	31.0% [27.1–34.9]
11–19 cigarettes	488	83.7% [77.8–89.6]	73.1% [67.1–79.1]	59.1% [52.8–65.4]	30.2% [24.2–36.2]	46.0% [39.5–52.6]	28.8% [22.6–35.0]	20.0% [15.3–24.8]
20+ cigarettes	767	85.2% [81.6–88.9]	66.6% [62.0–71.3]	65.9% [61.4–70.5]	30.4% [26.0–34.7]	45.6% [40.8–50.4]	29.7% [25.2–34.3]	28.0% [23.7–32.3]
Device type		P < 0.001	P = 0.004	P = 0.840	P < 0.001	P = 0.328	P < 0.001	P = 0.009
Disposable	558	80.0% [74.9–85.1]	65.0% [59.1–70.8]	58.0% [52.0–64.0]	19.6% [14.9–24.2]	49.1% [43.1–55.2]	20.6% [15.5–25.6]	23.3% [18.5–28.2]
Cartridges	1081	81.5% [77.5–85.6]	70.7% [66.6–74.9]	55.8% [51.4–60.2]	26.1% [22.2–30.1]	43.8% [39.5–48.2]	26.6% [22.5–30.6]	26.0% [22.5–29.6]
Tanks	796	91.0% [88.0–94.1]	77.0% [72.8–81.1]	57.0% [52.2–61.7]	54.1% [49.3–58.9]	44.0% [39.2–48.8]	53.3% [48.5–58.1]	33.0% [28.6–37.5]

[a] Respondents could provide multiple reasons for use.

[b] Data are weighted to match demographic (age, gender, race, education) distributions of current e-cigarette users in 2013–2014 National Adult Tobacco Survey.

[c] Bold P-values indicate statistically significant variance in reasons estimates across demographic categories

Table 3

Adjusted prevalence ratios for reasons for use among current *E*-cigarette users,[a] National Online Sample of U.S. Adults (2014).

Covariate	Weighted point estimates [95% Confidence Interval] (*n* = 2442)						
	Cessation/Health	Consideration of others	Convenience	Cost	Curiosity	Flavoring	Simulation of cigarettes
Age							
18–24	0.84[**] [0.75–0.94]	0.94 [0.81–1.09]	1.07 [0.90–1.28]	1.03 [0.78–1.35]	1.11 [0.89–1.39]	2.02[***] [1.60–2.55]	0.78 [0.55–1.12]
25–34	0.96 [0.90–1.03]	1.06 [0.96–1.17]	1.02 [0.88–1.18]	1.23[*] [1.01–1.49]	1.11 [0.93–1.31]	1.61[***] [1.30–2.01]	0.88 [0.68–1.12]
35–54	1.00 [0.96–1.04]	1.02 [0.95–1.10]	1.12[*] [1.02–1.23]	1.03 [0.89–1.20]	1.04 [0.92–1.18]	1.29[**] [1.08–1.54]	0.98 [0.83–1.15]
55	REF	REF	REF	REF	REF	REF	REF
Sex							
Female	1.00 [0.95–1.05]	1.02 [0.95–1.09]	0.95 [0.86–1.04]	0.93 [0.81–1.07]	0.93 [0.82–1.05]	1.00 [0.86–1.16]	1.05 [0.88–1.24]
Male	REF	REF	REF	REF	REF	REF	REF
Race/Ethnicity							
Black	0.84[*] [0.73–0.98]	0.96 [0.81–1.12]	0.82 [0.65–1.05]	1.07 [0.73–1.55]	0.97 [0.74–1.26]	0.85 [0.59–1.23]	0.85 [0.57–1.28]
Hispanic	1.00 [0.91–1.10]	0.95 [0.81–1.12]	0.80 [0.64–1.00]	0.75 [0.54–1.05]	1.00 [0.78–1.27]	0.84 [0.62–1.13]	0.81 [0.56–1.17]
Other	0.89 [0.78–1.02]	1.05 [0.92–1.19]	0.96 [0.79–1.17]	0.83 [0.61–1.11]	1.09 [0.87–1.37]	0.93 [0.66–1.29]	0.73 [0.51–1.03]
White	REF	REF	REF	REF	REF	REF	REF
Education							
Less than high school	REF	REF	REF	REF	REF	REF	REF
High school graduate	1.03 [0.91–1.17]	1.11 [0.93–1.32]	0.91 [0.74–1.11]	1.20 [0.85–1.67]	1.02 [0.78–1.32]	0.97 [0.72–1.29]	0.81 [0.57–1.14]
Some college	1.11 [0.99–1.25]	1.20[*] [1.02–1.42]	1.01 [0.83–1.22]	1.28 [0.93–1.76]	1.05 [0.82–1.35]	1.04 [0.78–1.37]	0.93 [0.67–1.29]
College graduate or higher	1.05 [0.93–1.19]	1.22[*] [1.03–1.45]	0.94 [0.76–1.17]	1.27 [0.90–1.80]	1.20 [0.92–1.57]	0.94 [0.68–1.30]	1.08 [0.76–1.52]
Household income							
<$20,000	REF	REF	REF	REF	REF	REF	REF
$20,000–49,999	0.97 [0.89–1.05]	1.00 [0.90–1.12]	0.85[*] [0.74–0.98]	0.81[*] [0.67–0.99]	0.91 [0.76–1.08]	0.85 [0.68–1.06]	0.92 [0.72–1.17]
$50,000–99,999	1.07 [1.00–1.15]	1.08 [0.97–1.20]	1.00 [0.87–1.14]	0.85 [0.69–1.05]	0.91 [0.76–1.10]	1.00 [0.81–1.24]	0.96 [0.74–1.24]
$100,000	0.95 [0.85–1.06]	1.09 [0.96–1.23]	1.04 [0.88–1.22]	0.71[*] [0.53–0.94]	0.99 [0.80–1.23]	0.95 [0.73–1.24]	0.96 [0.69–1.34]
Region							
Northeast	REF	REF	REF	REF	REF	REF	REF
Midwest	1.02 [0.94–1.11]	0.96 [0.86–1.08]	0.99 [0.84–1.16]	1.06 [0.82–1.39]	0.90 [0.74–1.09]	1.34 [0.98–1.83]	0.82 [0.63–1.09]

Covariate	Weighted point estimates [95% Confidence Interval] (n = 2442)						
	Cessation/Health	Consideration of others	Convenience	Cost	Curiosity	Flavoring	Simulation of cigarettes
South	1.00 [0.92–1.09]	0.98 [0.88–1.09]	1.05 [0.90–1.22]	0.99 [0.77–1.27]	0.93 [0.78–1.11]	1.36* [1.01–1.83]	0.84 [0.65–1.09]
West	0.98 [0.89–1.08]	0.91 [0.80–1.04]	1.02 [0.86–1.22]	1.05 [0.80–1.38]	0.91 [0.74–1.13]	1.22 [0.89–1.69]	0.89 [0.66–1.19]
Children in household							
Yes	0.99 [0.93–1.05]	1.04 [0.96–1.13]	0.97 [0.87–1.08]	0.87 [0.73–1.03]	0.99 [0.85–1.14]	1.03 [0.87–1.21]	0.88 [0.72–1.08]
No	REF	REF	REF	REF	REF	REF	REF
Smoking status							
Current smoker	1.15 [0.98–1.35]	1.18 [0.96–1.44]	1.49* [1.09–2.04]	1.14 [0.85–1.53]	1.54* [1.06–2.22]	1.23 [0.92–1.65]	1.17 [0.83–1.65]
Nonsmoker	REF	REF	REF	REF	REF	REF	REF
Device type							
Cartridges	1.00 [0.92–1.09]	1.07 [0.96–1.19]	0.95 [0.83–1.08]	1.20 [0.91–1.58]	0.93 [0.79–1.09]	1.27 [0.95–1.69]	1.09 [0.85–1.39]
Tanks	1.12** [1.04–1.21]	1.17** [1.05–1.31]	0.98 [0.86–1.13]	2.67*** [2.08–3.42]	0.92 [0.77–1.09]	2.55*** [1.97–3.32]	1.46** [1.14–1.86]
Disposable	REF	REF	REF	REF	REF	REF	REF

***
$P < 0.001$.

**
$P < 0.01$.

*
$P < 0.05$.

[a]Data are weighted to match demographic (age, gender, race, education) distributions of current e-cigarette users in 2013–2014 National Adult Tobacco Survey. Each individual model controls for all covariates listed.