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Advertising exposure and use of e-cigarettes among female current and former tobacco users of childbearing age

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Abstract

Objective—The study examined the relationship between exposure to e-cigarette advertising and e-cigarette use by pregnancy status, including use of flavored e-cigarette products, among women of childbearing age.

Design—A cross-sectional, correlational design was used.

Subjects—Female current or former tobacco users in Central and Eastern Kentucky, 18–45 years old ($N = 194$, 52% pregnant).

Measures—Demographics, pregnancy status, cigarette and e-cigarette use, and exposure to e-cigarette advertising.

Results—Younger age, White/non-Hispanic race, and greater exposure to e-cigarette advertising were associated with a higher likelihood of ever using e-cigarettes ($p < .05$ for each variable). Pregnancy was not associated with ever use ($p = .11$). Younger age was associated with use of flavored e-cigarettes (p = .0027). Among e-cigarette users, those who used flavored products were more likely to have seen advertisements or information about e-cigarettes on social media, compared to those who used unflavored e-cigarettes only ($p = .016$).

Conclusion—There is a link between advertising exposure and ever use of e-cigarettes. Pregnancy status is not significantly associated with ever use. Use of flavored e-cigarettes is associated younger age. E-cigarette users with greater exposure to advertising on social media were more likely to use flavored products.

Keywords

e-cigarettes; flavored e-cigarettes; advertising exposure; tobacco use; women

Introduction

E-cigarettes were first introduced in the world market in 2004 as a “healthy” alternative to existing tobacco products (Denmick, 2009). Since that time, they have been heavily advertised as healthier, cheaper, and more socially acceptable than conventional cigarettes, in addition to providing help with smoking cessation (Rom, Pecorelli, Valacchi, & Reznick, 2015). Many people understand the association of cigarettes with lung disease among

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smokers in general, as well as fetal harm during pregnancy. What may be less well-known is the link between nicotine itself and poor perinatal outcomes, including low birth weight, preterm birth, Sudden Infant Death Syndrome (SIDS), and auditory-cognitive dysfunction (Dwyer, Broide, & Leslie, 2008). Thus, women who try to quit smoking during pregnancy by using e-cigarettes are continuing to put themselves and their fetuses at risk, perhaps unknowingly.

It has also been demonstrated that nicotine exposure in adolescents and young adults has been associated with long-term impairments to behavior and cognition, including attention and memory problems (U.S. Department of Health and Human Services, 2014). Given the nicotine content in most e-cigarettes (including those marketed as nicotine-free) and the presence of other chemicals associated with increased cancer risk that have been found in the e-liquid contained in these products (American Lung Association [ALA], 2016), the widespread use of e-cigarettes by youth and young adults, including women of childbearing age, is particularly alarming.

Although young adults ages 18–24 are less likely to report daily use compared to older adults, this younger age group is most likely to use e-cigarettes (Delnevo et al., 2016). This is hardly surprising, however, as e-cigarette companies have rapidly increased advertising spending, from $6.4 million in 2011 to $115 million in 2014 (Centers for Disease Control and Prevention [CDC], 2016), and much of this advertising is geared toward younger users. While e-cigarettes have been marketed as a tool to stop smoking, much of the advertising to younger populations presents e-cigarettes as an alternative to cigarette smoking (ALA, 2016; Radcliffe, 2016). Between 2011 and 2013, exposure of young adults ages 18 to 24 to e-cigarette advertising increased by 321% (Duke et al., 2014). Older adults are often secondary targets of these campaigns as more than two-thirds of eventual tobacco users initiate prior to age 19 (Rath, Villanti, Abrams, & Vallone, 2012). However, awareness of e-cigarettes in adults has nearly doubled from 40.9% in 2010 to 79.7% in 2013 (King, Patel, Nguyen, & Dube, 2014). While all socioeconomic groups increased in awareness, former and current smokers were more likely to be aware of e-cigarettes than nonsmokers. Adults are also more likely to be targets of heavy e-cigarette marketing on television, which is currently the most frequently viewed media source.

Flavoring is another component of e-cigarettes that have made them appealing to some users relative to combustible cigarettes. However, few adults that already smoke find flavoring to be of interest in e-cigarettes (Shiffman, Sembower, Pillitteri, Gerlach, & Gitchell, 2015). It appears that flavoring has been especially attractive to teen and young adult audiences, as teens who were exposed to ads about flavored e-cigarettes were more likely to have a positive image of these products relative to those exposed to ads about unflavored e-cigarettes or to no ads at all (Thompson, 2016). Flavoring can add another element of risk to e-cigarette use. Many brands of flavored e-cigarettes (including menthol flavoring) contain diacetyl or other chemicals (ALA, 2016). These chemicals have been associated with serious and irreversible lung damage, including bronchiolitis obliterans, which has been identified in industrial workers who inhale diacetyl (Allen et al., 2016).

The purposes of the study were to: a) examine the relationship between exposure to e-cigarette advertising and e-cigarette use in women of childbearing age, controlling for demographic factors, including pregnancy status; and b) assess the association between e-cigarette advertising exposure and use of flavored or menthol e-cigarette products among e-cigarette ever users, adjusting for the same demographic characteristics.

Methods

Design and Sample

The data were collected via a cross-sectional survey from July 2014 to April 2015. English-speaking women between 18 and 45 years of age who reported using tobacco within the past 12 months were eligible to participate. Quota sampling was used to ensure approximately equal numbers of pregnant (n = 101) and nonpregnant (n = 99) women. Pregnant women were recruited from two university-affiliated prenatal clinics and nonpregnant women of childbearing age were recruited from one women's health clinic; clinics were located in Central and Eastern Kentucky. The sampling was done using a recruitment schedule for each pregnancy status group; once 101 pregnant women were enrolled, only nonpregnant women were eligible. Recruitment continued until the sample totaled 200 women. The primary purpose of the study was to compare pregnant and nonpregnant women of childbearing age on tobacco use characteristics and media exposure. The sample size was chosen so that there would be at least 80% power to detect a group difference using two-sample t-tests and assuming an alpha level of .05 and an effect size of 0.6. Due to incomplete information on e-cigarette use, six participants were omitted from this analysis.

After approval from the medical Institutional Review Board, flyers describing the study were placed in the three clinics. Women who indicated interest were screened by nurses at their healthcare appointments. Those who were eligible and agreed to participate signed informed consent prior to survey completion. Recruitment methods were based on our prior experience with these populations (Ashford, Hahn, Hall, Rayens, & Noland, 2009; Ashford, Hahn, Hall, Rayens, Noland, & Collins, 2010). Nearly three-fourths of participants completed the survey via an iPad; the remainder completed a paper form and their responses were entered into the database. Data were stored on a secure server, protected by a password and firewall. Participants received a $10 gift card upon completing the survey.

Measures

Demographic characteristics—Demographics included age (in years), race/ethnicity, annual household income, and pregnancy status. To assess race/ethnicity, women indicated their race (with six options, including multiracial) and whether their ethnicity was Hispanic/Latina (yes/no). Given the small numbers in each racial/ethnic minority, these variables were combined and categorized as 'White/non-Hispanic' or 'Other.' Participants were asked the highest level of school completed (with seven options); a binary variable was created from this to indicate whether the woman was at least a high school graduate. Annual household income was measured with a 9-item scale ranging from '$4,999 or less' to '$50,000 or more.' This ordinal variable was used to create a binary indicator of whether the participant

had a household income of ‘less than $20,000’ or ‘$20,000 or more.’ Women were asked to indicate whether they were currently pregnant (yes/no).

Exposure to e-cigarette advertising—A 10-item instrument was used to assess degree of exposure to advertising and information about e-cigarettes in media, adapted from the National Institute on Drug Abuse [NIDA] (2014) Population Assessment of Tobacco and Health (PATH) survey. The items were anchored by source of media exposure, including ‘Newspaper,’ ‘Magazine,’ ‘Social media (i.e., Facebook, Instagram, Vine, etc.),’ ‘Internet blogs or advertisements on websites,’ ‘Internet news sources (i.e., MSN, ESPN, FOX, etc.),’ ‘Received mail,’ ‘Received an email,’ ‘At a health fair or community event,’ ‘Television,’ and ‘Radio.’ For each media source, the participant answered the question, ‘In the past six months, about how often did you read or hear stories or information about e-cigarettes in the following [source],’ and the response options were coded as 0 = ‘never,’ 1 = ‘once a month,’ 2 = ‘more than once a month,’ 3 = ‘once a week,’ and 4 = ‘more than once a week.’ A summary score of cumulative e-cigarette advertising exposure was formed by adding the 10 items together. The exposure score ranged from 0–40, with higher scores indicated greater degree exposure to advertisements and information about e-cigarettes. Cronbach’s alpha for the exposure scale with this sample was 0.85.

Conventional cigarette use—To assess use frequency for conventional cigarettes, participants were asked to indicate how many days within the past 30 they had smoked (‘used daily,’ ‘used often [more than 10 days this month],’ ‘used occasionally [less than 10 days this month],’ ‘have used, but not within the last 30 days’ or ‘never used’). Responses to this question were combined, with one category including all ever users (i.e., both current and former cigarette smokers) and the other including all who indicated they had never used conventional cigarettes. Those who indicated they were ‘never smokers’ were former or current users of some other form of tobacco (e.g., smokeless) in order to meet inclusion criteria.

E-cigarette use—With response options that matched those given for the question that assessed frequency of conventional cigarette use, participants were asked how often they had used e-cigarettes. Their responses were used to classify them as an ‘ever’ or ‘never’ user of e-cigarettes with the same cutoffs as for conventional cigarettes.

Use of flavored e-cigarettes—Ever users of e-cigarettes were asked if they had ‘ever used flavored e-cigarettes, including menthol.’ The response option was yes/no.

Analytic Strategy

Descriptive analysis included means and standard deviations or frequency distributions. Logistic regression was used to assess whether demographic factors, including pregnancy status, and degree of media exposure were associated with ever use of e-cigarettes. This same analysis strategy was used to determine the use of flavored e-cigarettes among e-cigarette users was associated with demographic factors and degree of media exposure. For both logistic models, variance inflation factors evaluated the presence of multicollinearity in the regression, and the Hosmer-Leesha goodness-of-fit test assessed the fit of the logistic

model to the data. Comparisons in degree of media exposure by source between those who had used flavored e-cigarette products (including menthol) and those who had only used unflavored e-cigarettes were done the Mann-Whitney U test. Data analysis was conducted using SAS, v. 9.4; an alpha level of .05 was used.

Results

The average age of the participants was 29.6 years (SD = 6.7), and participants ranged in age from 18 to 44 (Table 1). Most were White/non-Hispanic (78.1%), and had an annual income of less than $15,000 (56.0%). Slightly more than half were pregnant (51.5%). Nearly all were current or former cigarette users (96.4%), and most were current/former e-cigarette users (64.9%). Among ever users of e-cigarettes, 70.5% were current or former users of flavored e-cigarette products. The average score on the degree of media exposure to e-cigarettes was 14.1 (SD = 9.3), out of a maximum possible score of 40.

Demographic factors associated with ever e-cigarette use

The likelihood ratio test for the logistic model with e-cigarettes as the outcome was significant overall (likelihood ratio chi-square = 24.6; $p < .001$). The significant regressors in the model were age, race/ethnicity, and degree of media exposure (Table 2). For each additional year of age, a participant was 8% less likely to have ever used e-cigarettes. Equivalently, for every 5-year increase in participant age, the likelihood of being an ever e-cigarette user decreased by 34%. Compared to minority current and former tobacco users, those who were White/non-Hispanic were 254% more likely to be ever users of e-cigarettes. For each 1-point increase in degree of exposure to e-cigarette advertising, a participant was 4% more likely to be an ever user of these products. Analogously, for each 10-point increase in degree of exposure to media related to this product, a participant was 50% more likely to be an ever e-cigarette user. Ever use of e-cigarettes was not associated with household income or pregnancy status in this model. Variance inflation factors for this logistic model were less than 1.5, suggesting multicollinearity did not distort regression parameters. In addition, the Hosmer-Lemeshow test was not significant (chi-square = 6.7; $p = .57$), indicating the model fit the data well.

Demographic factors associated with use of flavored e-cigarette products

The likelihood ratio test for the logistic model to determine demographic factors associated with ever using flavored e-cigarettes was significant overall (likelihood ratio chi-square = 15.6; $p < .01$). The only variable significantly associated with the use of flavored e-cigarettes was age (Table 3). For each additional year of age, a current or former e-cigarette user was 12% less likely to have ever used flavored e-cigarettes. Equivalently, for every 5-year increase in participant age, the likelihood of being an ever e-cigarette user decreased by 48%. Ever use of flavored e-cigarettes was not associated with race, household income, or pregnancy status in this model. In addition, ever use of flavored products was not associated with degree of media exposure to e-cigarettes. Variance inflation factors for this logistic model were less than 1.5, suggesting multicollinearity did not distort regression parameters. In addition, the Hosmer-Lemeshow test was not significant (chi-square = 7.7; $p = .46$), indicating the model fit the data well.

Degree of exposure to media sources among e-cigarette users

The Figure displays the median response to the exposure item for each of the ten media sources of advertising for e-cigarettes; this figure has summary measures of degree of exposure for e-cigarette users who have and have not used flavored products. Also in the Figure (as indicated by the bar lines) are the 75th and 25th percentiles (i.e., interquartile range). The most frequent sources of exposure to advertising included: television, social media, and internet blogs, followed by radio and internet news. While degree of exposure was similar for most sources, those who had used flavored products indicated more frequent exposure to advertising about e-cigarettes in social media (Mann-Whitney U chi-square = 5.8, $p = .016$), compared with those who had only used unflavored e-cigarettes. Similarly, while the group who had used flavored products reported more frequent exposure to e-cigarette advertising in internet blogs, this difference was not significant (Mann-Whitney U chi-square = 3.0, p = .082). The other eight comparisons between participants who had used flavored versus those who had only used unflavored were also not significant.

Discussion

While nearly all participants in this study were current or former cigarette users (96.4%), a majority were also current or former e-cigarette users (64.9%). These results are similar to those of Zhu et al. (2013), who found that recent former smokers and current smokers were more likely to be current users of e-cigarettes than people who had never smoked cigarettes. Further, Zhu et al. found that smokers who recently quit traditional cigarettes were more likely to use e-cigarettes on a daily basis, and the majority of ever users of e-cigarettes indicated efforts to quit traditional cigarettes as one reason for e-cigarette use. The high rates of dual or sequential use of traditional and electronic cigarettes found in the present study could be an indication of participants' attempts to quit smoking. Since many pregnant women want to quit smoking and/or reduce the harmful health effects of smoking during pregnancy (Fallin, Miller, Assef, & Ashford, 2016), usage of e-cigarettes and dual use of electronic and conventional cigarettes might be expected during pregnancy. However, this study found no association between ever use of e-cigarettes and current pregnancy status. It is possible that both pregnant and non-pregnant women were motivated to quit smoking, or that one or both groups were primarily motivated by other factors.

Greater exposure to e-cigarette advertising across a variety of media sources was associated with a greater likelihood of being a current or former e-cigarette smoker in the logistic model. This result echoes previous findings that exposure to e-cigarette advertising among youth increased the likelihood of e-cigarette use (Singh et al., 2016). Younger people have reported greater exposure to e-cigarette information on the internet than older people (Zhu et al., 2013). E-cigarette advertising may be particularly effective for those who are already smoking cigarettes. In one experiment, Smith, Bansal-Travers, O'Connor, Goniewicz, and Hyland (2015) found that smokers were more likely to respond favorably to e-cigarette ads than non-smokers. In 2013, another study found that more smokers than non-smokers had ever heard of e-cigarettes, and that the two most common sources of information about e-cigarettes were television and personal conversations (Zhu et al., 2013). It is important to note that the data in the Zhu study were collected "before any major paid advertisement of e-

cigarettes appeared on television" (p. 1). E-cigarette advertising was estimated to exceed $115 million in 2014 (CDC, 2016), so it is likely that increased exposure to advertising is one cause of increased use of e-cigarettes, especially among smokers.

Other risk factors associated with ever use of e-cigarettes were younger age and white/non-Hispanic race. Relative to age, this is consistent with prior research that determined young adults between the ages of 18–24 are more likely to use e-cigarettes than those 25 years and older (Cooper, Harrell, & Perry, 2016). A study of high school and college students found reasons for experimenting with e-cigarettes unique to the age group, including the abundance of flavors and the ability to 'do smoke tricks' (Kong, Morean, Cavallo, Camenga, & Krishnan-Sarin, 2015, p. 852).

On race, our finding that White/non-Hispanic women were more at risk for e-cigarette usage than those in minority groups is similar to previous findings. Mark, Farquhar, Chisolm, Coleman-Cowger, and Terplan (2015) found that among pregnant women sampled, white women were more likely to have ever used e-cigarettes compared with African-American women or women of other races. However, Agaku et al. (2014) found that in a national, stratified sample of the general population, reported usage rates of e-cigarettes were highest among those of "Other, non-Hispanic" race, but not whites. Differences in findings could be due to changes over time—data for the present study and for the Mark et al. study were collected more recently (2014–2015) compared with the Agaku et al. study (2012–2013). This also could be a function of differing demographics in our study, conducted in a geographic area that is primarily populated by non-Hispanic whites, relative to a national sample that was more racially diverse. Since the Agaku et al. study included men, it is also possible that ever use of e-cigarettes varies by both race and gender. The finding that White/non-Hispanic women were more at risk for ever use of e-cigarettes is consistent with the high rates of e-cigarette use among current or former smokers coupled with higher smoking rates in general among whites compared to other racial and ethnic groups (Mark et al., 2015).

Most e-cigarette users had used flavored products, including menthol, and use of flavored products was higher among younger users. While total exposure to e-cigarette advertising was not related to use of flavored e-cigarette products, current or former users of flavored products indicated a greater degree of exposure to e-cigarette advertising on social media sites in particular, compared to e-cigarette users who only chose unflavored products. E-cigarette advertisements often include available flavors such as candy, fruit, menthol, tobacco, and coffee (Grana & Ling, 2014). The presence of flavors may be encouraging youth uptake and experimentation with e-cigarettes. Researchers have reported that among adolescents and young adults, appealing flavors was one of the top reasons for experimentation with e-cigarettes (Cooper et al., 2016) with nearly 44% of respondents indicating availability of flavors as intriguing (Kong et al., 2015). Flavors have also been reported as popular among pregnant and postpartum women (Fallin et al., 2016). The finding that those who used flavored products had greater exposure to social media e-cigarette advertising compared to those who used only unflavored e-cigarettes could be the result of age differences: younger people use both flavored products and social media more

frequently than older people. It is also possible that e-cigarette advertising on social media is targeting youth with promotion of flavored products, resulting in increased usage.

Implications for Public Health Nursing

Reported exposure to e-cigarette advertising was correlated with ever use of e-cigarettes, and those who had used flavored e-cigarettes indicated greater exposure to e-cigarette advertising on social media specifically. The findings of this study suggest that younger female current and former tobacco users may be at greater risk of e-cigarette use in general, and flavored products specifically, compared with their older peers. When screening younger women for tobacco use, practitioners may need to ask specific questions about e-cigarettes to conduct a complete assessment. These could include questions regarding ever use, knowledge of, and curiosity about flavored e-cigarettes, and exposure to e-cigarette advertising on social media. Of particular importance, public health nurses can also debunk myths regarding the relative safety of e-cigarettes as compared to traditional cigarettes.

This analysis also found no association between e-cigarette usage and pregnancy status. While practitioners may expect that women who are pregnant may be more motivated to quit smoking, and therefore have higher rates of e-cigarette usage as a method to reduce or stop using tobacco, this was not the case in our sample. While nurses may be more concerned about e-cigarette usage among pregnant women due to associated risks to both mother and fetus, women of childbearing age who are not pregnant may be just as much at risk of e-cigarette usage. Practitioners serving both pregnant and nonpregnant women, then, should consider assessment and intervention for e-cigarette usage regardless of pregnancy status.

Limitations

One study limitation is that tobacco use other than cigarettes and e-cigarettes was not recorded, though nearly all were current or former cigarette smokers and most were current or former e-cigarette users. In addition, tobacco use was not verified using biochemical validation, but this concern is mitigated since indication of use is unlikely to be fabricated given the social desirability of being a nonsmoker. In addition, the instrument we used to measure advertising exposure to e-cigarette content did not explicitly refer to advertisements; instead the questions asked about ‘stories or information about e-cigarettes,’ which is a broad category that would include advertisements. The purposive sampling design, while providing detailed information about female current and former tobacco users of childbearing age, is not generalizable to the wider population. Finally, while we tested for the associations of demographic factors and exposure to e-cigarette advertising with ever use of e-cigarettes and ever use of flavored e-cigarettes, we were not able to show cause-and-effect due to the cross-sectional design. Perhaps a clearer test of causality, particularly as e-cigarette use continues to accelerate, is to explore the relationships between the amount of e-cigarette advertising, including messages on social media platforms, and to see how this proxy for exposure to e-cigarette media is linked to subsequent population usage rates of e-cigarettes.

Conclusions

There is a link between advertising exposure and ever use of e-cigarettes, though surprisingly, pregnancy status is not significantly associated with ever use. Use of flavored e-cigarettes is associated with increased exposure to advertising on social media. The findings of this study suggest increased risk for e-cigarette usage among younger women and White/non-Hispanic women. Public health advocates can use these findings to guide assessment of use and develop interventions for cessation and prevention of initiation of e-cigarettes among women of childbearing age.

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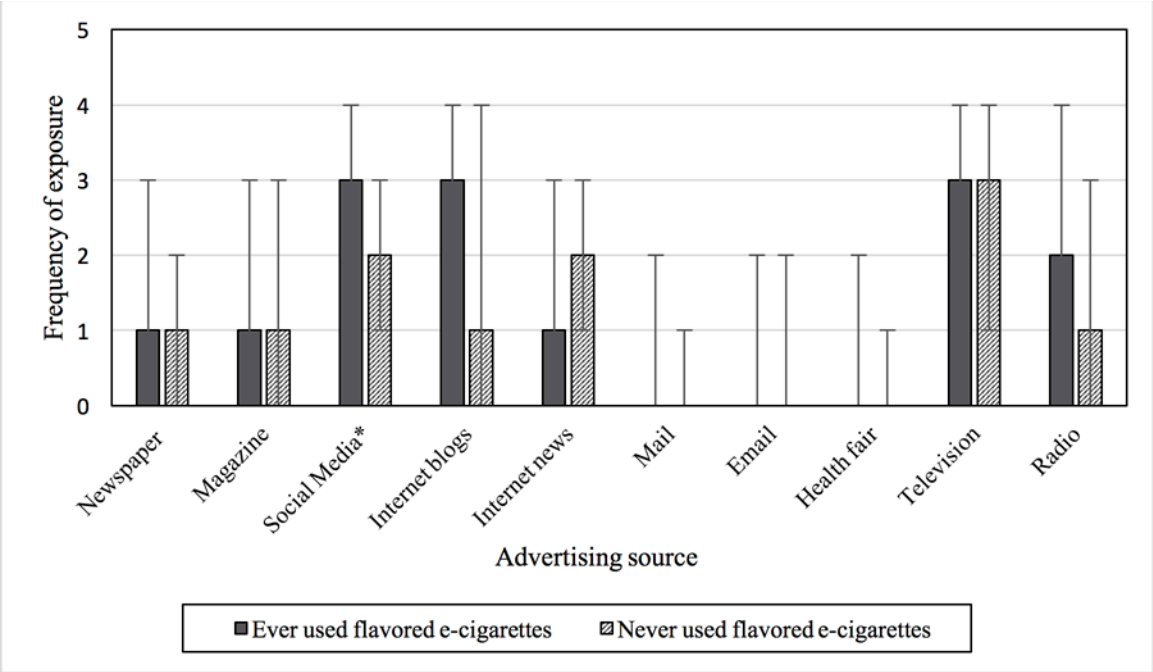

Figure.

Medians and interquartile ranges for frequency of exposure to each e-cigarette advertising source among ever e-cigarette users, by ever use of flavored products*

* p<.05 from Mann-Whitney U test; all other comparisons not significant at the .05 level

Table 1

Sociodemographic characteristics and ever use of specific tobacco products ($N = 194$)

	***Mean* (SD) or *n* (%)**
Age	29.56 (6.71)
Race/ethnicity	
White/non-Hispanic	143 (78.1%)
Other	40 (21.9%)
Household income	
Less than $15,000	108 (56.0%)
$15,000 and above	85 (44.0%)
Pregnant	
Yes	100 (51.5%)
No	94 (48.5%)
Conventional cigarette use	
Ever	187 (96.4%)
Never	7 (3.6%)
E-cigarette use	
Ever	126 (64.9%)
Never	68 (35.1%)
Flavored e-cigarette use (among current/former e-cigarette users)	
Ever	86 (70.5%)
Never	36 (29.5%)
Media exposure to e-cigarettes	14.06 (9.31)

Table 2

Multiple logistic regression to assess factors related to ever e-cigarette use in full sample (n = 182)

	***Odds Ratio* (OR)**	**95% Confidence Interval for OR**	***p***
Age	0.92	0.87 – 0.98	.0078
Race/ethnicity			
White/non-Hispanic	3.54	1.62 – 7.76	.0016
Other	ref		
Household income			
Less than $15,000	0.70	0.35 – 1.39	.31
$15,000 and above	ref		
Pregnant			
Yes	0.51	0.23 – 1.15	.11
No	ref		
Media exposure to e-cigarettes	1.04	1.00 – 1.08	.048

Table 3

Multiple logistic regression to assess factors related to current/former use of flavored e-cigarettes among those who had ever used e-cigarettes (n = 119)

	***Odds Ratio* (OR)**	**95% Confidence Interval for OR**	***p***
Age	0.88	0.81 – 0.96	.0027
Race/ethnicity			
White/non-Hispanic	0.33	0.068 – 1.59	.17
Other	ref		
Household income			
Less than $15,000	1.25	0.54 – 2.93	.60
$15,000 and above	ref		
Pregnant			
Yes	0.36	0.12 – 1.10	.072
No	ref		
Media exposure to e-cigarettes	1.01	0.97 – 1.06	.61