

Original investigation

# Opinions About Electronic Cigarette Use in Smoke-Free Areas Among U.S. Adults, 2012

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## Abstract

**Introduction:** In the United States, electronic cigarettes (e-cigarettes) are currently unregulated, extensively marketed, and experiencing a rapid increase in use. The purpose of this study was to examine the opinions of U.S. adults about e-cigarette use in smoke-free public areas.

**Methods:** Data were obtained from the online *HealthStyle* survey administered to a probability sample of a nationally representative online panel. The study included 4,043 U.S. adults, aged 18 years or older who responded to this question, “Do you think e-cigarette should be allowed to be used in public areas where tobacco smoking is prohibited?” Multinomial logistic regression analyses were used to examine opinions on e-cigarette use in smoke-free areas by sex, age, race/ethnicity, household income, education, census region, and cigarette smoking status and e-cigarette awareness and ever use.

**Results:** Overall, about 40% of adults were uncertain whether e-cigarettes should be allowed in smoke-free areas, 37% opposed, while 23% favored their use in smoke-free public places. Multinomial logistic regression analyses showed that adults who were aware, ever used e-cigarettes, and current cigarette smokers were more likely to express an “in favor” opinion than adults who expressed an uncertain opinion (don’t know).

**Conclusion:** Over 75% of U.S. adults reported uncertainty or disapproval of the use of e-cigarettes in smoke-free areas. Current cigarette smokers, adults aware or have ever used e-cigarettes were more supportive to exempting e-cigarettes from smoking restrictions. With impending regulation and the changing e-cigarette landscape, continued monitoring and research on public opinions about e-cigarette use in smoke-free places are needed.

## Introduction

The use of electronic cigarettes (e-cigarettes), also known as Electronic Nicotine Delivery Systems, has increased in popularity within the United States. E-cigarettes are battery-operated devices that heat a liquid containing nicotine and other ingredients, such as water, propylene glycol, vegetable glycerin, citric acid, natural flavors, and artificial flavors in a cartridge.<sup>1</sup> When the liquid ingredients are heated, a vapor is created and the nicotine is delivered to the user through the inhalation of vapor. E-cigarettes were originally designed to closely resemble regular cigarettes.<sup>2</sup> They

now vary in design, shape, ingredients,<sup>3,4</sup> as well as the amounts of nicotine in a cartridge and that delivered per puff.<sup>5</sup> E-cigarettes are a class of products that come in three main models: cigarette-like e-cigarettes that mimic regular cigarettes in shape and size and can either have a disposable (e.g., NJOY) or a rechargeable power source (e.g., Blu, GreenSmoke); pen-like, medium-sized rechargeable e-cigarettes (e.g., Vapor King); and tank-style vaporizers, also known as “mods,” which contain a large cartridge and an efficient battery (e.g., Volcano).<sup>6</sup>

E-cigarettes are marketed to consumers as a healthier alternative to regular cigarettes<sup>7</sup> that can be used anywhere,<sup>8</sup> although

restrictions on e-cigarette use in public places are beginning to be seen in local jurisdictions.<sup>6</sup>

E-cigarettes were originally created and manufactured by entrepreneurs in China in 2006, and they became widely available in the global market in 2007. In April 2014, the Food and Drug Administration (FDA) released proposed rules to extend their existing regulatory authority over tobacco products to include e-cigarettes and other tobacco products.<sup>9</sup> Currently, e-cigarette marketing strategies resemble those used by conventional tobacco cigarette manufacturers 50 years ago including glamorous images, portraying smokers as carefree, popular, and independent.<sup>10</sup> Additionally, specific marketing messages, such as “freedom to use anywhere” promote the use of e-cigarettes as an alternative or supplement to smoking regular cigarettes.<sup>8</sup>

The prevalence rates of e-cigarette awareness, ever use, and current use are on the rise in the United States.<sup>11,12</sup> The Centers for Disease Control and Prevention (CDC) reported in 2009 only 0.6% of U.S. adults had ever used e-cigarettes.<sup>13</sup> According to the CDC, the prevalence of ever use was 6.2% in 2011.<sup>11</sup> Furthermore, approximately one in five current smokers indicated that they had ever tried e-cigarettes in 2011.<sup>11</sup> Between 2011 and 2012, the CDC observed an increase in ever use (3.3%–6.8%) and in current use (1.1%–2.1%) of e-cigarettes among youth.<sup>14</sup>

Over the last two decades, smoke-free policies have been implemented widely across the United States, gained public support, and proven to be effective in protecting public health.<sup>15</sup> As of July 2014, 26 states and 646 municipalities have adopted 100% smoke-free laws in non-hospitality workplaces, restaurants and bars.<sup>16</sup> The benefits of smoke-free laws have surpassed their original purpose of protecting non-smokers from environmental secondhand smoke. The additional benefits recognized include: reducing smoking rates, increasing quit attempts, reducing the number of cigarettes smoked by current smokers, and lowering initiation rates among young people.<sup>17</sup> Smoke-free laws have also been instrumental in reducing social acceptability of smoking.<sup>17</sup> Smoking denormalization has been effective in increasing smoking cessation and reducing initiation.<sup>18</sup> If e-cigarette use in smoke-free areas reverse the social norms and undermine the benefits of smoking restrictions, then they would be harmful at the population level.<sup>6</sup> Alternatively, permitting e-cigarette use in smoke-free areas could have the potential to motivate current smokers to shift from smoking regular cigarettes to using e-cigarettes, resulting in some possible harm reduction at the individual and the public health levels.

Furthermore, public opinion is an important indicator for the development, implementation, and evaluation of public policies because public opinion reflects social norms and demonstrates the level of societal support for new and existing tobacco control policies.<sup>9,19</sup> Given the rapid increase in e-cigarette use and the differing perspectives of whether e-cigarette use should be encouraged or discouraged, there is a pressing need to examine public attitudes about allowing the use of e-cigarettes in currently smoke-free areas. The objectives of the current study were to examine public opinion on whether e-cigarette use should be allowed in public areas where smoking is currently prohibited and to examine these opinions by socio-demographic characteristics, cigarette smoking status, e-cigarette awareness, and ever use of e-cigarettes.

## Methods

### Sampling

Porter Novelli, a for profit communications consulting firm, administers a series of national consumer surveys known as Styles. The

surveys are conducted by Knowledge Networks which maintains an online research panel (KnowledgePanel®). This panel is nationally representative of the U.S. adult population and maintains approximately 50,000 members.<sup>20</sup> The panel members are randomly recruited by a probability-based sampling (random-digit-dialing and address-based) to reach people with and without landline phones and Internet access. If needed, survey respondents are provided with laptop computers and Internet access.<sup>20,21</sup>

One of the consumer surveys, *HealthStyles* measures health-related information, opinions, and behaviors among U.S. adults. To examine behaviors and opinions regarding e-cigarettes among U.S. adults, we included e-cigarette questions in the *HealthStyles* survey. The survey was fielded in June through July 2012. A random sample of 6,402 adults from KnowledgePanel was invited to participate in the *HealthStyles* survey. Of these, 4,170 adults completed the survey (response rate: 65%). All information was collected online with a median survey completion duration of 38 min. Participants who completed the survey were eligible to receive 10,000 reward points (equivalent to \$10) and enter a sweepstake and to win an in-kind prize. More information on the recruitment, participation incentives, and statistical weighting procedures are found on the company's website.<sup>20</sup>

After excluding respondents with missing information for the dependent and independent variables of interest, the final sample size for this study was 4,043 adults. The study has been approved by the Institutional Review Board at Georgia State University.

## Measures

### Socio-Demographic Characteristics

Socio-demographic characteristics of the respondents included sex, age, race/ethnicity, annual household income, education level, and U.S. census region of residence.

### Awareness of E-cigarette

Awareness was measured using this question, “Have you heard of electronic cigarettes or E-cigarettes, such as Ruyan or NJOY?” Response categories included “yes,” and “no.” Participants who answered “yes” were considered aware of e-cigarettes.

### Ever Use of E-cigarette

Ever use of e-cigarettes was defined by selecting “Electronic Cigarettes or E-cigarettes, such as Ruyan or NJOY” in response to this question, “Have you ever tried any of the following products, even just one time?”

### Cigarette Smoking Status

Current smokers were defined as those who had smoked 100 cigarettes or more in their lifetime, and responded “everyday” or “some days” to this follow up question: “Do you currently smoke cigarettes every day, some days, or not at all?” Respondents who had smoked 100 cigarettes or more in their lifetime but selected “not at all” were considered former smokers. Never-smokers were defined as those who had not smoked 100 cigarettes or more in their lifetime.

### Opinions About E-cigarette Use in Smoke-Free Public Areas

All survey participants were asked to indicate their opinions about whether e-cigarette use should be permitted where tobacco smoking is not allowed, using this question, “Do you think e-cigarette should be allowed to be used in public areas where tobacco smoking

is prohibited?" There were three responses to this question "yes," "no," and "don't know."

## Analysis

Data were analyzed using Stata (v. 11.2) SVY program and weighted according to 2012 U.S. Current Population Survey proportions. The study-specific weighting variable is computed in stages. The survey company computed a "base weight" to adjust for any selection deviations associated with recruitment to the research panel. Further, panel post-stratification weight is computed using nine demographic factors: gender, age, race/ethnicity, household income, education, census region, metro status, and Internet access. Finally, a study-specific post-stratification weighting variable was employed to adjust for potential biases related to sampling, and non-response.

We calculated weighted point prevalence and 95% confidence intervals. Opinions about e-cigarette use in smoke-free public places among U.S. adults were assessed by demographic characteristics: sex, age (18–24, 25–34, 35–44, 45–54, 55–64, and ≥65 years), race/ethnicity (non-Hispanic White, non-Hispanic Black and Hispanic), education levels (<high school, high school graduate, some college, and ≥college graduate), household income (<\$15K, \$15K–\$24.9K, \$25K–\$39.9K, \$40K–\$59.9K, and ≥\$60K), and census region (Northeast, Midwest, South, and West); cigarette smoking status (current, former, and never smokers); and awareness and ever use of e-cigarettes. Chi-square analyses of two-way tables were conducted to examine associations among opinions about e-cigarette use in public areas with respondents' characteristics ( $\alpha = .05$ ). We calculated the relative standard errors (RSE) for all estimates, and all reported estimates had RSE < 20%, which is within the accepted range—national health surveys consistently use 30% as their maximum acceptable RSE (30%).<sup>22,23</sup>

Since the opinion outcome variable has three discrete categories: "yes," "no," and "don't know," we used a weighted multinomial logistic regression to model the probabilities of stating a particular opinion as to whether e-cigarette use should be allowed where smoking is prohibited as a function of e-cigarette awareness, ever use, cigarette smoking status, and demographic variables. In order to compare the characteristics of respondents who were in favor of permitting e-cigarette use in smoke-free areas, to the characteristics of those who did not have enough information and did not form an opinion, we specified the reference group in the model to be those who replied "don't know." Adjusted odds ratios and their 95% confidence intervals were calculated to characterize the relationship between the predictors and opinions about e-cigarette use in smoke-free areas.

## Results

### Sample Characteristics

In 2012, among the 4,043 adult respondents aged 18 years and older, 51.8% were females; the mean age was 46.5 years ( $\pm 17.5$ ) (Table 1). The majority were non-Hispanic White (68.0%), followed by Hispanic (13.7%), non-Hispanic Black (11.3%) and other race (7.0%). Levels of annual household income were: 50.1% ( $\geq \$60,000$ ), 16.9% ( $\$40,000$ – $\$59,000.9$ ), 14.4% ( $\$25,000$ – $\$39,000.9$ ), 9.3% ( $\$15,000$ – $\$24,000.9$ ); and 9.3% ( $< \$15,000$ ). About 12.6% of adults reported having less than a high school diploma; 29.8% reported graduating from high school; and about 57.6% reported having some college education or being a college graduate. More than one-third of adults resided in the South (37.1%); followed by

West (22.9%); Midwest (21.8%); and Northeast (18.3%). Among respondents, 68.0% were aware of e-cigarettes and 8.1% were ever e-cigarette users. More than half of adults (58.1%) were never-smokers; 24.7% were former smokers; and 17.2% were current smokers.

### Opinions About E-cigarette Use in Smoke-Free Public Areas

Overall, 22.6% of respondents reported that e-cigarette use should be allowed in areas where tobacco smoking is currently prohibited; 37.5% stated that e-cigarette use should not be allowed in smoke-free areas, and 39.8% stated they did not know (Table 1). Bivariate analysis using chi-square testing showed that adults who were males (25.3%), aged 25–34 years (30.2%), had less than a high school education (27.2%), were aware of e-cigarettes (30.0%), ever used e-cigarettes (64.1%), and were current cigarette smokers (51%) were more likely ( $p < .05$ ) to report that e-cigarettes should be allowed where tobacco smoking is prohibited (Table 1). No statistically significant relationships were observed between opinions and race/ethnicity, household income, or U.S. census region.

### Multiple Multinomial Regression Analyses

In the multinomial logistic regression model, compared to adults not aware of e-cigarettes, those aware of e-cigarettes had a more than five times greater odds (Adjusted Odds Ratio or AOR = 5.5, 95% CI = 3.9–7.8) of expressing an opinion "in favor of" allowing e-cigarette use in smoke-free areas to expressing an uncertain that is, a "don't know" opinion, after controlling for the other predictors (Table 2). The odds of being "in favor of" allowing e-cigarette use in smoke-free areas versus being uncertain (i.e., reporting "don't know") was almost four times greater for ever e-cigarette users, than for never users (AOR = 3.8, 95% CI = 2.4–6.0). Compared with respondents who expressed an uncertain "don't know" opinion, for current cigarette smokers, the odds of expressing an opinion "in favor" were twice as large as the odds for never smokers (AOR = 2.3, 95% CI = 1.6–3.3).

Compared to young adults (18–24), older adults aged (45–54), (55–64), and (65+) were significantly less likely to express, an opinion "in favor" (AOR = 0.5, 95% CI = 0.3–0.9), (AOR = 0.5, 95% CI = 0.3–0.9), (AOR = 0.3, 95% CI = 0.1–0.4) than to report, "don't know." Compared to the reference group, individuals who expressed either a supportive or opposing opinion did not significantly differ by gender, race/ethnicity, household income, education level, or U.S. census region (Table 2).

## Discussion

To our knowledge, this is one of the first studies to examine public opinion about e-cigarette use in areas where smoking is prohibited. While the majority of respondents either report, "don't know" or oppose allowing e-cigarette use in smoke-free areas, about one in five adults support e-cigarette use in smoke-free areas. It should be noted that adults who responded, "don't know" were also more likely to lack awareness about e-cigarettes compared to adults who had an opinion, suggesting that their lack of opinion could be due to the novelty of the device on the market. E-cigarette awareness, ever use of e-cigarettes, and being a current cigarette smoker were independently associated with expressing supportive opinion to allowing e-cigarette use in smoke-free areas compared to reporting, "don't know."

**Table 1.** Opinions About Allowing Electronic Cigarette (E-Cigarette) Use in Smoke-Free Public Areas Among U.S. Adults by Respondents' Characteristics—HealthStyles, 2012

“Do you think e-cigarettes should be allowed to be used in public areas where tobacco smoking is prohibited?”				
Characteristics	All (N = 4,043) <sup>a</sup>	Yes, allow <sup>b</sup>	No, don't allow <sup>b</sup>	Don't know <sup>b</sup>
	Weighted % (95% CI)			
Overall		22.6 (20.9–24.5)	37.5 (35.5–39.6)	39.8 (37.8–42.0)
Sex				
Male	48.2 (46.1–50.3)	25.3 (22.7–28.2)*	36.4 (33.5–39.3)	38.3 (35.4–41.3)
Female	51.8 (49.7–53.9)	20.2 (17.9–22.7)	38.6 (35.8–41.4)	41.2 (38.4–44.1)
Age group (year)				
18–24	12.5 (11.0–14.1)	25.8 (20.2–32.4)*	40.8 (34.5–47.5)	33.3 (27.3–40.0)
25–34	17.4 (15.7–19.2)	30.2 (25.2–35.6)	36.9 (31.6–42.6)	33.0 (27.8–38.5)
35–44	16.8 (15.3–18.4)	23.3 (19.3–27.7)	39.3 (34.6–44.3)	37.5 (32.7–42.4)
45–54	19.0 (17.5–20.6)	24.6 (20.9–28.7)	33.7 (29.8–37.8)	41.8 (37.5–46.2)
55–64	16.4 (14.9–17.9)	21.6 (17.7–26.2)	37.7 (33.0–42.5)	40.7 (36.1–45.5)
65+	18.0 (16.5–19.6)	11.6 (9.0–14.9)	38.1 (33.7–42.6)	50.3 (45.8–54.9)
Race/ethnicity				
White, NH	68.0 (65.9–70.1)	23.1 (21.1–25.2)	38.2 (35.9–40.5)	38.7 (36.5–41.1)
Black, NH	11.3 (9.9–12.8)	21.4 (16.3–27.7)	37.3 (30.8–44.2)	41.3 (34.9–48.1)
Hispanic	13.7 (12.2–15.4)	19.8 (15.0–25.7)	36.6 (30.6–42.9)	43.7 (37.3–50.2)
Other	7.0 (5.9–8.4)	26.0 (18.4–35.3)	33.6 (25.7–42.6)	40.5 (32.0–49.6)
Household income				
<\$15K	9.3 (8.0–10.7)	28.0 (21.5–35.6)	30.0 (23.6–37.2)	42.0 (34.7–49.7)
\$15K–\$24.9K	9.3 (8.1–10.7)	24.5 (18.6–31.5)	35.4 (28.8–42.8)	40.1 (33.2–47.4)
\$25K–\$39.9K	14.4 (13.0–16.0)	25.8 (21.2–31.0)	38.3 (33.1–43.8)	35.9 (30.8–41.2)
\$40K–\$59.9K	16.9 (15.4–18.5)	23.6 (19.5–28.3)	37.5 (32.8–42.5)	38.9 (34.1–43.8)
\$60K+	50.1 (48.0–52.2)	20.1 (17.9–22.6)	39.1 (36.3–41.9)	40.8 (38.0–43.7)
Education level				
<HS	12.6 (11.0–14.4)	27.2 (21.0–34.4)*	34.5 (27.9–41.7)	38.4 (31.5–45.8)
HS graduate	29.8 (27.9–31.8)	23.3 (20.1–26.9)	36.9 (33.1–40.8)	39.8 (36.0–43.8)
Some college	29.0 (27.2–30.8)	25.0 (22.0–28.3)	38.1 (34.7–41.7)	36.9 (33.5–40.4)
College graduate+	28.6 (26.9–30.5)	17.7 (15.1–20.7)	38.9 (35.5–42.4)	43.4 (40.0–46.9)
U.S. census region				
Northeast	18.3 (16.7–19.9)	21.6 (17.8–25.9)	36.9 (32.4–41.6)	41.6 (36.9–46.4)
Midwest	21.8 (20.2–23.5)	24.5 (20.9–28.5)	37.5 (33.4–41.7)	38.1 (34.1–42.1)
South	37.1 (35.1–39.2)	22.4 (19.5–25.5)	37.4 (34.1–40.8)	40.3 (36.9–43.7)
West	22.9 (21.2–24.8)	22.2 (18.6–26.4)	38.3 (34.0–42.8)	39.4 (35.1–44.0)
E-cigarette awareness				
Aware	68.0 (66.0–69.9)	30.0 (27.6–32.4)*	37.3 (34.9–39.8)	32.7 (30.4–35.1)
Unaware	32.0 (30.1–34.0)	7.2 (5.4–9.5)	37.9 (34.3–41.6)	54.9 (51.2–58.6)
E-cigarette ever use				
Ever user	8.1 (7.0–9.4)	64.1 (56.5–70.9)*	18.8 (13.4–25.7)	17.1 (12.2–23.5)
Never user	91.9 (90.7–93.0)	19.0 (17.3–20.9)	39.2 (37.1–41.3)	41.8 (39.7–44.0)
Cigarette smoking status				
Current smoker	17.2 (15.6–18.9)	51.0 (45.6–56.3)*	17.6 (13.9–21.9)	31.5 (26.6–36.7)
Former smoker	24.7 (23.0–26.5)	18.3 (15.4–21.6)	37.0 (33.2–41.0)	44.7 (40.8–48.7)
Never-smoker	58.1 (65.0–60.2)	16.2 (14.1–18.4)	43.6 (40.9–46.4)	40.2 (37.6–43.0)

HS = high school; NH = non-Hispanic.

<sup>a</sup>For each variable, total sums vertically to 100%.

<sup>b</sup>For each row, total sums horizontally to 100%.

\*Statistically significant by chi-square test for bivariate analysis.

E-cigarettes are widely available<sup>24</sup> and marketed through multiple channels, including the Internet and television.<sup>25,26</sup> From 2008 to 2010, the relative Internet search volume for the topic of e-cigarettes, using the Google search engine, sharply increased, suggesting the rapid rise in its popularity, especially in states where strict tobacco control laws were implemented.<sup>24</sup>

In 2009, the Family Smoking Prevention and Tobacco Control Act granted the FDA the power to regulate the manufacturing, marketing, and distribution of tobacco products.<sup>27</sup> Because e-cigarettes

deliver a drug (nicotine), the FDA attempted to regulate them as drug delivery devices in 2010. Sottera Inc. (the maker of a popular e-cigarette brand: NJOY) took the matter to court. In December 2010, the U.S. Court of Appeals for the D.C. circuit ruled in favor of Sottera, declaring that e-cigarettes should be regulated as tobacco products rather than drug delivery or therapeutic devices.<sup>28</sup> Most recently, in 2014, the FDA proposed rules to regulate e-cigarettes.<sup>9</sup> However, this proposed rulemaking does not include flavored e-cigarette products, marketing practices, or online sales.

**Table 2.** Adjusted Odds Ratios for the Association of Respondents' Characteristics with Their Opinions About Allowing Electronic Cigarettes (E-Cigarettes) Use in Smoke-Free Public Areas Among U.S. Adults—HealthStyles, 2012

Predictors	"Do you think e-cigarettes should be allowed to be used in public areas where tobacco smoking is prohibited?"	
	Yes, allow (vs. don't know)	No, don't allow (vs. don't know)
	Adjusted OR (95% CI) <sup>a</sup>	Adjusted OR (95% CI) <sup>a</sup>
<b>Sex</b>		
Male	0.8 (0.6–1.0)	1.0 (0.8–1.0)
Female (referent)	1.0	1.0
<b>Age group (year)</b>		
18–24 (referent)	1.0	1.0
25–34	1.0 (0.6–1.6)	1.0 (0.7–1.6)
35–44	0.7 (0.4–1.1)	1.0 (0.7–1.5)
45–54	0.5 (0.3–0.9)	0.8 (0.5–1.1)
55–64	0.5 (0.3–0.9)	0.9 (0.6–1.3)
65+	0.3 (0.1–0.4)	0.7 (0.5–1.0)
<b>Race/ethnicity</b>		
Black, non-Hispanic	0.8 (0.5–1.3)	1.0 (0.7–1.4)
Hispanic	0.9 (0.6–1.4)	0.9 (0.6–1.2)
Other	1.2 (0.7–2.2)	0.9 (0.6–1.3)
White, non-Hispanic (referent)	1.0	1.0
<b>Household income</b>		
<\$15K	1.0 (0.6–1.7)	0.8 (0.5–1.2)
\$15K–\$24.9K	1.1 (0.7–1.7)	1.0 (0.7–1.4)
\$25K–\$39.9K	1.4 (1.0–2.1)	1.2 (0.9–1.6)
\$40K–\$59.9K	1.1 (0.8–1.6)	1.0 (0.8–1.3)
\$60K + (referent)	1.0	1.0
<b>Education level</b>		
<HS	1.4 (0.8–2.3)	1.3 (0.9–2.0)
HS graduate	1.3 (0.9–1.8)	1.2 (0.9–1.5)
Some college	1.4 (1.0–1.9)	1.2 (0.9–1.5)
College graduate+ (referent)	1.0	1.0
<b>U.S. census region</b>		
Northeast	1.0 (0.7–1.5)	0.9 (0.7–1.3)
Midwest	1.0 (0.7–1.4)	1.0 (0.7–1.3)
South	0.9 (0.6–1.3)	1.0 (0.8–1.3)
West (referent)	1.0	1.0
<b>Awareness status</b>		
Aware	5.5 (3.9–7.8)*	1.8 (1.4–2.2)
Unaware (referent)	1.0	1.0
<b>E-cigarette ever use</b>		
Ever user	3.8 (2.4–6.0)*	1.3 (0.8–2.3)
Never user (referent)	1.0	1.0
<b>Cigarette smoking status</b>		
Current smoker	2.3 (1.6–3.3)*	0.4 (0.3–0.6)
Former smoker	1.0 (0.7–1.4)	0.8 (0.6–0.9)
Never-smoker (referent)	1.0	1.0

HS = high school.

<sup>a</sup>Adjusted OR (95% CI) = adjusted odds ratio (95% confidence interval).\*Statistically significant ( $p = .000$ ), compared to the reference group, by multinomial logistic regression.

E-cigarettes have existed in a regulatory vacuum.<sup>3</sup> Recently, an increasing number of states and local governments are adopting legislation to control youth access to e-cigarettes and to restrict where e-cigarette could be used. As of April 2014, three states (New Jersey, North Dakota, and Utah) banned the use of e-cigarettes in 100% smoke-free venues: non-hospitality work places, restaurants, and bars. Ten states prohibited e-cigarette use in certain facilities such as school and state workplace properties. In addition, 172 municipalities including New York, Los Angeles, and Chicago restricted e-cigarette use in work places and other venues.<sup>29</sup>

Some public health officials argue that e-cigarette use should be allowed in smoke-free environments to encourage smokers to switch from combustible cigarettes.<sup>30</sup> Other argue that introducing e-cigarettes to smoke-free environments could undermine smoking restrictions.<sup>31</sup> Smoking restrictions have resulted in protecting non-smokers from secondhand smoke, reducing overall cigarette consumption,<sup>32</sup> and de-normalizing smoking behavior that in turn led to increased cessation<sup>18</sup> and to reduction in initiation.<sup>33</sup>

Potential unintended consequences of allowing e-cigarettes to be used freely in smoke-free areas include: undermining tobacco control efforts, and re-normalizing smoking, encouraging dual use—the use

of both regular and electronic cigarettes, and subjecting non-smokers and non-e-cigarette users to secondhand vapor which could contain nicotine. E-cigarette emissions are not “harmless water vapor,”<sup>6</sup> but contain nicotine, volatile organic compounds, and ultrafine particles.<sup>34,35</sup> Further studies are urgently needed to ascertain the safety of secondhand vapor, including its potential effect on people who have not used nicotine products, as well as whether it could be a vehicle for infectious agents. Understanding these issues will help determine the need for restrictions on e-cigarette use in public areas.

The industry markets e-cigarettes as a product to regain freedom from smoking bans,<sup>8</sup> by allowing smokers to administer nicotine in smoke-free environments, which may lead to dual use and perpetuation of nicotine dependency. This marketing could explain our finding that current smokers favor allowing e-cigarette use in smoke-free areas. Previous research has shown that current smokers do indeed use e-cigarettes in situations where they cannot smoke cigarettes.<sup>36–38</sup>

If permitted in smoke-free areas, e-cigarettes could be used to subvert smoking restrictions and re-normalize smoking.<sup>6</sup> Social denormalization of smoking played a critical role in reducing smoking prevalence and youth initiation.<sup>32</sup> It is plausible that introducing a smoking-like behavior and a cigarette-like product to smoke-free areas could undo decades of work, renormalize smoking, and reverse youth initiation. A recent study among children aged 6–10 years showed that they could mistake e-cigarette vapor for cigarette smoke.<sup>39</sup>

Exempting e-cigarettes from smoking bans could undermine compliance with anti-smoking laws and their enforcement. The strong resemblance of e-cigarette-produced vapor and cigarette-produced smoke could potentially confuse bystanders, leading them to conclude that smoking is permitted in the facility. The difficulty of distinguishing clouds of vapor from clouds of smoke could impede efforts to enforce smoking bans.<sup>40</sup> Future studies need to focus on understanding whether people recognize vapor from smoke or confuse the two.

### Limitations

The current study is not free of limitations. First, the data are self-reported. Thus, data are subject to recall bias, and underreporting of socially unfavorable behaviors. Second, a small proportion of respondents (3.0%) did not respond to the question on opinions about e-cigarette use in smoke-free public areas, which could lead to item non-response bias. Third, the regression model did not include all potential confounding variables that could affect the public opinion regarding use of e-cigarette in smoke-free areas; for example, political ideology, and state, and local smoke-free laws for the survey participants.<sup>41,42</sup> Fourth, the study sample was recruited from an online research panel (KnowledgePanel). However, this online research panel is a representative sample of the U.S. population,<sup>20</sup> and the data were weighted to be nationally representative. The weights were computed in stages to account for biases that could originate from non-coverage and non-response. Further, tobacco-related indicators based on *HealthStyles* are comparable with those of national surveys.<sup>13</sup> Using the 2012 *HealthStyles*, we obtained a current smoking prevalence of 17.2 (95% CI = 15.6–18.9), and the prevalence of current smoking was 18.1 (95% CI = 17.5–18.7) using the 2012 National Health Interview Survey data,<sup>43</sup> supporting that the estimates obtained in our study are consistent with NHIS.<sup>13</sup>

### Conclusion

The study revealed that a substantial proportion of U.S. adults did not know whether e-cigarettes should be banned in smoke-free

public places. This might be explained by the lack of awareness of the existence of e-cigarettes. As e-cigarette awareness and popularity continue to increase and the diversity of the product continues to expand, we anticipate the proportion of adults with a “don’t know” response to decrease. Current smokers favored allowing e-cigarette use in smoke-free areas and opposed bans, which is consistent with previous findings of e-cigarette use to circumvent smoking bans. As e-cigarette popularity and use continue to rise, along with ensuing efforts to regulate its use, it will be important to continue to monitor public opinion regarding allowing e-cigarette use in smoke-free areas. Qualitative studies, especially among non-smokers, are also needed to explore the reasons behind favoring or opposing e-cigarette use in public areas. In addition, the potential effects of e-cigarette use on social norms, youth smoking initiation, and compliance with smoke-free laws warrant future research.

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### Declaration of Interests

None declared.

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### References

- McQueen A, Tower S, Sumner W. Interviews with “vapers”: implications for future research with electronic cigarettes. *Nicotine Tob Res.* 2011;13:860–867.
- O’Connor RJ. Non-cigarette tobacco products: what have we learnt and where are we headed? *Tob Control.* 2012;21:181–190.
- Cobb NK, Byron MJ, Abrams DB, Shields PG. Novel nicotine delivery systems and public health: the rise of the “e-cigarette”. *Am J Public Health.* 2010;100:2340–2342.
- FDA. E-cigarettes: questions and answers. 2011. <http://www.fda.gov/forconsumers/consumerupdates/ucm225210.htm>. Accessed November 11, 2012.
- Goniewicz ML, Kuma T, Gawron M, Knysak J, Kosmider L. Nicotine levels in electronic cigarettes. *Nicotine Tob Res.* 2013;15:158–166.
- Grana RA, Benowitz N, Glantz SA. E-cigarettes: a scientific review. *Circulation.* 2014;129:1972–1986.
- Cobb NK, Brookover J, Cobb CO. Forensic analysis of online marketing for electronic nicotine delivery systems. *Tob Control.* 2013 [published online ahead of print]. doi:10.1136/tobaccocontrol-2013-051185.
- Grana RA, Ling PM. “Smoking revolution”: a content analysis of electronic cigarette retail websites. *Am J Prev Med.* 2014;46:395–403.
- The 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; regulations on the sale and distribution of tobacco products and required warning statements for tobacco products proposed rule,” 79 Federal Register 80. 2014. <https://www.federalregister.gov/articles/2014/04/25/2014-09491/deeming-tobacco-products-to-be-subject-to-the-federal-food-drug-and-cosmetic-act-as-amended-by-the>. Accessed May 2, 2014.

10. Benowitz NL, Goniewicz ML. The regulatory challenge of electronic cigarettes. *JAMA*. 2013;310:685–686.
11. King BA, Alam S, Promoff G, Arrazola R, Dube SR. Awareness and ever use of electronic cigarettes among U.S. adults, 2010–2011. *Nicotine Tob Res*. 2013;15(9):1623–1627. doi: 10.1093/ntr/ntt013.
12. Tan AS, Bigman CA. E-Cigarette awareness and perceived harmfulness. Prevalence and associations with smoking-cessation outcomes. *Am J Prev Med*. 2014. <http://dx.doi.org/10.1016/j.amepre.2014.02.011>. Accessed July 20.
13. Regan AK, Promoff G, Dube SR, Arrazola R. Electronic nicotine delivery systems: adult use and awareness of the ‘e-cigarette’ in the USA. *Tob Control*. 2011 [published online ahead of print]. doi:10.1136/tobaccocontrol-2011-050044.
14. Centers for Disease Control and Prevention. Electronic cigarette use among middle and high school students—United States, 2011–2012. *MMWR*. 2013;62:729–730.
15. Eriksen M, Chaloupka F. The economic impact of clean indoor air laws. *CA Cancer J Clin*. 2007;57:367–378.
16. American Nonsmokers’ Rights Foundation. Smokefree lists, maps, and data. 2014. <http://www.no-smoke.org/pdf/WRBLawsMap.pdf>. Accessed July 31, 2014.
17. Guide to Community Preventive Services. Reducing tobacco use and secondhand smoke exposure: smoke-free policies. 2012. [www.thecommunityguide.org/tobacco/smokefreepolicies.html](http://www.thecommunityguide.org/tobacco/smokefreepolicies.html). Accessed November 2012.
18. Hammond D, Fong GT, Zanna MP, Thrasher J, Borland R. Tobacco denormalization and industry beliefs among smokers from four countries. *Am J Prev Med*. 2006;31:225–232.
19. Farley SM, Coady MH, Mandel-Ricci J, et al. Public opinions on tax and retail-based tobacco control strategies. *Tob Control*. 2013;0:1–4.
20. GfK. KnowledgePanel design summary. 2013. [http://www.knowledgenetworks.com/knpanel/docs/knowledgePanel\(R\)-design-summary-description.pdf](http://www.knowledgenetworks.com/knpanel/docs/knowledgePanel(R)-design-summary-description.pdf). Accessed April 20, 2014.
21. GfK. GfK KnowledgePanel. 2014. <http://www.gfk.com/us/Solutions/consumer-panels/Pages/GfK-KnowledgePanel.aspx>. Accessed October 2, 2014.
22. Klein RJ, Proctor SE, Boudreault MA, Turczyn KM. *Healthy people 2010 criteria for data suppression*. *Statistical Notes, no 24*. Hyattsville, MD: National Center for Health Statistics; 2002.
23. National Environmental Public Health Tracking Networks (NEPHTN). *Data re-releasing plan version 2.5*. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Environmental Hazards and Health Effects, Environmental Health Tracking Branch; 2008. [http://ephttracking.cdc.gov/docs/Tracking\\_Re-Release\\_Plan\\_v2.5.pdf](http://ephttracking.cdc.gov/docs/Tracking_Re-Release_Plan_v2.5.pdf). Accessed October 6, 2014.
24. Ayers JW, Ribisl KM, Brownstein JS. Tracking the rise in popularity of electronic nicotine delivery systems (electronic cigarettes) using search query surveillance. *Am J Prev Med*. 2011;40:448–453.
25. Kim AE, Lee YO, Shafer P, Nonnemaker J, Makarenko O. Adult smokers’ receptivity to a television advert for electronic nicotine delivery systems. *Tob Control*. 2013 [published online first on May 1, 2014]. doi:10.1136/tobaccocontrol-2013-051130.
26. Hodge JG, Collmer V, Orenstein DG, Millea C, Buren L. Reconsidering the legality of cigarette smoking advertisements on television public health and the law. *J Law Med Ethics*. 2013;41:369–373.
27. Ashley DL, Backinger CL. The Food and Drug Administration’s regulation of tobacco: the Center for Tobacco Products’ Office of Science. *Am J Prev Med*. 2012;43(suppl. 3):S255–S263.
28. Deyton LR, Woodcock J. Regulation of e-cigarettes and other tobacco products letter to stakeholders. 2011. <http://www.fda.gov/newsevents/publichealthfocus/ucm252360.htm>. Accessed November 1, 2013.
29. American Nonsmokers’ Rights Foundation. U.S. state and local lawsregulation use of electronic cigarettes. 2014. <http://no-smoke.org/pdf/ecig-slaws.pdf>. Accessed May 14, 2014.
30. Saitta D, Ferro GA, Polosa R. Achieving appropriate regulations for electronic cigarettes. *Ther Adv Chronic Dis*. 2014;5:50–61.
31. Etter JF, Bullen C, Flouris AD, Laugesen M, Eissenberg T. Electronic nicotine delivery systems: a research agenda. *Tob Control*. 2011;20:243–248.
32. Hopkins DP, Razi S, Leeks KD, Kalra GP, Chattopadhyay SK, Soler RE; Task Force on Community Preventive Services. Smokefree policies to reduce tobacco use. A systematic review. *Am J Prev Med*. 2010;38:S275–S289.
33. Wechsler H, Lee JE, Rigotti NA. Cigarette use by college students in smoke-free housing: results of a national study. *Am J Prev Med*. 2001;20:202–207.
34. Schripp T, Markewitz D, Uhde E, Salthammer T. Does e-cigarette consumption cause passive vaping? *Indoor Air*. 2013;23:25–31.
35. Schober W, Szendrei K, Matzen W, et al. Use of electronic cigarette (e-cigarette) impairs indoor air quality and increases FeNO levels of e-cigarette consumers. *Int J Hyg Environ Health*. 2014;217(6):628–637. doi: 10.1016/j.ijheh.2013.11.003.
36. Adkinson SE, O’Conner RJ, Bansal-Travers M, et al. Electronic nicotine delivery systems International Tobacco Control Four-Country Survey. *Am J Prev Med*. 2013;44:207–215.
37. Dawkins L, Turner J, Roberts A, Soar K. ‘Vaping’ profiles and preferences: an online survey of electronic cigarette users. *Addiction*. 2013;108:1115–1125. doi: 10.1111/add.12150.
38. Vickerman KA, Carpenter KM, Altman T, Nash CM, Zbikowski SM. Use of electronic cigarettes among state tobacco cessation quitline callers. *Nicotine Tob Res*. 2013;15:1787–1791. doi: 10.1093/ntr/ntt061.
39. Faletau J, Glover M, Nosa V, Pienaar F. Looks like smoking, is it smoking?: Children’s perceptions of cigarette-like nicotine delivery systems, smoking and cessation. *Harm Reduct J*. 2013;10:30. <http://www.harmreduction-journal.com/content/10/1/30>. Accessed March 1, 2014.
40. Kurutz S. Confounding a smoking ban, and bouncers. *New York Times*. 2013. [http://www.nytimes.com/2013/08/08/fashion/smoking-is-back-without-the-tigma.html?pagewanted=all&\\_r=0](http://www.nytimes.com/2013/08/08/fashion/smoking-is-back-without-the-tigma.html?pagewanted=all&_r=0). Accessed April 20, 2014.
41. Tung GJ, Vernick JS, Stuart EA, Webster DW. Political factors affecting the enactment of state-level clean indoor air laws. *Am J Public Health*. 2014;104:e92–e97.
42. Huang J, Tauras J, Chaloupka FJ. The impact of price and tobacco control policies on the demand for electronic nicotine delivery systems. *Tob Control*. 2014;23:iii41–iii47. doi:10.1136/tobaccocontrol-2013-051515.
43. Centers for Disease Control and Prevention. Current cigarette smoking among adults—United States, 2005–2012. *MMWR*. 2014;63:29–34.