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## E-Cigarette Marketing Exposure is Associated with E-cigarette Use among U.S. Youth

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### Abstract

**Introduction**—E-cigarettes are currently the most commonly used tobacco product among U.S. youth. However, unlike conventional cigarettes, e-cigarettes are not subject to marketing restrictions. This study investigates the association between exposure to e-cigarette marketing and susceptibility and use of e-cigarettes in youth.

**Methods**—Data were obtained from the 2014 National Youth Tobacco Survey. Participants were 22,007 U.S. middle and high school students. Multivariate logistic regression models assessed the relationship between e-cigarette marketing (internet, print, retail, TV/movies) and current and ever use as well as susceptibility to use e-cigarettes among never e-cigarette users.

**Results**—Exposure to each type of e-cigarette marketing was significantly associated with increased likelihood of ever and current use of e-cigarettes among middle and high school students. Exposure was also associated with susceptibility to use of e-cigarettes among current non-users. In multivariate models, as the number of channels of e-cigarette marketing exposure increased, the likelihood of use and susceptibility also increased.

**Conclusions**—Findings highlight the significant associations between e-cigarette marketing and e-cigarette use among youth, and the need for longitudinal research on these relationships.

### Introduction

Electronic cigarettes (e-cigarettes) are the most commonly used nicotine product among adolescents, outpacing conventional cigarettes<sup>1</sup>. E-cigarette use among high school students increased from 1.5% in 2011 to 13.4% in 2014<sup>1</sup>. From 2013 to 2014, e-cigarette use tripled among middle school (1.1% to 3.9%) and high school (4.5% to 13.4%) students<sup>1</sup>. While research is limited on the short and long-term health consequences of e-cigarette use, exposure to nicotine and e-cigarette aerosols present several public health concerns.

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Preliminary studies have detected the presence of harmful chemicals<sup>2</sup> and carcinogens<sup>3</sup> in e-cigarette liquids and aerosols. Studies show that exposure to nicotine during adolescence negatively influences adolescent brain development<sup>4</sup> and is associated with attention and cognition deficits<sup>5,6</sup>, mood dysfunctions<sup>7</sup>, and increased propensity for risk taking<sup>8</sup>. Indirectly, studies have shown a link between e-cigarette use and use of combustible tobacco products, such as conventional cigarettes<sup>9</sup>. Furthermore, research suggests a temporal relationship, indicating use of e-cigarettes may act as the impetus for combustible tobacco use<sup>10</sup>.

There is limited research on the impact of marketing on the use of e-cigarettes. However, tobacco advertising and point-of-sale marketing have been shown to cause tobacco use among youth and young adults<sup>12</sup> and increase positive perceptions of tobacco use among non-users<sup>13</sup>. A study of adolescents who had never used e-cigarettes found a positive relationship between exposure to e-cigarette advertising and intentions to use e-cigarettes<sup>14</sup>. Another study, using data from 2011, found an association between tobacco marketing and other pro-tobacco influences (e.g., seeing products used on TV/movie), and use of e-cigarettes among adolescents<sup>15</sup>. However, the prevalence of e-cigarette experimentation among the adolescents in the sample was relatively low (3.1%) and current use was not assessed. Rapid changes in industry marketing<sup>16</sup>, product awareness<sup>14</sup>, and use by adolescents<sup>1</sup>, warrant ongoing research. It is vital to understand the relationship between marketing and e-cigarette use and susceptibility to use among adolescents, particularly as significant regulatory gaps remain as compared to conventional tobacco products. The Food and Drug Administration (FDA) does not currently regulate the marketing or distribution of electronic cigarettes<sup>17</sup>, and state laws have not kept up with the market changes. This lack of regulation has allowed this industry to launch marketing campaigns that appeal particularly to adolescents.

The United Kingdom is, currently, the only country in the world with comprehensive e-cigarette regulations, including restrictions on marketing<sup>18</sup>. Marketing restrictions to protect youth include banning advertisements likely to appeal to minors and those using people appearing to be under 25 years of age to sell e-cigarettes. Additionally, mediums with an adolescent audience of more than 25% cannot be used to advertise e-cigarettes, and e-cigarette advertisements cannot run adjacent to programs likely to appeal to adolescents. Many countries including Uruguay, Brazil and Mexico have banned e-cigarettes entirely<sup>19</sup>.

From 2011 to 2013, e-cigarette marketing expenditures increased nearly tenfold, from \$6.4 million to more than \$60 million<sup>16, 20</sup> in the United States. These figures account for print, television, radio, and digital advertising. Over this same time period, there has been a corresponding growth in initiation, current use, and product awareness of e-cigarettes among youth<sup>1</sup>. This is not surprising, given prior experience with cigarette advertising and cigarette use among young people.

The 2012 Report of the Surgeon General on Preventing Tobacco Use Among Youth and Young Adults documents the causal relationship between advertising and promotion for cigarettes and initiation of cigarette smoking among young populations. Recent reports document that e-cigarette marketing reaches the vast majority of young populations. The

Centers for Disease Control and Prevention (CDC) estimated that almost 7 in 10 middle school and high school students are reached by e-cigarette marketing<sup>21</sup> and the truth initiative found that 84% of young people ages 13-21 are aware of e-cigarette advertising<sup>22</sup>. However, it is still unknown whether consistent associations exist between exposure to e-cigarette marketing and susceptibility to and use of e-cigarettes among youth.

### Study Aims and Hypothesis

This study aims to determine the association between exposure to e-cigarette marketing through several channels (internet, print, retail, TV/movies) and e-cigarette use and susceptibility to use in a nationally representative sample of middle school and high school students. We hypothesize that exposure to e-cigarette marketing will be positively associated with ever use, current use and susceptibility to e-cigarette use among young people. We further hypothesize that the magnitude of the relationship will increase with each additional marketing channel to which a young person is exposed. This study is the first to examine exposure to e-cigarette marketing, specifically, and its relationship to e-cigarette use and susceptibility to use e-cigarettes among youth in a nationally representative sample.

## Methods

### Study Sample and Population

Data were obtained from the 2014 National Youth Tobacco Survey (NYTS); a stratified, three-stage cluster sample design to produce a nationally representative sample of middle school and high school students in the United States. These data were collected from 207 schools with a sample size of 22,007.

### Procedure

NYTS sampling procedures are probabilistic and conducted without replacement at all stages, and entail selection of Primary Sampling Units (PSUs) within each stratum, schools within each selected PSU, and classes within each selected school. Participation by schools and students are voluntary and student responses remain anonymous. The procedure is described in detail elsewhere<sup>23</sup>.

The university's committee for the protection of human subjects determined that the current study was exempt from institutional review board (IRB) review.

### Measures

**E-Cigarette Use**—Ever use of e-cigarettes (experimentation) as well as use in the past 30 days (current use) were outcome variables in the analysis. Ever use of e-cigarettes was assessed by the questions “Have you ever tried an electronic cigarette or e-cigarette such as Blu, 21<sup>st</sup> Century Smoke or NJOY?” Those that responded “yes” (coded as 1) were considered to have had experimented with e-cigarettes; everyone else was considered a non-user (coded as 0). Current use status of e-cigarettes was assessed by “During the past 30 days, on how many days did you use electronic cigarettes or e-cigarettes such as Blu, 21<sup>st</sup> Century Smoke or NJOY?” with those responding with anything other than “0” considered to be a current user of e-cigarettes (coded as 1).

**Susceptibility to E-cigarette Use**—This measure employed three items, similar to cigarette susceptibility criteria established by Pierce and colleagues<sup>24</sup> (1996), and was coded as a binary variable (susceptible=1/not susceptible=0). Questions used to measure susceptibility among students who reported they had never used an e-cigarette were: “Do you think you will try an electronic cigarette or e-cigarette soon?”, “Have you ever been curious about using an electronic cigarette or e-cigarette such as Blu, 21<sup>st</sup> Century Smoke, or NJOY?” and “If one of your best friends were to offer you an electronic cigarette or e-cigarette, would you use it?” Responses for these questions included “definitely yes,” “probably yes,” “probably not,” and “definitely not.” If the given response for any of these three questions was anything other than “definitely not” (coded as 0), the respondent was categorized as susceptible to using e-cigarettes (coded as 1)<sup>24,26</sup>.

**Exposure to E-cigarette Marketing**—Self-reported exposure to e-cigarette marketing served as the independent variable. Channels of exposure to e-cigarette marketing included: the internet; newspapers/magazines; retail stores; and when watching TV/movies (e.g. “When you are using the Internet, how often do you see ads or promotions for electronic cigarettes or e-cigarettes?” “When you read newspapers or magazines, how often do you see ads or promotions for electronic cigarettes or e-cigarettes?” “When you go to a convenience store, supermarket, or gas station, how often do you see ads or promotions for electronic cigarettes or e-cigarettes?” and “When you watch TV or go to the movies, how often do you see ads or promotions for electronic cigarettes or e-cigarettes?”) Response options ranged from “never,” “rarely,” “sometimes,” “most of the time,” or “always.”

Consistent with previous research<sup>15, 21, 25</sup> respondents who answered “sometimes,” “most of the time,” or “always” were categorized as being exposed to the respective channel of e-cigarette marketing (coded as 1). Respondents who answered “never,” “rarely,” as well as those who stated they did not use the Internet, read newspapers/magazines, visit retail stores, or watch TV/movies, were categorized as unexposed (coded as 0).

**Covariates**—Socio-demographic factors and current combustible tobacco use were included as covariates. Race/ethnicity was categorized as: White, non-Hispanic; Black, non-Hispanic; Hispanic; and other. Other included Asian, non-Hispanic; American Indian/Alaska Native, non-Hispanic; and Native Hawaiian & Other Pacific Islander, non-Hispanic. Gender was dichotomized into male (coded as 0)/female (coded as 1). Grade level was coded as middle school (0) or high school (1). Current use of any combustible tobacco product was defined as use of a combustible tobacco product within the past 30 days. These products included: cigarettes, cigars, cigarillos, little cigars, pipe tobacco, bidis, and hookah. Any subject that responded “yes” to use of any of these products within the past 30 days was considered a current combustible tobacco user (coded as 1). All other students were considered non-users (coded as 0).

## Statistical Analysis

Data were weighted to be representative of U.S. middle school and high school students and to adjust for nonresponse and probability of selection. Multivariate logistic regression models assessed the relationship between e-cigarette marketing exposure and 1) current e-

cigarette use and 2) ever e-cigarette use. Further, a subpopulation analysis was performed among students who reported they had never used e-cigarettes whereby multivariate logistic regression models assessed the association between both individual and cumulative exposure to e-cigarette marketing and susceptibility to e-cigarette use. For models assessing cumulative exposure, the independent variable of interest was exposure to number of e-cigarette marketing channels, a variable ranging from zero to four that was created by summing the number of channels (including internet, magazine/newspaper, retail and TV/movies). In order to determine the odds of use and susceptibility for an individual exposed to all four types of e-cigarette marketing, we exponentiated the beta coefficient multiplied by four:  $OR_4 = \exp(\beta \times 4)^{27}$ . The following covariates were included in all models: sex, race/ethnicity, grade and current use of any combustible tobacco product. For the included variables, missing data due to non-response ranged from 0.8%-6.7%. Therefore, the sample size for each model varied minimally. All analyses were conducted using STATA 14.0 (College Station, TX).

## Results

### Descriptive Statistics

Nearly half of the sample (49.8%) was female, and 56.1% were in high school. In terms of race/ethnicity status, 53.2% were non-Hispanic White, 14.6% were non-Hispanic Black, 21.9% were Hispanic and 10.3% were classified as other. In regard to e-cigarette use, 19.8% of youth reported ever use and 9.3% reported current use of e-cigarettes while 32.8% of never users were susceptible to use. Retail advertising and promotions (54.8%) was the most prevalent source of marketing exposure, followed by internet (39.8%), TV/movies (36.5%), and print media (30.4%).

### E-cigarette Ever Use

As seen in Table 1, exposure to e-cigarette marketing via internet, print, retail and TV/movies was significantly associated with ever use of e-cigarettes when adjusting for sex, race/ethnicity, grade and other tobacco use. With each additional exposure to another channel of e-cigarette marketing, students' odds of ever use of e-cigarettes increased by 1.16 when adjusting for sex, race/ethnicity, grade and other tobacco use (Table 2). Given that these odds are for a *one unit change in the predictor*, we further considered the effect of exposure to all marketing channels rather than just one.. Thus, for students who were exposed to four channels of e-cigarette marketing, the odds of ever e-cigarette use increased by 1.81.

### Current E-cigarette Use

As seen in Table 1, exposure to e-cigarette marketing via internet, print, retail and TV/movies was significantly associated with current e-cigarette use among middle and high school students when adjusting for sex, race/ethnicity, grade and other tobacco use. Further, with each additional exposure to another channel of e-cigarette marketing, students' odds of current e-cigarette use increased by 1.22 when adjusting for sex, race/ethnicity, grade and other tobacco use (Table 2). Again, for students who were exposed to four channels of e-cigarette marketing, the odds of current e-cigarette use increased by 2.22.

## Susceptibility to E-cigarette Use

As seen in Table 1, among youth who had never used e-cigarettes, exposure to e-cigarette marketing via internet, print, retail and TV/movies was significantly associated with susceptibility to e-cigarette use. Moreover, among youth who had never used e-cigarettes, with each additional exposure to another channel of e-cigarette marketing, students' odds of susceptibility to e-cigarette use increased by 1.11 when adjusting for sex, race/ethnicity, grade and other tobacco use (Table 2). For students who were exposed to four channels of e-cigarette marketing, the odds of current e-cigarette use increased by 1.52.

## Discussion

To our knowledge, this is the first study to investigate the association between exposure to e-cigarette marketing from several channels and use/susceptibility of e-cigarettes using a nationally representative sample. However, findings are consistent with studies showing an association between exposure to advertising and promotional activities for conventional tobacco and the use of cigarettes<sup>4</sup> and emerging tobacco products<sup>15</sup>, as well as susceptibility to e-cigarette use<sup>14</sup>. In particular, Pierce and colleagues<sup>24, 26</sup> showed that non-susceptible, non-using teens became susceptible to smoking after exposure to cigarette marketing, and that susceptibility was a significant predictor of onset in adolescence.

Our findings indicate that exposure to e-cigarette marketing from all channels is significantly associated with increased likelihood of adolescents' e-cigarette use. Further, there was a significant and increasingly stronger relationship between cumulative exposure (i.e., with each additional channel exposed, an increase in odds of use was observed) to e-cigarette marketing and current and ever use of e-cigarettes among adolescents. These findings suggest that youth who are exposed to e-cigarette marketing via multiple channels have an increased likelihood of also using e-cigarettes. Results extend previous research which found a dose-response relationship in exposure to conventional tobacco advertising and both cigarette and alternative tobacco product use<sup>15</sup>. This study highlights widespread environmental influences promoting e-cigarette use through a variety of platforms, and that these influences increase the odds that a young person might also be using e-cigarettes.

In our subpopulation analysis, we also found a significant association between exposure to e-cigarette marketing via all channels and susceptibility to use e-cigarettes among youth who had never used e-cigarettes. Further, among these students who had never used e-cigarettes, there was a significant relationship between cumulative exposure to e-cigarette marketing and susceptibility to e-cigarette use. These findings indicate that youth who are exposed to multiple channels of e-cigarette marketing have increased susceptibility to use e-cigarettes. As noted above, susceptibility to tobacco use is an established predictor of future tobacco use<sup>24, 26</sup>; this finding raises concern about the role of e-cigarette marketing in recruiting new e-cigarette users. Future longitudinal research is warranted to determine the temporality of this relationship.

The association between exposure to e-cigarette marketing and product use is of particular concern as e-cigarette marketing expenditures continue to rapidly increase<sup>16, 28</sup>. Annual e-cigarette advertising expenditures tripled from 2011 to 2012, increasing from \$6.4 million to



\$18.3 million<sup>16</sup> (Kim et al, 2014). Furthermore, expenditures through the second quarter of 2013 outpaced all of 2012<sup>28</sup> suggesting this trend is not likely to change. Over this time, youth exposure to e-cigarette marketing tripled<sup>29</sup>, and this is particularly worrisome given the associations documented in this paper.

This study has some limitations. First, the analyses were cross-sectional which prohibits causal inference. For example, e-cigarette users or those more susceptible to e-cigarette use may be more likely to notice e-cigarette marketing, and report greater exposure. Thus, longitudinal data are critically needed. Other studies have demonstrated a causal relationship between marketing exposure and adolescent risk behavior<sup>12,13</sup>; however, with the relative novelty of e-cigarettes, longitudinal data that are necessary to support a temporal relationship are not yet available. Thus, this paper serves as a point or origin for including e-cigarette marketing in the established literature of marketing exposure and adolescent risk behavior. Note that the odds ratios presented in this manuscript remain significant when controlling for concomitant combustible tobacco use (cigarettes, cigars, etc.), which is a strong predictor of e-cigarette use. Previous studies examining conventional cigarette use and marketing exposure have seldom controlled for dual/poly tobacco use<sup>13,30-31</sup>, thus highlighting the robustness of our findings. Second, data are self-reported and are subject to recall bias, although these data are consistent with other large national data sets. Third, the single-item measures used to assess exposure to e-cigarette marketing may be less psychometrically robust than multiple-item measures. Nevertheless, this study has implications for public health in terms of regulation of e-cigarettes and prevention campaigns, especially since prior associations between cigarette marketing and cigarette use among youth have been shown to be causally related, with marketing exposure predicting subsequent onset and prevalence of cigarette smoking<sup>4</sup>.

Thus, in terms of the need to be precautionary, it seems prudent to develop policies and programs to discourage e-cigarette use among young people. Though research on the short and long-term health consequences of e-cigarette use is still developing, exposure to nicotine during adolescence can negatively impact brain development<sup>32,33</sup>. The increasing reach and intensity<sup>21</sup> of e-cigarette marketing, along with the potential for these messages to recruit adolescent users, highlights the need for regulation of marketing strategies that are used by these companies in order to prevent and reduce adolescent initiation of these products.

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### **Implications and Contributions**

This study reveals an association between adolescent e-cigarette use and e-cigarette marketing exposure. Further revealed is an association between adolescent e-cigarette use susceptibility and exposure to e-cigarette marketing. Further, each channel of advertising examined in this study is individually associated with a statistically significant increase in e-cigarette use and susceptibility.

**Table 1**  
**Association between E-cigarette Use / Susceptibility and Exposure to Individual Pro E-cigarette Marketing among Middle School and High School Students, (National Youth Tobacco Survey, 2014, n=22,007)**

	Current E-cigarette Use (9.3%)	Ever E-cigarette Use (19.8%)	Susceptibility to E-cigarettes, among never users (32.8%)
	adjOR <sup>a</sup> (95% CI)	adjOR <sup>a</sup> (95% CI)	adjOR <sup>a</sup> (95% CI)
Internet	1.68 *** (1.45-1.95)	1.61 *** (1.41-1.83)	1.38 *** (1.26-1.51)
Print	1.36 *** (1.15- 1.60)	1.22 ** (1.07-1.39)	1.22 *** (1.10- 1.35)
Retail	1.27 *** (1.19-1.35)	1.61 *** (1.43-1.80)	1.30 *** (1.20-1.41)
TV / Movies	1.41 ** (1.22-1.62)	1.20 ** (1.07-1.35)	1.16 ** (1.07-1.27)

<sup>a</sup>Odds ratio adjusted for sex, grade, race/ethnicity and past 30 day use of other tobacco products (yes/no) including cigarettes, cigars/cigarillos, snuff, pipe, bidis, hookah

\* p < .05

\*\* p <.01

\*\*\* p <.001

**Table 2**  
**Association between E-cigarette Use / Susceptibility and Cumulative Exposure to Number of Pro E-cigarette Marketing Channels (National Youth Tobacco Survey, 2014)**

	Past 30 E-cigarette Day Use (all students, n = 22,007)	Ever E-cigarette Use (all students, n = 22,007)	Susceptibility to E-cigarette Use <sup>d</sup> (never users of e-cigarettes, n = 17,286)
	Adj OR (95% CI)	Adj OR (95% CI)	Adj OR (95% CI)
	p-value	p-value	p-value
<u>Advertising Exposure<sup>a</sup></u>			
Exposure to pro-ecig marketing sources	1.22 (1.15 – 2.02)	1.16 (1.11 – 1.22)	1.11 (1.08 – 1.15)
	< .001	< .001	< .001
<u>Grade</u>			
High school	2.37 (1.61-3.50)	2.50 (1.94-3.21)	1.20 (1.06-1.35)
	< .001	< .001	.003
<u>Sex</u>			
Female	0.81 (0.70 – 0.93)	0.82 (0.73 – 0.93)	0.98 (.89 – 1.07)
	.004	.003	.644
<u>Race/ethnicity</u>			
Black, non-Hispanic	0.40 (0.25 – 0.64)	0.60 (0.44 – 0.83)	0.92 (0.79 – 1.07)
Hispanic	1.01 (0.73 – 1.40)	1.12 (0.92 – 1.35)	1.40 (1.25 – 1.57)
Other <sup>b</sup>	0.89 (0.61 – 1.29)	0.99 (.81 – 1.21)	1.17 (1.03 – 1.33)
	.526	.929	.015
<u>Other Tobacco Use<sup>c</sup></u>	15.66 (13.09 – 18.73)	12.65 (10.66 – 15.00)	2.57 (2.10 – 3.16)
	< .001	< .001	< .001

<sup>a</sup>Sum of number of e-cigarette advertising sources exposed (including internet, print, retail, and TV/movies) ranging from 0-4; exposed is answering “sometimes,” “most of the time,” or “always”

<sup>b</sup>“Other” is where a response was “Asian, non-Hispanic”, “American Indian/Alaska Native, non-Hispanic”, or Native Hawaiian & Other Pacific Islander, non-Hispanic”