Journal of Applied Research on Children: Informing Policy for Children at Risk

Volume 8
Issue 2 *Youth at Risk: New and Emerging Issues related to Tobacco, Alcohol and Other Drug Use*

Article 3

2017

Does Exposure and Receptivity to E-cigarette Advertisements Relate to E-cigarette and Conventional Cigarette Use Behaviors among Youth? Results from Wave 1 of the Population Assessment of Tobacco and Health Study

Nicole E. Nicksic PhD, MPH
Virginia Commonwealth University, nenicksic@vcu.edu

L. Morgan Snell MPP
Virginia Commonwealth University, snelllm@mymail.vcu.edu

Andrew J. Barnes PhD
Virginia Commonwealth University, andrew.barnes@vcuhealth.org

Does Exposure and Receptivity to E-cigarette Advertisements Relate to E-cigarette and Conventional Cigarette Use Behaviors among Youth? Results from Wave 1 of the Population Assessment of Tobacco and Health Study

Acknowledgements
Dr. Nicksic's effort was supported by the National Institute on Drug Abuse of the National Institutes of Health under Award Number P50DA036105 and the Center for Tobacco Products of the U.S. Food and Drug Administration. The content is solely the responsibility of the authors and does not necessarily represent the views of the NIH or the FDA.

INTRODUCTION

E-cigarettes (EC) have risen quickly in popularity since being introduced to the U.S. market in 2007[1] and are now more popular among youth than conventional cigarettes (CC).[2] ECs frequently contain nicotine, an addictive substance that encourages future use after initiation.[3] According to the 2015 National Youth Tobacco Survey (NYTS), 5.3% of middle school students and 16% of high school students reported current, or past-30 day, use of ECs,[4] and the prevalence of EC ever and current use continues to increase.[2,4,5] While smoking rates for CCs have declined among youth over the past several decades,[4] recent evidence suggests that this decline has leveled off since 2009.[5] Emerging evidence suggests that EC use among never-smoking youth is associated with future use of CCs and other combustible tobacco products.[6,7] Research on factors that influence youth EC initiation and use behaviors, such as EC advertising, is needed to support federal, state, and local regulatory efforts.

Youth gain information and model behavior seen in advertisements.[8] The 2012 Surgeon General's Report established that CC advertising has influenced youth to initiate and sustain CC smoking.[9] Although various federal tobacco control regulations have prohibited CC advertising across multiple outlets,[10] these regulations have not yet encompassed EC advertisements. Despite the Food and Drug Administration extending their authority on regulating EC as tobacco products in 2016, requirements for EC advertising are minimal, only prohibiting modified risk messages and requiring nicotine warning labels beginning in 2018.[11] Without regulations, youth perceptions of ECs as a desirable alternative to traditional tobacco products may be influenced by exposure to EC advertising.[12] EC manufacturers use image-based advertising strategies, themes that appeal to youth (such as "freedom" and "rebellion"), celebrity endorsements, and marketing campaigns on social media—all strategies known to be effective in reaching young consumers.[12,13] From the 2014 NYTS, 69% of middle and high school students reported being exposed to EC advertising via at least one outlet.[14] Several studies have determined that EC advertising exposure was associated with increased susceptibility to trying ECs in the future and higher prevalence of both ever and current use of ECs among youth participants.[13,15–20] These studies suggest advertising is a significant influence on youth opinions about ECs and use behaviors.

Researchers frequently rely on self-reported recall of advertising exposure to analyze associations with EC initiation and use; however, research has been limited on the role of receptivity to EC advertising among youth. EC receptivity refers to the liking or recognition of an EC

advertisement.[21] One study found an association between the positive appeal of EC video advertisements and intended EC use; however, the study population consisted of college students only.[22] Evidence from longitudinal studies of CC susceptibility among youth shows that higher CC advertising receptivity is associated with increased susceptibility to future CC use at baseline and with "established" CC smoking behavior at 3- and 6-year follow-up, even after controlling for social and demographic risk factors.[23,24] As previous research has shown a positive linear relationship between CC advertising exposure and receptivity to CC advertising, these results indicate that mere exposure to CC advertising may increase receptivity to CC advertisements.[25] Therefore, a better understanding of both EC advertising exposure and receptivity is essential to determine the influence of advertising on EC use behaviors among youth, and to inform future efforts to regulate product advertising.

Understanding how youth respond to EC advertising is of paramount importance, based on emerging evidence suggesting that EC advertising appeals to youth and influences future EC use.[12,13,15,18] The current study not only measures EC advertisement exposure, but also determines participants' receptivity to EC advertisements by randomizing exposure to common EC advertisements. Additionally, this study determines the relationship of EC advertisements to both EC and CC use behaviors among a large, diverse, and nationally representative sample. Using data from Wave 1 of the Population Assessment on Tobacco and Health (PATH) Study, the current study investigates the relationships between EC advertising exposure and receptivity, and EC and CC ever use, current use, and susceptibility to future use, among a nationally representative sample of youth. Further, we examine whether youth receptivity to EC advertising amplifies the associations between EC advertising exposure and susceptibility.

METHODS

Data on 13,651 US youth (aged 12-17) were collected from October 2013 to December 2014 in Wave 1 of the PATH Study, a nationally representative, longitudinal cohort. One parent or guardian of 13,859 youth was also interviewed to obtain information on parental tobacco use as well as child health. Using a four-stage stratification design, mailing addresses were used to sample household participants. Generally, two youth per household were invited to participate. Survey weights adjusted for nonresponse, selection probabilities, and underrepresentation of populations within the sampling frame. Further details on PATH methods are described elsewhere.[26] Youth who responded "Yes" to the question

"Have you ever seen or heard of an electronic cigarette or e-cigarette before this study?" were considered aware of EC and included in analyses (n=12,199 (88% of the overall sample), which generalizes to a population N=22,253,202).

Measures

EC Use. EC ever users responded "Yes" to the question, "Have you ever use an e-cigarette, such as NJOY, Blu, or Smoking Everywhere, even one or two times?", with generic images of ECs displayed. Participants who had ever used an EC were asked, "When did you last use an e-cigarette, even one or two times?" Those who responded either "Earlier today," "Not today but sometime in the past 7 days," or "Not in the past 7 days but sometime in the past 30 days," were considered to be current, or past 30 day, EC users.[2,4]

EC Susceptibility. EC susceptibility was evaluated by modifying traditional measures of CC susceptibility.[27,28] Participants who had never used an EC were asked three questions. The first question, "Have you ever been curious about using e-cigarettes?", had response options on a 4-point scale from "Not at all curious" to "Very curious." The other two questions, "Do you think that you will try an e-cigarette soon?" and "If one of your best friends were to offer you an e-cigarette, would you use it?", had response options on a 4-point scale from "Definitely not" to "Definitely yes." In order to be considered non-susceptible to EC use, participants had to answer "Not at all curious" to the first question and "Definitely not" to the other questions.[27,28] Any other response combination deemed participants susceptible, for lack of a firm commitment to not using ECs.

CC Use. CC ever users responded "Yes" to "Have you ever tried cigarette smoking, even one or two puffs?" Participants were considered CC current users when they reported smoking CCs, even one or two puffs, within the past 30 days.[2,4]

CC Susceptibility. Youth who reported never smoking CCs were asked three questions, based on established susceptibility measures: "Have you ever been curious about smoking a cigarette?", "Do you think you will smoke in the next year?", and "If one of your best friends were to offer you a cigarette, would you smoke it?"[27,28] CC susceptibility was coded the same as EC susceptibility, where responding "Not at all curious" and "Definitely not" to all three questions meant participants were non-susceptible to future CC use.

EC Advertisement Exposure. Each participant was shown five recently used EC advertisements in random order, two TV and three print. To determine exposure to each advertisement, participants were asked, "In the past 12 months, have you seen this advertisement before this study?" Answering "Yes" to this question for at least one of these advertisements considered one exposed to EC advertising.

EC Advertisement Receptivity. For each of the five EC advertisements shown, participants were also asked, "How much do you like this advertisement?" The three response options were "Like this ad," "Have no opinion about this ad," and "Dislike this ad." Youth who answered "Dislike this ad" to all five advertisements were considered not receptive to EC advertising, while youth who answered either "Like this ad" or "Have no opinion about this ad" for any of the five advertisements were considered receptive to EC advertising. These response options were combined as a more conservative approach to receptivity.

Covariates. Five covariates were included in analyses: gender, age (12-14 years, 15-17 years), race/ethnicity (White, Black, Other, and Hispanic), other combustible tobacco use, and parent education. Other combustible tobacco use included the use of CCs, cigarillos, filtered cigars, traditional cigars, pipe, hookah, bidis, and kreteks for all EC outcome analyses. For CC outcomes, the other combustible tobacco use variable replaced CC with EC use. Parent education was categorized as high school or lower, some college/Associate's degree, and Bachelor's degree or advanced.

Statistical Analysis

Weighted descriptive analyses summarized national estimates of EC and CC use and susceptibility among youth aged 12-17. Weighted bivariate associations were performed on EC and CC use and susceptibility outcomes, exposures, and covariates. Weighted logistic regressions, adjusted for covariates, were fit to the data to evaluate associations between exposure and receptivity to EC advertisements, and the outcomes of EC and CC ever use, current use, and susceptibility to future use. Additionally, in a second set of models, interactions between exposure and receptivity to EC advertising were included to test whether participants' level of receptivity modified the adjusted associations between EC advertisement exposure and our outcomes. To more easily interpret the interaction terms and main effects in the second set of

models, marginal effects were estimated to transform logistic regression coefficients into predicted probabilities. Analyses were performed using Stata 12.0 (College Station, TX).

RESULTS

Sample Characteristics

Ever use among youth was higher for CCs than ECs (15% vs. 12%). The same pattern was observed for current use (5% for CCs vs. 3.5% for ECs; Table 1). A third of youth who were never-users were susceptible to future use of both ECs (34.7%) and CCs (34.8%). Additionally, a third of youth (34%) were exposed to at least one EC advertisement, while over half (57%) were receptive. Over half of the sample (56%) was Non-Hispanic White, 52% were male, and 52% were in the older age group (15-17 years).

EC Use Behaviors

Bivariate associations for EC use behaviors are shown in Table 2. In comparison to EC never users, EC ever users had increased exposure (42% vs. 33%, $p<0.01$) and receptivity (75% vs. 54%, $p<0.01$) to EC advertisements. Current users of ECs had increased exposure (44% vs. 33%, $p<0.01$) and receptivity (82% vs. 56%, $p<0.01$) to EC advertisements compared to non-current EC users. In comparison to youth not susceptible to CCs, youth susceptible to CCs had increased exposure (41% vs. 29%, $p<0.01$) and were more receptive to EC advertisements (72% vs. 45%, $p<0.01$). Significant differences were found between race/ethnicity and age by all three of the EC outcomes ($p<0.01$, each). Males were more likely to be ever or current users compared to females ($p<0.01$, each).

Exposure to EC advertisements was positively associated with EC ever use, EC current use, and susceptibility to EC use (AOR=1.36-1.44, $p<0.01$, each) after adjusting for covariates (Table 4). Receptivity to EC advertisements was also positively associated with all three EC behaviors (AOR=1.70-2.84; $p<0.01$, each). Females had decreased odds of ever use, current use, and susceptibility (AOR=0.57-0.90, $p<0.05$, each) in comparison to males. Older youth had increased odds of EC ever use, current EC use, and susceptibility (AOR=1.27-2.41, $p<0.01$, each). Non-Hispanic Black youth had decreased odds of ever and current use (AOR=0.52-0.53, $p<0.01$, each) and Hispanic youth had increased odds of being susceptible to future EC use (AOR=1.28, $p<0.01$) compared to Non-Hispanic White youth.

CC Use Behaviors

Compared to CC never users, CC ever users had increased exposure (39% vs. 33%, p<0.01) and receptivity (74% vs. 54%, p<0.01) to EC advertisements (Table 3). Current users of CCs had increased exposure (38% vs. 34%, p=0.04) and receptivity (81% vs. 56%, p<0.01) to EC advertisements compared to non-current CC users. In comparison to youth not susceptible to CCs, youth susceptible to CCs had increased exposure (40% vs. 29%, p<0.01) and receptivity (69% vs. 46%, p<0.01) to EC advertisements. Significant differences were found by race/ethnicity and age by all three of the CC outcomes (p<0.01; each).

Similar to the results for susceptibility to EC use, exposure to EC advertisements was positively associated with susceptibility to CC use (AOR=1.35, p<0.01) after adjusting for covariates (Table 4). Receptivity to EC advertisements was positively associated with CC ever use, CC current use, and susceptibility (AOR=1.81-2.42, p<0.01, each). Older youth had increased odds of ever use, current use, and susceptibility (AOR=1.18-3.00, p<0.01, each). Non-Hispanic Black and youth of other races had decreased odds of CC ever and current use (AOR=0.41-0.70, p<0.05, each), while Hispanic youth had decreased odds for CC ever and current use (AOR=0.48-0.64, p<0.01, each) and increased odds of being susceptible to future CC use (AOR=1.29, p<0.01) compared to Non-Hispanic White youth. Youth of parents with some college or at least a Bachelor's degree had decreased odds of CC ever and current use (AOR=0.30-0.74, p<0.01, each) compared to youth of parents with a high school education or lower.

Receptivity Modifies Associations between Exposure to EC Advertisements and EC and CC Use Behaviors

There were statistically significant interactions between exposure and receptivity to EC advertisements in the models of EC and CC ever use and susceptibility to EC use (p<0.01, each). Youth exposed and receptive to EC advertisements are 6.8 percentage points (PP) more likely to be EC ever users compared to non-exposed, non-receptive youth (16.4% vs 9.6%, Figure 1). Those who were exposed and receptive to EC advertisements were also 6.4 PP more likely to be CC ever users compared to non-exposed, non-receptive youth (18.0% vs 11.6%). In regard to EC susceptibility, youth who were exposed and receptive to EC advertisements were 30.5 PP more likely to be susceptible to using EC compared to non-exposed, non-receptive youth (52.0% vs 21.5%).

DISCUSSION

As EC use continues to rise among youth, understanding what influences EC initiation and continued use is critical to inform policy, especially as evidence suggests that youth EC initiation may lead to subsequent CC use.[2,5–7,29,30] While previous studies have found positive associations between youth exposure to advertising and EC use behaviors, our study expands to include EC and CC use behaviors, receptivity to EC advertising, and the role of receptivity as an effect modifier in the relationship between EC advertisement exposure and use behaviors. Our results from a nationally representative sample of 12-17 year olds support previous studies by finding that exposure to EC advertising was associated with all EC use behaviors.[16,17] We found new evidence that exposure to EC advertisements was associated with higher odds of susceptibility to CC use, a discovery that warrants further investigation into cross-product effects of EC advertising among youth. Additionally, receptivity to EC advertisements was also associated with all EC and CC use behaviors, and the exposure and receptivity interactions were significant for EC and CC ever use and EC susceptibility.

Our results document an association between EC advertising exposure and EC ever use, current use, and susceptibility to future use among youth, while controlling for age, gender, race/ethnicity, other combustible tobacco use, and parent education. Previous studies relied on self-reported level of exposure to advertising via different media,[16–18] whereas exposure in our study was measured by showing actual EC TV or print advertisements in random order and asking participants if they had seen the advertisement before. We found that one-third of U.S. youth aware of EC were exposed to specific EC advertising in the past 12 months, a conservative estimate of overall exposure if youth had seen other advertisements not shown during the survey. EC exposure was associated with higher odds of all EC use behaviors, and with CC susceptibility, but not with CC ever use or current use. These results suggest that seeing EC advertisements may influence youth propensity to try CCs in addition to EC use behaviors, which could explain the crossover of tobacco products seen among youth.[6,7] However, further longitudinal research is necessary to determine if susceptible youth eventually initiate using CCs after exposure to EC advertising.

Receptivity to advertisements was associated with higher odds of ever use, current use, and susceptibility for both EC and CC. These findings highlight the importance of further work focused on the specific role of receptivity to EC advertisements in influencing attitudes and behaviors related to EC and CC use. Though only 33.8% of youth were exposed to specific EC advertisements in the 12 months before survey

participation, 56.8% were receptive to the EC advertisements they were shown. This reinforces the importance of studying EC advertising receptivity and points to the role of youth advertising perception in shaping tobacco use behavior.

Our results also illustrate an important interaction between EC advertising exposure and receptivity when examining associations with EC and CC ever use and EC susceptibility. Compared to non-exposed, non-receptive youth, youth who were exposed and receptive to EC advertisements were more likely to be EC and CC ever users. Youth exposed and receptive to EC advertisements were 30.5 PP more likely to be susceptible to EC use, a concerning finding, as youth may be exposed to EC advertisements across multiple media outlets. Additional studies focusing on youth-oriented advertising and youth receptivity to tobacco advertising messages are needed to inform EC advertising policy interventions.

Our results showing differences in demographic groups provide future avenues for research and policy intervention. Female youth had decreased odds to use or be susceptible to ECs compared to males, while no gender differences were found among CC outcomes. Non-Hispanic white youth were more likely to be current CC smokers compared to all the other racial groups. Non-Hispanic Black youth were less likely to be EC and CC ever or current users in comparison to Non-Hispanic White youth. Older youth had increased odds to be ever users, current users, and susceptible to use for both products compared to younger youth. In general, our findings support previous research on CC and EC use that identifies male, Non-Hispanic White, and older youth as groups particularly vulnerable to tobacco use.[31] These demographic findings provide suggestions for targeting anti-tobacco messaging and policy toward groups of particularly susceptible youth. These results also support the need for further research on how different groups of youth experience and perceive tobacco advertising, make tobacco use decisions based on peer group norms, and model their own behavior based on product availability and desirability in their homes.

Limitations in the current study include the abbreviated nature of the survey questions related to EC advertising exposure and receptivity. Participants were able to answer “Yes,” “No,” or “Don’t Know,” when asked if they had seen a particular advertisement. They were not asked the frequency with which they saw EC advertisements in general, the types of outlets where they typically saw this advertising, or where they had seen the specific advertisement they were shown if they answered “Yes.” This limits our knowledge of which media are particularly effective

at reaching and influencing youth audiences—knowledge that could be used in tobacco regulation policies. Receptivity was assessed using answers “Like this ad,” “Dislike this ad,” or “Have no opinion about this ad,” which limited response choices, as nearly half the sample chose the “Have no opinion about this ad” option for each of the EC advertisements. Additionally, they were not asked follow-up questions about why they might like or dislike the ads shown. This limits our ability to draw conclusions about what qualities or perceptions of EC advertising might be associated with receptivity and use behaviors. Youth participants were shown three print advertisements and two TV advertisements; however we have limited information about how exposure to social media advertising might impact responses to these specific advertisements. Previous investigators have pointed out that this field of research would greatly benefit from the development of a tobacco advertising exposure measure reflecting advertising expenditures and audience data, an “opportunity to see” visual measure that could help address limitations involved in relying on youth to simply remember whether they had seen advertising or not.[12] In an advertising-saturated environment, a participant might be exposed to EC advertisements, but not necessarily take conscious notice or recall a particular level of advertising exposure. An “opportunity to see” measure would help researchers add to our models by offering a way to estimate likely exposure variation among participants based on advertising expenditures and audience data. Finally, this study was cross-sectional and no causal conclusions can be drawn from the results. However, our study’s strengths include the addition of advertising receptivity to the field of research, the nationally representative sample of 12-17 year olds, and the treatment of receptivity as an effect modifier in associations between advertisement exposure and EC and CC use behaviors. Another significant strength of our study is the potential for longitudinal investigation. The PATH study follows this cohort of youth over multiple waves of data collection; therefore, advertising exposure and receptivity, as well as EC and CC use behaviors, can be followed over time utilizing the same large, nationally-representative sample.

CONCLUSION

Adolescence is a critical time for developing tobacco use behaviors. The prevalence of EC ever and current use continues to rise among youth in the US, despite evidence that most ECs contain nicotine and EC use is associated with subsequent use of other combustible tobacco products. A major concern of not regulating EC advertising is the uptake of both ECs and CCs among youth. There is strong evidence from the CC literature

and emerging evidence from the EC literature that tobacco advertising exposure is associated with susceptibility, initiation, and continued use of tobacco products. Great strides have been made to regulate CC advertising to prevent exposure to youth across several outlets (e.g. banning CC advertisements on TV, radio, billboards, and in print). Failure to regulate EC advertising similar to CC could promote EC use behaviors as well as use of other products, such as CCs. Our study illustrates the critical association between advertising exposure and receptivity with EC and CC use behaviors and can inform policies at federal, state, and local levels aimed at restricting EC advertising to prevent initiation of and continued tobacco use among youth. To improve the effectiveness of such regulations, further research on advertising messages and receptivity to these messages, as well as strategies utilized to target youth, are needed.

REFERENCES

1. Chang AY, Barry M. The global health implications of e-cigarettes. *JAMA J Am Med Assoc*. 2015;314(7):663-664. doi:10.1001/jama.2015.8676.
2. Kasza KA, Ambrose BK, Conway KP, et al. Tobacco-Product Use by Adults and Youths in the United States in 2013 and 2014. *N Engl J Med*. 2017;376(4):342-353. doi:10.1056/NEJMsa1607538.
3. England LJ, Bunnell RE, Pechacek TF, Tong VT, McAfee TA. Nicotine and the Developing Human: A Neglected Element in the Electronic Cigarette Debate. *Am J Prev Med*. 2015;49(2):286-293. doi:10.1016/j.amepre.2015.01.015.
4. Singh T, Arrazola RA, Corey CG, et al. Tobacco Use Among Middle and High School Students - United States, 2011-2015. *MMWR Morb Mortal Wkly Rep*. 2016;65(14):361-367. doi:10.15585/mmwr.mm6514a1.
5. Dutra LM, Glantz SA. E-cigarettes and National Adolescent Cigarette Use: 2004–2014. *Pediatrics*. 2017;139(2):2004-2014. doi:10.1542/peds.2016-2450.
6. Leventhal AM, Strong DR, Kirkpatrick MG, et al. Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence. *JAMA*. 2015;314(7):700-707. doi:10.1001/jama.2015.8950.
7. Primack BA, Soneji S, Stoolmiller M, Fine MJ, Sargent JD. Progression to Traditional Cigarette Smoking After Electronic Cigarette Use Among US Adolescents and Young Adults. *JAMA Pediatr*. 2015;169(11):1018-1023. doi:10.1001/jamapediatrics.2015.1742.
8. Pechmann C, Levine L, Loughlin S, Leslie F. Impulsive and Self-Conscious: Adolescents' Vulnerability to Advertising and Promotion. *J Public Policy Mark*. 2005;24(2):202-221. doi:10.1509/jppm.2005.24.2.202.
9. U.S. Department of Health & Human Services. Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General. 2012. http://www.ncbi.nlm.nih.gov/books/NBK99237/. Accessed February 18, 2016.
10. U.S. Department of Health & Human Services. Laws/Policies. August 2012. http://betobaccofree.hhs.gov/laws/#marketing. Accessed October 22, 2015.
11. U.S. Food & Drug Administration. *Vaporizers, E-Cigarettes, and Other Electronic Nicotine Delivery Systems (ENDS)*. Center for Tobacco Products; 2017.

https://www.fda.gov/TobaccoProducts/Labeling/ProductsIngredientsComponents/ucm456610.htm. Accessed June 13, 2017.
12. Krugman DM. Understanding the Impact That Marketing, Advertising, and Promotion Have on Adolescent E-cigarette Behavior. *J Adolesc Heal*. 2016;59(6):609-611. doi:10.1016/j.jadohealth.2016.09.016.
13. Dai H, Hao J. Exposure to Advertisements and Susceptibility to Electronic Cigarette Use Among Youth. *J Adolesc Heal*. 2016;59(6):620-626. doi:10.1016/j.jadohealth.2016.06.013.
14. Singh T, Marynak K, Arrazola RA, Cox S, Rolle I V, King BA. Vital Signs: Exposure to Electronic Cigarette Advertising Among Middle School and High School Students - United States, 2014. *MMWR Morb Mortal Wkly Rep*. 2016;64(52):1403-1408. doi:10.15585/mmwr.mm6452a3.
15. Giovenco DP, Casseus M, Duncan DT, Coups EJ, Lewis MJ, Delnevo CD. Association Between Electronic Cigarette Marketing Near Schools and E-cigarette Use Among Youth. *J Adolesc Heal*. 2016;59(6):627-634. doi:10.1016/j.jadohealth.2016.08.007.
16. Mantey DS, Cooper MR, Clendennen SL, Pasch KE, Perry CL. E-Cigarette Marketing Exposure Is Associated With E-Cigarette Use Among US Youth. *J Adolesc Heal*. 2016;58(6):686-690. doi:10.1016/j.jadohealth.2016.03.003.
17. Singh T, Agaku IT, Arrazola RA, et al. Exposure to Advertisements and Electronic Cigarette Use Among US Middle and High School Students. *Pediatrics*. 2016;137(5). doi:10.1542/peds.2015-4155.
18. Agaku IT, Ayo-Yusuf OA. The Effect of Exposure to Pro-Tobacco Advertising on Experimentation With Emerging Tobacco Products Among U.S. Adolescents. *Health Educ Behav*. 2014;41(3):275-280. doi:10.1177/1090198113511817.
19. Duke JC, Lee YO, Kim a. E, et al. Exposure to Electronic Cigarette Television Advertisements Among Youth and Young Adults. *Pediatrics*. 2014;134(1):e29-e36. doi:10.1542/peds.2014-0269.
20. Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, Grucza RA, Bierut LJ. Hazards of new media: Youth's exposure to tobacco ads/promotions. *Nicotine Tob Res*. 2014;16(4):437-444. doi:10.1093/ntr/ntt168.
21. Pierce JP, Sargent JD, White MM, et al. Receptivity to Tobacco Advertising and Susceptibility to Tobacco Products. *Pediatrics*. 2017;139(6):e20163353.
22. Trumbo CW, Kim S-JS. The effect of electronic cigarette advertising on intended use among college students. *Addict Behav*. 2015;46:77-

81. doi:10.1016/j.addbeh.2015.03.005.
23. Feighery E, Borzekowski DL, Schooler C, Flora J. Seeing, wanting, owning: the relationship between receptivity to tobacco marketing and smoking susceptibility in young people. *Tob Control*. 1998;7(2):123-128. doi:10.1136/tc.7.2.123.
24. Gilpin EA, White MM, Messer K, Pierce JP. Receptivity to tobacco advertising and promotions among young adolescents as a predictor of established smoking in young adulthood. *Am J Public Health*. 2007;97(8):1489-1495. doi:10.2105/AJPH.2005.070359.
25. Morgenstern M, Isensee B, Hanewinkel R. Seeing and Liking Cigarette Advertisements: Is There a “Mere Exposure” Effect? *Eur Addict Res*. 2013;19(1):42-46. doi:10.1159/000339836.
26. Hyland A, Ambrose BK, Conway KP, et al. Design and methods of the Population Assessment of Tobacco and Health (PATH) Study. *Tob Control*. 2016;0:1-8. doi:10.1136/tobaccocontrol-2016-052934.
27. Pierce JP, Choi WS, Gilpin EA, Farkas AJ, Merritt RK. Validation of susceptibility as a predictor of which adolescents take up smoking in the United States. *Health Psychol*. 1996;15(5):355-361. doi:10.1037/0278-6133.15.5.355.
28. Pierce JP, Distefan JM, Kaplan RM, Gilpin EA. The role of curiosity in smoking initiation. *Addict Behav*. 2005;30(4):685-696. doi:10.1016/j.addbeh.2004.08.014.
29. Singh T, Arrazola R, Corey C, Al. E. Tobacco Use Among Middle and High School Students — United States, 2011–2015. *MMWR Morb Mortal Wkly Rep*. 2016;65:361–367. doi:http://dx.doi.org/10.15585/mmwr.mm6514a1.
30. Flores G, Lin H, Frey W, et al. Trends in racial/ethnic disparities in medical and oral health, access to care, and use of services in US children: has anything changed over the years? *Int J Equity Health*. 2013;12:10. doi:10.1186/1475-9276-12-10.
31. Pepper JK, Reiter PL, McRee A-L, Cameron LD, Gilkey MB, Brewer NT. Adolescent males’ awareness of and willingness to try electronic cigarettes. *J Adolesc Health*. 2013;52(2):144-150. doi:10.1016/j.jadohealth.2012.09.014.

Table 1. Weighted characteristics of youth aware of E-cigarettes in Wave 1 of the PATH Study (n=12,199; N=22,253,202)[a]

	%	95% CI
EC Ever Use	11.9	11.2-12.7
EC Current Use	3.5	3.1-3.9
Susceptible to EC Use	34.7	33.6-35.8
CC Ever Use	14.6	13.8-15.5
CC Current Use	5.0	4.6-5.5
Susceptible to CC Use	34.8	33.7-35.8
Exposed to EC Advertisements	33.8	32.8-34.7
Receptive to EC Advertisements	56.8	55.6-58.0
Female	48.2	47.9-48.5
15 to 17 years old	51.5	51.2-51.9
Race/Ethnicity		
White	56.4	56.0-56.9
Black	13.5	13.2-13.8
Other	8.9	8.6-9.2
Hispanic	21.2	20.8-21.6
Other Combustible Tobacco Use[b]	7.3	6.8-7.9
Other Combustible Tobacco Use with EC[c]	6.3	5.8-6.9
Parent Education		
High School or lower	35.2	33.4-37.2
Some college/Associate's	32.9	31.4-34.4
Bachelor's or advanced	31.9	29.7-34.2

a N represents the population of US youth to which the sample generalizes
b Youth has used another form of combustible tobacco product, excluding EC, in the past 30 days, adjusted for in EC outcome analyses
c Youth has used another form of combustible tobacco product, including EC but not CC, in the past 30 days, adjusted for in CC outcome analyses

Table 2. Weighted bivariate associations by e-cigarette (EC) ever use, current use, and susceptibility to future use outcomes among EC aware youth in 2013-2014 PATH Study

	EC Ever Use			EC Current Use			Susceptible to EC Use		
	No (%)	Yes (%)	p-value[a]	No (%)	Yes (%)	p-value[a]	No (%)	Yes (%)	p-value[a]
Exposure to EC Advertisements	32.7	41.7	**<0.01**	33.4	43.5	**<0.01**	28.5	40.6	**<0.01**
Receptivity to EC Advertisements	54.3	75.4	**<0.01**	55.9	82.0	**<0.01**	44.8	72.2	**<0.01**
Female	49.2	41.2	**<0.01**	48.6	37.9	**<0.01**	49.4	48.7	0.49
15 to 17 years old	48.1	77.4	**<0.01**	50.4	83.6	**<0.01**	44.1	55.7	**<0.01**
Race/Ethnicity			**<0.01**			**<0.01**			**<0.01**
White	55.7	61.8		56.1	65.5		57.0	53.4	
Black	14.1	8.8		13.7	7.9		14.1	13.9	
Other	9.0	8.4		8.9	9.0		9.2	8.5	
Hispanic	21.2	21.0		21.3	17.6		19.7	24.2	
Other Combustible Tobacco Use[b]	2.9	39.9	**<0.01**	5.4	59.9	**<0.01**	1.1	6.4	**<0.01**
Parent Education			**<0.01**			0.14			0.38
High School or lower	34.7	38.8		35.1	38.3		34.4	35.5	
Some college/ Associate's	32.3	37.2		32.8	25.3		32.1	32.5	
Bachelor's or advanced	33.0	24.0		32.1	26.4		33.5	32.0	

a Bolded *p*-values indicate statistical significance at 0.05 using Pearson's Chi-square test.
b Youth has used another form of combustible tobacco product, excluding EC, in the past 30 days, adjusted for in EC outcome analyses

Table 3. Weighted bivariate associations by conventional cigarette (CC) ever use, current use, and susceptibility to future use outcomes among EC aware youth in 2013-2014 PATH Study[a]

	CC Ever Use			CC Current Use			Susceptible to CC Use		
	No (%)	Yes (%)	p-value	No (%)	Yes (%)	p-value	No (%)	Yes (%)	p-value
Exposure to EC Advertisements	32.9	38.8	**<0.01**	33.6	38.1	**0.04**	29.2	40.0	**<0.01**
Receptivity to EC Advertisements	53.8	74.3	**<0.01**	55.5	81.0	**<0.01**	45.6	69.1	**<0.01**
Female	48.4	46.8	0.19	48.2	48.0	0.90	48.0	49.2	0.31
15 to 17 years old	47.1	77.6	**<0.01**	49.8	84.8	**<0.01**	44.3	52.4	**<0.01**
Race/Ethnicity			**<0.01**			**<0.01**			**<0.01**
White	55.5	62.3		55.9	67.6		57.1	52.4	
Black	14.1	10.0		13.7	8.3		13.8	14.6	
Other	9.1	7.5		9.0	7.4		9.1	9.1	
Hispanic	21.3	20.2		21.4	16.7		20.0	23.9	
Other Combustible Tobacco Use with EC[b]	2.0	31.6	**<0.01**	3.8	53.3	**<0.01**	1.1	3.8	**<0.01**
Parent Education			**<0.01**			**<0.01**			0.51
High School or lower	33.5	45.2		34.6	46.6		33.7	33.0	
Some college/ Associate's	32.4	35.9		32.7	35.4		32.0	33.2	
Bachelor's or advanced	34.1	18.9		32.7	18.0		34.3	33.8	

Bolded *p*-values indicate statistical significance at 0.05 using Pearson's Chi-square test.
b Youth has used another form of combustible tobacco product, including EC but not CC, in the past 30 days, adjusted for in CC outcome analyses

Table 4. Weighted adjusted associations of EC advertising exposure and receptivity with EC and CC ever use, current use, and susceptibility to future use among EC aware youth in 2013-2014 PATH Study[a]

	EC Ever Use	EC Current Use	Susceptible to EC Use	CC Ever Use	CC Current Use	Susceptible to CC Use
Exposure to EC Advertisements	**1.36 (1.18-1.57)**	**1.40 (1.12-1.75)**	**1.44 (1.30-1.59)**	1.08 (0.96-1.23)	0.95 (0.78-1.16)	**1.35 (1.23-1.47)**
Receptivity to EC Advertisements	**1.70 (1.45-2.00)**	**1.83 (1.36-2.46)**	**2.84 (2.57-3.14)**	**1.81 (1.58-2.08)**	**2.04 (1.57-2.64)**	**2.42 (2.20-2.66)**
Female	**0.63 (0.55-0.72)**	**0.57 (0.45-0.72)**	**0.90 (0.81-0.99)**	0.96 (0.86-1.08)	1.14 (0.94-1.40)	1.01 (0.91-1.12)
15 to 17 years old	**2.41 (2.09-2.78)**	**2.35 (1.77-3.12)**	**1.27 (1.15-1.41)**	**2.76 (2.39-3.19)**	**3.00 (2.35-3.82)**	**1.18 (1.09-1.28)**
Race/Ethnicity						
White	Ref	Ref	Ref	Ref	Ref	Ref
Black	**0.53 (0.39-0.71)**	**0.52 (0.33-0.82)**	0.97 (0.83-1.15)	**0.53 (0.42-0.67)**	**0.41 (0.29-0.58)**	1.13 (0.98-1.29)
Other	0.95 (0.74-1.21)	1.02 (0.67-1.56)	0.94 (0.79-1.12)	**0.70 (0.56-0.88)**	**0.60 (0.43-0.85)**	1.05 (0.89-1.22)
Hispanic	0.89 (0.73-1.09)	0.75 (0.54-1.05)	**1.28 (1.14-1.44)**	**0.64 (0.55-0.74)**	**0.48 (0.37-0.63)**	**1.29 (1.16-1.44)**
Other Combustible Tobacco Use[b]	**17.43 (14.60-20.81)**	**18.54 (14.46-23.77)**	**5.18 (3.74-7.18)**	-	-	-
Other Combustible Tobacco Use with EC[c]	-	-	-	**16.72 (13.23-21.14)**	**20.25 (16.00-25.64)**	**2.97 (2.21-3.99)**
Parent Education						
High School or lower	Ref	Ref	Ref	Ref	Ref	Ref
Some college/ Associate's	1.09 (0.91-1.31)	1.02 (0.74-1.41)	1.01 (0.89-1.14)	**0.74 (0.63-0.86)**	**0.70 (0.54-0.90)**	1.10 (0.99-1.22)
Bachelor's or advanced	**0.69 (0.56-0.85)**	0.91 (0.64-1.28)	0.98 (0.88-1.09)	**0.30 (0.25-0.37)**	**0.31 (0.22-0.42)**	1.08 (0.96-1.21)

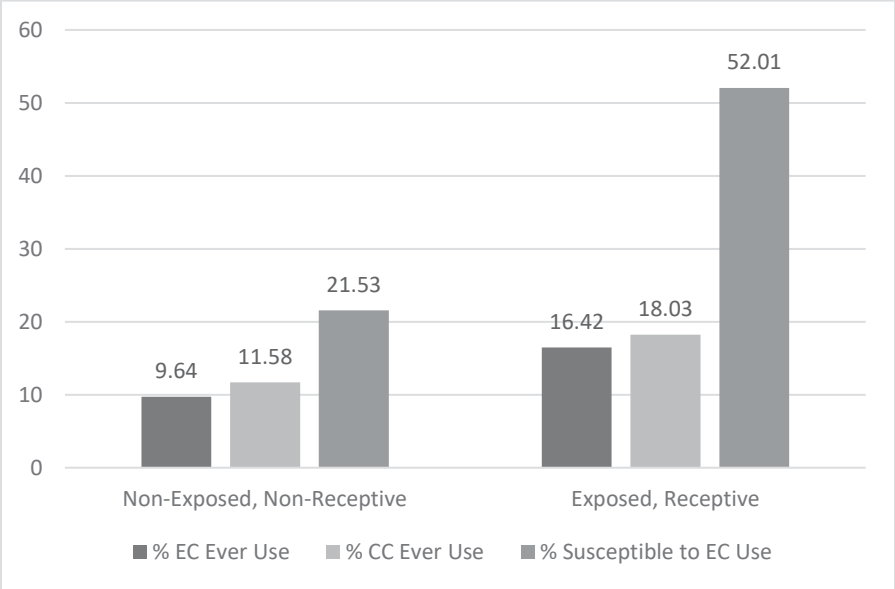
Bolded *p*-values indicate statistical significance at 0.05.

a All associations reported as Odds Ratios (OR)

b Youth has used another form of combustible tobacco product, excluding EC, in the past 30 days, adjusted for in EC outcome analyses

c Youth has used another form of combustible tobacco product, including EC but not CC, in the past 30 days, adjusted for in CC outcome analyses

Figure 1. Predictive probabilities of tobacco use behaviors from marginal effects of exposure and receptivity to EC advertisements[a]



a All marginal effects were statistically significant (p<0.01)