Exploring how tobacco advertisements are associated with tobacco use susceptibility in tobacco naive adolescents from the PATH study

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Abstract

Adolescents' susceptibility to pro-tobacco marketing advertisements puts them at risk for initiating and continued use of tobacco. The objective of this study was to quantify the cross-sectional association between tobacco ad exposure and tobacco use susceptibility (e.g., curiosity about tobacco products, willingness, and future intention to try tobacco products) among tobacco-naive adolescents. Data came from Wave 4 of the Population Assessment of Tobacco and Health (PATH) study, a nationally-representative sample of US adolescents ages 12–17. We used logistic regression to examine (1) characteristics associated with tobacco ad exposure; (2) associations between tobacco ad exposures (by product type/venue) and tobacco use susceptibility (among tobacco-naive adolescents only). The results suggested that higher household income, living with tobacco user(s), substance use history, and mental health problem(s) were associated with increased odds of tobacco marketing exposure. Among tobacco naïve adolescents ($N = 9455$), tobacco ads exposure was positively associated with tobacco use susceptibility, compared with the non-exposure group. Seeing cigarettes/other non-ENDS tobacco products only was associated with a 1.64 increase in odds being susceptible to tobacco use; tobacco ads exposure via website and/or social media sites only (cigarette/other non-ENDS tobacco, AOR: 1.87, 95%CI: 1.25–2.81; ENDS, AOR: 2.25, 95%CI: 1.43–3.55) was associated with higher odds of tobacco use susceptibility, compared to the non-exposure group. With rapidly increasing rates of ENDS use in adolescents, it is crucial that advertisements promoting the initiation and continued use of ENDS are strictly regulated, especially among advertisements that are online and on social media sites.

Keywords

Tobacco; Advertisements; Adolescents; ENDS; Susceptibility; PATH

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1. Introduction

Every day, nearly 4000 adolescents begin smoking in the United States, and approximately 600 youth under the age of 18 become daily smokers (Makadia et al., 2017). In addition to conventional tobacco use (i.e., cigarettes and other combustible products), electronic nicotine delivery systems (ENDS) are the most commonly used products among high school (27.5%) and middle school students (10.5%) (CDC, 2019), with over 5 million youth reporting using ENDS in 2019 (FDA, 2019).

Nearly 9 in 10 middle and high school students (22.9 million) reported exposure to cigarette and ENDS advertisements from at least one source (CDC, 2019), and marketing of both products has been shown to influence adolescent overall tobacco use and susceptibility (Patthi et al., 2018; Thrasher et al., 2016). High correlations have been found between the timing of advertising campaigns and increases in the rates at which adolescents initiate cigarette smoking (Hastings and Angus, 2008; Pierce et al., 1994). In particular, adolescents who have never smoked and have frequent exposure to cigarette marketing via the Internet or physical stores are more than two times as likely to begin smoking by the time they become young adults (Cruz et al., 2019) versus counterparts who do not have frequent exposures to these advertisements. In addition, companies that sell ENDS tend to employ advertisement strategies which are more attractive to young people, such as celebrity endorsements, social media promotions, and ads on popular online games (Grana and Ling, 2014; Kirkpatrick et al., 2017; Lee, 2017; Padon et al., 2017) and by promoting aesthetically pleasing and easily concealable ENDS devices and popular flavors. Prior research suggests that positive associations have been observed between experimental ENDS use and tobacco marketing, including traditional advertisements (e.g., convenience store, billboards) and online advertisements (Chen et al., 2020; Glasser et al., 2017; Loukas et al., 2019; Mantey et al., 2016; Pokhrel et al., 2015). In addition, ENDS ads tend to emphasize uncertainties about the long term health consequences of these products, and this has been found to both reduce risk perception and increase susceptibility to ENDS use among youth (Pepper et al., 2015; Pepper et al., 2019).

Although associations between ENDS/tobacco advertisements and adolescent use have previously been examined, continued research is needed to monitor changes within these associations as the tobacco product landscape and marketing tactics evolve. In response, the present study used a nationally representative dataset from the Population Assessment of Tobacco and Health (PATH) study to quantify the association between tobacco advertisement exposure (e.g., cigarettes/other non-ENDS tobacco product, ENDS) and tobacco use susceptibility (e.g., curiosity about tobacco products, willingness, and future intention to try tobacco products) among tobacco naïve adolescents using the most recent national survey data available.

2. Methods

This study utilized the most recent cross-sectional data from Wave 4 (2016–2018) of the PATH study. The PATH study is a nationally representative sample of tobacco users and

non-users assessed using audio computer-assisted self-interviewing (ACASI) to collect data about tobacco use and risk factors. For more details about interviewing and sampling, please refer to the Public-Use Files User Guide (USDHHS, 2018). The analyses in this manuscript were conducted on publicly available de-identified data, thus the Washington University Institutional Review Board determined this study to be exempt from review (IRB# 202006016).

Our analyses focused on adolescent respondents aged 12–17 years old at Wave 4 of the PATH study. The dataset initially contained 14,798 adolescent respondents. We excluded respondents without complete information on variables of interest. The total sample size of the current study is 12,016 (with complete cases) respondents. Of them, 9544 participants reported that they had never used any type of tobacco product during their lifetime and they were considered as tobacco-naïve adolescents.

2.1 Measures

Independent Variable: Tobacco ads exposure (Yes vs. No).—Recent (P30D: within the past 30 days) exposure to tobacco ads was assessed for (1) e-cigarettes or electronic nicotine products (ENDS) and (2) cigarettes or other tobacco products ("other products" did not include ENDS, and we refer to it as "cigarettes/other non-ENDS tobacco products" in the following context), respectively. The following question was asked for each tobacco product: "In the past 30 days, have you noticed [tobacco products] being advertised in any of the following places? Choose all that apply.", and ten possible options were provided, including: (1) have not seen any advertisements; (2) on websites or social media sites; (3) at gas stations, convenience stores or other retail stores; (4) on billboards; (5) in newspapers or magazines; (6) on radio; (7) on television; (8) at events such as fairs, festivals, or sporting events; (9) at nightclubs, bars, or music concerts; (10) somewhere else (e.g., in malls). Participants were asked to choose all that apply, but if option 1 ("Have not seen any advertisements") was selected, no other option could be selected. Youth who had not seen any type of advertisement were coded as non-exposed, and youth who had seen at least one type of advertisement were coded as exposed.

Independent Variable: Exposure to advertisements for different types of tobacco products.—Participants who reported that they had not seen any advertisements for both types of products (ENDS and cigarettes/other non-ENDS tobacco products) were coded as non-exposed and were treated as the reference group. Youth who reported noticing ads were classified as one of three mutually exclusive exposure subgroups: (1) have seen ENDS ads only; (2) have seen cigarette/other non-ENDS tobacco product ads only; and (3) have seen both ENDS and cigarette/other non-ENDS tobacco product ads.

Independent Variable: Venue of tobacco ads exposure.—Respondents were also classified into four mutually exclusive groups: 1) have not seen any advertisements; 2) have seen advertisements on websites or social media sites only (including Facebook, Google Plus, YouTube, Myspace, LinkedIn, Twitter, Tumblr, Instagram, Pinterest, or Snapchat); 3) have seen advertisements from traditional venues only; 4) have seen advertisements both on social media and from traditional venues.

Dependent Variable: Tobacco Use Susceptibility (4 items).—Tobacco use susceptibility was assessed by responses to four questions queried separately among tobacco naïve adolescents, including: (1) "Have you ever been curious about using [tobacco product]?"; (2) "If one of your best friends were to offer you a [tobacco product], would you smoke it?"; (3) "Do you think that you will try a [tobacco product] soon?"; and (4) "Do you think you will try a [tobacco product] in the next year?". Four response options were provided: (1) definitely yes/very curious, (2) probably yes/somewhat curious, (3) probably not/a little curious, and (4) definitely not/not at all curious. The responses to each question item were recoded as dichotomous, either "non-susceptible" (i.e., "definitely not/not at all curious") or "susceptible" (i.e., "definitely yes/very curious", "probably yes/ somewhat curious", "probably not/a little curious"), which was consistent with previous work (Coleman et al., 2019; Pierce et al., 2017). Participants who responded "definitely not/not at all curious" across all four questions were considered as "non-susceptible" to general tobacco use; otherwise, we classified them as "susceptible" to general tobacco use. On each question, the following tobacco products were assessed: cigarettes, ENDS, traditional cigar, cigarillo, filtered cigar, hookah, smokeless tobacco, and hookah.

2.2 Covariates

Socio-demographics.—Age group, gender, race, ethnicities, annual household income (reported by parents), and if the respondent lives with a smoker (assessed by the item "Does anyone who lives with you now do any of the following: smoke cigarettes, use smokeless tobacco, smoke cigars, cigarillos or filtered cigars or use any other form of tobacco?") were included as socio-demographics.

Substance Use History.—Substance use history was assessed by asking the participant if they had used any of the following substances in the past 12 months: marijuana (including blunts), alcohol, and other illicit drugs (including prescription drugs (i.e., Ritalin, Adderall, painkillers, sedatives, and tranquilizers), cocaine, crack, stimulants (i.e., methamphetamine or speed), heroin, inhalants, solvents, and hallucinogens. These answers were then combined as one variable containing three categories: none, one, and more than one.

Tobacco use history (lifetime).—Lifetime and current (within the past 30-day) use of twelve tobacco products were assessed in the questionnaire, including: cigarettes, ENDS, any cigar (traditional cigars, cigarillos, filtered cigars), pipes, hookah, smokeless tobacco (i.e., loose snus, moist snuff, dip, spit, chewing tobacco, snus pouches, or dissolvable tobacco), bidis, and kreteks. Respondents were grouped as never, ever (used in lifetime), and current (past 30-day) tobacco users, based on their responses. Only those who responded "never" to using all tobacco products listed above would be defined as a never smoker. This variable was only used to determine the characteristics of tobacco ads exposure and not included into the analyses regarding the tobacco use susceptibility section.

Mental health problems.—Mental health comorbidities were assessed with the short version of the Global Appraisal of Individual Needs (GAIN-SS) questionnaire, which was modified for the PATH study (Conway et al., 2017). Internalizing problems were assessed with four items, externalizing problems were assessed with five items, and hyperactivity

was assessed by two items. Researchers have previously found hyperactivity to be highly collinear with items of externalizing problems; therefore, these two items were also included in the externalizing scale (Green et al., 2018). Points were assigned for each item, indicating having experienced the specific symptoms within the past 12 months and summed for scaling, respectively (0–4 symptoms for internalizing problems and 0–7 symptoms for externalizing problems). Each was then categorized into four-level variables: no/low (0–1 symptoms), moderate (2–3 symptoms), or severe (4 symptoms for internalizing problems and 4 symptoms for externalizing problems; Conway et al., 2017; Riehm et al., 2019).

2.3. Statistical analyses

Descriptive statistics (N/weighted %) of sociodemographic were presented by recent tobacco ads exposure (Yes/No) among all eligible participants from PATH Wave 4 ($N = 12,016$). To examine the characteristics associated with recent tobacco ads exposure, unadjusted and adjusted survey-weighted logistic regression were applied to obtain the effect size of estimates, controlling for covariates listed above.

Furthermore, the same models were used to estimate the associations between tobacco ads exposure and tobacco use susceptibility by type of tobacco products, among adolescent who never used tobacco ($N = 9544$), controlling for gender, age, race, ethnicity, substance use history, internalizing problems, externalizing problems, money received weekly, and living with smokers. Finally, to understand how tobacco advertisements influence tobacco use susceptibility by site among never tobacco users (N = 9544), logistic regressions were applied, controlling for all covariates but no tobacco use history.

All analyses were performed using SAS 9.4 PROCSURVEY procedure, accounting for the complex survey design (SAS Institute, Cary, North Carolina, USA). All results applied PATH Wave 4 cross-sectional weights with the balanced repeated replication (BRR) method (Fay's adjustment set to 0.3) to reach the national representativeness and increase the stability of estimates (USDHHS, 2018). To be consistent with previous work, all the statistical analyses were two-sided, and *P* values <0.05 were considered statistically significant (Chen-Sankey et al., 2019; Riehm et al., 2019).

3. Results

Noticing tobacco (including any ENDS and cigarettes/other non-ENDS tobacco product) advertisements by socio-demographic variables are shown in Table 1 and Supplementary Table 1. Overall, 8262 respondents reported recently noticing an advertisement about a tobacco product. Participants with a history of substance use, mental health symptoms within the past 12-months, annual household incomes above $25,000, and who currently live with smokers were more likely to have noticed tobacco advertisements.

In the unadjusted model, current tobacco users were more likely to notice tobacco advertisements (OR = 1.17, 95% CI: 1.01–1.36). Adjusting for sociodemographic resulted in an odds ratio near 1 for current use. However, the fully adjusted version of this model (in Table 1) counter-intuitively suggested that current tobacco users were substantially *less* likely to notice tobacco advertisements (AOR = 0.68, 95% CI: 0.58–0.80). In examining this

result further, we determined that specifically including substance use history as a covariate attenuated the strength of the relationship between current tobacco use and ad exposure (See Appendix A, MacKinnon et al., 2000). The results indicated that all three variables were strongly inter-related thus there was a possibility of over-adjustment bias (Schisterman et al., 2009).

3.1 Tobacco ads exposure by tobacco product type

Among never tobacco users, those who reported noticing cigarettes/other non-ENDS tobacco ads only (AOR = 1.64, 95% CI: 1.31–2.05), noticing ads for both cigarettes/other non-ENDS tobacco ads only and ENDS (AOR = 1.61, 95% CI: 1.45–1.80), or noticing only ENDS ads (AOR = 1.43, 95% CI: 1.18–1.74) had higher odds of tobacco use susceptibility, compared with those who reported not seeing any tobacco ads (in Table 2). Notably, reporting noticing cigarettes/other non-ENDS tobacco ads only was positively associated with the intention to smoke if tobacco was offered by best friends (AOR = 1.52, 95% CI: 1.16–1.99), and willingness to try tobacco soon (AOR = 1.51, 95% CI: = 1.15–1.99) or next year (AOR = 1.49, 95% CI: 1.14–1.96).

3.2 Tobacco ads exposure by venues

The analyses of the association between tobacco ads exposure and tobacco use susceptibility among never-tobacco users was collapsed by venue as shown in Table 3. The results indicate that seeing tobacco ads from websites and/or social media sites only (ENDS ads: AOR = 1.87, 95% CI = 1.25–2.81; cigarettes/other non-ENDS tobacco ads: AOR = 2.25, 95% CI = 1.43–3.55), from both traditional and websites and/or social media sites (ENDS ads: AOR = 1.97, 95% CI = 1.75–2.22; cigarettes/other non-ENDS tobacco ads: AOR = 1.84, 95% CI = 1.60–2.11), and from traditional venues only (ENDS ads: AOR = 1.27, 95% CI = 1.13–1.42; cigarettes/other non-ENDS tobacco ads: AOR = 1.37, 95% CI 1.24–1.52) were associated with increased odds of tobacco use susceptibility, compared with those who reported not seeing tobacco ads. Moreover, results related to curiosity about tobacco use indicate that seeing tobacco ads from websites and/or social media sites only (ENDS ads: AOR = 2.18, 95% CI = 1.44–3.31; cigarettes/other non-ENDS tobacco ads: AOR = 2.44, 95% CI = 1.61–3.69), from both traditional and websites and/or social media sites (ENDS ads: AOR = 2.03, 95% CI = 1.79–2.31; cigarettes/other non-ENDS tobacco ads: AOR = 1.87, 95% CI = 1.62–2.16), and from traditional venues only (ENDS ads: AOR = 1.34, 95% CI = 1.19–1.51; cigarettes/other non-ENDs tobacco ads: AOR = 1.46, 95% CI = 1.31–1.62) were associated with higher odds of curiosity about tobacco use, compared with those who reported not seeing any tobacco ads. Additionally, exposure to cigarette/non-ENDS tobacco ads was positively associated with odds of future tobacco use susceptibility (soon or next year), no matter the venue of exposure, compared to those who reported not seeing any tobacco ads.

3.3. Susceptibility by demographics, substance use history and mental health comorbidities

Among tobacco-naive adolescents, the results from the adjusted model suggest that female participants, those in the older age range group (15–17 years old), and participants belonging to minority racial/ethnicity groups were more likely to endorse tobacco use susceptibility.

Additionally, participants with positive substance use histories, moderate or severe mental health problems (especially severe externalizing problems), and those who lived with smokers were more likely to be susceptible to tobacco use.

4. Discussion

This study explored associations between ENDS and cigarette advertisement exposure and tobacco use susceptibility among tobacco-naive adolescents in the PATH study. While exposure to any type of tobacco marketing was positively associated with tobacco use susceptibility, exposure to cigarettes/other non-ENDS tobacco ads only was associated with the highest association with overall tobacco use susceptibility and intent to use among this group. Further, tobacco naive adolescents who were exposed to cigarette/other non-ENDS tobacco product advertisements online only were found to be more susceptible to tobacco use and report feeling more likely to use tobacco soon or within the next year than those exposed to advertisements only in traditional marketing locations. These findings expand the literature by delineating the associations between ENDS advertisements and cigarette/ non-ENDS tobacco advertisements and adolescents' tobacco-related attitudes and intentions, and highlight the need for additional regulation considerations to limit exposure to online and social media tobacco marketing among youth, especially due to the high rate of social media use among this group.

The findings of the current study are consistent with previous literature linking pro-tobacco advertisements and increased risk for adolescent tobacco use behaviors and expand upon this literature to include ENDS and cigarette/non-ENDS tobacco advertisements online and on social media sites. Previous research has found that many youth are open to and curious about cigarettes and ENDS use, and exposure to advertisements may increase this curiosity and subsequently drive use behaviors (Margolis et al., 2018; Nicksic et al., 2017). Similarly, cigarette and ENDS advertising is found to prompt experimental, continued, and increased tobacco product use among youth, supporting the results of the current study (Jenco, 2019; Singh et al., 2016). This may be due to ENDS marketing utilizing strategies similar to conventional cigarette advertising tactics that appeal to adolescents, including themes of romance, freedom, and rebellion; celebrity endorsements; and health claims (USDHHS, 2012, 2016). However, newer ENDS brands are becoming less likely to compare their products to combustible cigarettes or tout these products as smoking cessation aids; in contrast, they now promote other features, such as having sleek and innovative design and having tasty, youth-friendly flavors (McKelvey, Baiocchi, Ramamurthi, McLaughlin, & Halpern-Felsher, 2019; Morean et al., 2018; Pu & Zhang, 2017). Even a relatively low level of exposure to cigarette advertisements can increase curiosity about smoking among adolescents who have never used tobacco (Soneji et al., 2019), which is important to consider given that these types of advertisements are highly prevalent in magazines, convenience stores, online websites and social media platforms (Farber and Patricia Folan, 2017).

Reporting noticing any ENDS advertisements was associated with all tobacco use susceptibility items (e.g., curiosity, intention to use in the future, willingness to try tobacco if offered by friends), even after controlling for a variety of covariates that could influence

tobacco and ENDS use, including living with a smoker and mental health concerns. Promotional ENDS-related content on social media is highly prominent (Chu et al., 2017; Huang et al., 2016; Huang et al., 2014) with over 90% of tweets on Twitter related to ENDS having promotional content (Huang et al., 2014). Additionally, it is reported that adolescents who use social media more frequently in their daily lives had greater willingness and intention to use e-cigarettes (Vogel et al., 2020) and content on ENDS websites can be easily viewed by underage youth (i.e., implementing questions like "Are you over 18 years of age?" that can be easily surpassed by adolescents) (Mackey et al., 2015). Further, unlike conventional websites, social media sites do not prohibit underage youth from networking with social media influencers who promote tobacco and ENDS products (Meyers, 2019), regardless of existing policies which prohibit paid advertisements from tobacco companies. Thus, given that social media (Lenhart et al., 2015) and ENDS use (Bonnie et al., 2015) are particularly prevalent among adolescents, it is important for policy makers to consider the ways in which individuals, especially those who are underage, engage with ENDS advertisements online.

Our findings additionally indicate that those who are members of racial or ethnic minority groups are more likely to be susceptible to tobacco use. This is in line with previous research finding that tobacco advertisements have historically been strategically placed in non-White, lower socioeconomic status communities (Golden et al., 2018; Tucker-Seeley et al., 2016), with up to five times greater concentration of tobacco billboards in urban, low-income, minority areas (Burgoon et al., 2019). The marketing of menthol and other flavors in tobacco have historically targeted vulnerable populations including youth and African Americans, as well as to Hispanics as a means to facilitate experimentation and uptake of these products among these groups (Klausner, 2011; Landrine et al., 2005). Furthermore, participants in the current study with positive substance use histories, moderate or severe mental health problems (especially externalizing disorder), and who are living with smokers were more like to have pro-tobacco attitudes. Indeed, youth with mental illness and/or non-tobacco substance use problems have been targeted by tobacco companies (Baig et al., 2017; Prochaska et al., 2017). Tobacco industries may tailor their advertisement content to appeal to those who may be experiencing psychological distress, including sadness and anxiety (Audrain-McGovern et al., 2006; Cook et al., 2003; King et al., 2018) as a means for stress reduction and relaxation particularly among youth (Moran et al., 2019). The findings of this study support the development of further regulation for targeted marketing campaigns particularly among vulnerable populations, such as racial/ethnic minorities and those with mental health and additional substance use concerns and indicate the need for additional prevention and intervention strategies for ENDS and tobacco use among these groups.

This study has several strengths. First, by using the latest, nationally representative dataset with more comprehensive assessment about tobacco marketing exposure, we were able to control for numerous socioeconomic and demographic status covariates that could confound the association between tobacco advertisements exposure and tobacco susceptibility among tobacco never users. This study build upon prior literature by distinguishing between specific venues of tobacco ad exposure variables, differentiating between cigarettes/other non-END tobacco products and ENDS products; however, it should be noted that regulation of tobacco versus ENDS advertisements may vary across venues (e.g., cigarette

advertisement restrictions at traditional sites; FDA, 2020). Other limitations of the current investigation include the use of self-report data which may be subject to bias and the use of a cross-sectional design which limits our ability to make causal associations, as well as the potential for participation in previous waves of the PATH study to influence advertisement exposure or level of susceptibility. Additionally, it unknown whether the advertisements that youth were exposed had promoted tobacco use or campaigned against it, and the PATH study does not assess exposure to advertisements for other types of tobacco products (e.g., mini cigarillos) that may be popular among teens (Sterling et al., 2016; Antognoli et al., 2018). Further, based on the way the PATH survey assessed marketing exposure (using either yes or no for each item) and the categorizations applied in the current analysis, we were unable to assess the frequency of advertisement exposure from specific venues or from specific tobacco products within the past 30 days, especially because some categories may contain cumulative effects from multiple venues (i.e., both social media and traditional locations) or tobacco products (i.e., seeing ENDS and cigarette/other non-ENDS tobacco product ads). Future investigations could expand upon the results of this study by analyzing marketing exposure longitudinally, including advertisement sentiment and venue, to determine if the intention to use tobacco matches individuals' subsequent behaviors.

Overall, exposure to ENDS and tobacco advertisements has a strong relationship with adolescent ENDS and tobacco susceptibility, as is shown in previous literature and supported further here using current national-level population data. Our study is consistent with the notion that tobacco product marketing is an important contributor to tobacco use among young people and demonstrates that exposure from social media is associated with increased ENDS and tobacco susceptibility among this group. The development of effective regulation aimed at mitigating the impact of tobacco promotions and advertisements on youth tobacco susceptibility is crucial, especially policies to reduce exposure to ENDS advertisements and limit product access among underage youth. Health professionals could work to develop innovative outreach methods, possibly utilizing social media, to prevent and intervene with adolescents who are susceptible to tobacco use initiation in order to reduce the likelihood of this behavior.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding

Appendix A.: Logistic regression for P30D tobacco ads exposure (yes/no) (*N* = 12,016, PATH wave 04, 2016–2018)

	Model 1	Model 2	Model 3	Model 5	Model 6
	OR, 95% CI	AOR, 95% CI	AOR, 95%	CI AOR, 95% CI	AOR,95% CI
Tobacco use history[1] (ref: No)					
Ever (tried)	**1.29 (1.11,1.50)**	**1.28 (1.10, 1.49)**	**1.19 (1.02, 1.38)**	0.94 (0.81, 1.09)	0.90 (0.77, 1.05)
Current (used within P30D)	**1.17 (1.01, 1.36)**	1.12 (0.96, 1.30)	1.01 (0.87, 1.18)	**0.70 (0.59, 0.82)**	**0.69 (0.58, 0.81)**
Socio-demographics					
Gender (ref: Female)	-	**1.20 (1.10, 1.31)**	**1.19 (1.09, 1.30)**	**1.12 (1.03, 1.23)**	1.07 (0.98, 1.17)
Age range (ref: 12–14 yrs.)		**1.09 (1.00, 1.18)**	**1.11 (1.02, 1.21)**	1.01 (0.92, 1.10)	1.03 (0.94, 1.12)
Race (ref: White)					
Black	-	**0.84 (0.75, 0.95)**	0.97 (0.85, 1.11)	0.99 (0.86, 1.13)	1.00 (0.87, 1.15)
Others	-	**0.86 (0.75, 0.99)**	0.90 (0.78, 1.03)	0.90 (0.79, 1.03)	0.90 (0.79, 1.03)
Ethnicity (ref: Not Hispanic)					
Hispanic	-	**0.80 (0.68, 0.93)**	0.93 (0.81, 1.07)	0.93 (0.81, 1.06)	0.96 (0.84, 1.09)
Household annual income ($; ref: <25,000)					
25,000 – 50,000	-	-	**1.22 (1.06, 1.40)**	**1.19 (1.03, 1.37)**	**1.17 (1.01, 1.34)**
>50,000	-	-	**1.58 (1.41, 1.77)**	**1.46 (1.30, 1.64)**	**1.42 (1.27, 1.59)**
Lives with a smoker[2] (ref: No)					
Yes	-	-	**1.66 (1.50, 1.84)**	**1.61 (1.46, 1.79)**	**1.54 (1.39, 1.71)**
Ever used substance[3] (ref: 0)					
1	-	-	-	**2.04 (1.82, 2.29)**	**1.82 (1.62, 2.04)**
2+	-	-	-	**2.27 (1.90, 2.71)**	**1.84 (1.53, 2.21)**
Mental health comorbidities (P12M)					
Internalizing disorder (ref: No/Low)					
Moderate	-	-	-	-	**1.28 (1.15, 1.42)**
Severe	-	-	-	-	**1.25 (1.08, 1.45)**
Externalizing disorder (ref: No/Low)					
Moderate	-	-	-	-	**1.39 (1.23, 1.57)**
Severe	-	-	-	-	**1.77 (1.56, 2.01)**

ENDS: Electronic nicotine delivery system (products); P30D: Past 30-day, P12M: Past 12-month, AOR: Adjusted odds ratio, CI: Confidence interval.

Bold indicates statistically significant.

*
Noticed tobacco products being advertised at following locations: 1) at gas stations, convenience stores or other retail stores; 2) on billboards; 3) in newspapers or magazines; 4) on radio; 5) on television 6) at events such as fairs, festivals, or sporting events 7) at nightclubs, bars, or music concerts; 8) on websites or social media sites; 9) somewhere else;

1
Tobacco products include: cigarettes, ENDS, traditional cigars, cigarillos, filtered cigars, pipes, hookah, smokeless tobacco (i.e., loose snus, moist snuff, dip, spit, or chewing tobacco), snus pouches, dissolvable tobacco, bidis, and kreteks.

2
Long description of question: Does anyone who lives with you now do any of the following: Smoke cigarettes, use smokeless tobacco, smoke cigars, cigarillos or filtered cigars or use any other form of tobacco?

3
Substances include: marijuana (including blunts), alcohol and other illicit drugs (including prescription drugs (i.e., Ritalin, Adderall, painkillers, sedatives, and tranquilizers), cocaine, crack, stimulants (i.e., methamphetamine or speed), heroin, inhalants, solvents, and hallucinogens.

Appendix B.: Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2021.106758.

References

Audrain-McGovern J, Rodriguez D, Patel V, Faith MS, Rodgers K, Cuevas J, 2006. How do psychological factors influence adolescent smoking progression? The evidence for indirect effects through tobacco advertising receptivity. Pediatrics 117 (4), 1216–1225. [PubMed: 16585318]

Baig SA, Pepper JK, Morgan JC, Brewer NT, 2017. Social identity and support for counteracting tobacco company marketing that targets vulnerable populations. Soc. Sci. Med 182, 136–141. [PubMed: 28427731]

Bonnie RJ, Stratton K, Kwan LY (Eds.), 2015. Public Health Implications of Raising the Minimum Age of Legal Access to Tobacco Products National Academies Press, Washington, DC.

Burgoon ML, Albani T, Keller-Hamilton B, Lu B, Roberts ME, Craigmile PF, Ferketich AK, 2019. Exposures to the tobacco retail environment among adolescent boys in urban and rural environments. Am. J. Drug Alcohol Abuse 45 (2), 217–226. [PubMed: 30601033]

CDC, 2019. Fast Facts and Fact Sheets Retrieved from. https://www.cdc.gov/tobacco/data_statistics/fact_sheets/index.htm.

Chen Y, Tilden C, Vernberg DK, 2020. Adolescents' interpretations of e-cigarette advertising and their engagement with e-cigarette information: results from five focus groups. Psychol. Health 35 (2), 163–176. [PubMed: 31418593]

Chen-Sankey JC, Unger J, Bansal-Travers M, Niederdeppe J, Bernat E, Choi K, 2019. The association between marketing exposure and subsequent E-cigarette experimentation among youth and Young adult never tobacco users. Pediatrics 144 (5) (Pii: e20191119). [PubMed: 31659003]

Chu K-H, Allem J-P, Cruz TB, Unger JB, 2017. Vaping on Instagram: cloud chasing, hand checks and product placement. Tob. Control 26 (5), 575–578.

Coleman B, Rostron B, Johnson SE, Persoskie A, Pearson J, Stanton C, Cummings KM, 2019. Transitions in electronic cigarette use among adults in the population assessment of tobacco and health (PATH) study, waves 1 and 2 (2013–2015). Tob. Control 28 (1), 50–59. [PubMed: 29695458]

Conway KP, Green VR, Kasza KA, Silveira ML, Borek N, Kimmel HL, Compton WM, 2017. Co-occurrence of tobacco product use, substance use, and mental health problems among adults: findings from wave 1 (2013–2014) of the population assessment of tobacco and health (PATH) study. Drug Alcohol Depend 177, 104–111. 10.1016/j.drugalcdep.2017.03.032. [PubMed: 28582698]

Cook BL, Wayne GF, Keithly L, Connolly G, 2003. One size does not fit all: how the tobacco industry has altered cigarette design to target consumer groups with specific psychological and psychosocial needs. Addiction 98 (11), 1547–1561. [PubMed: 14616181]

Cruz TB, McConnell R, Low BW, Unger JB, Pentz MA, Urman R, Barrington-Trimis JL, 2019. Tobacco marketing and subsequent use of cigarettes, e-cigarettes, and hookah in adolescents. Nicotine Tob. Res 21 (7), 926–932. [PubMed: 29846704]

Farber HJ, Patricia Folan RN, 2017. The tobacco industry targets youth. Am. J. Respir. Crit. Care Med 196 (6), 11. [PubMed: 28530111]

FDA, 2019. Youth Tobacco Use: Results from the National Youth Tobacco Survey Retrieved from. https://www.fda.gov/tobacco-products/youth-and-tobacco/youth-tobacco-use-results-national-youth-tobacco-surveyFDA.

FDA, 2020. Advertising and Promotion. US Food and Drug Administration Retrived from. https://www.fda.gov/tobacco-products/products-guidance-regulations/advertising-and-promotion#:~:text=For%20cigarette%20tobacco%2C%20roll%2Dyour,product%20unless%20each%20advertisement%20bears.

Glasser AM, Collins L, Pearson JL, Abudayyeh H, Niaura RS, Abrams DB, Villanti AC, 2017. Overview of electronic nicotine delivery systems: a systematic review. Am. J. Prev. Med 52 (2), e33–e66. [PubMed: 27914771]

Golden SD, Kong AY, Lee JG, Ribisl KM, 2018. Disparities in cigarette tax exposure by race, ethnicity, poverty status and sexual orientation, 2006–2014, USA. Prev. Med 108, 137–144. [PubMed: 29289642]

Grana RA, Ling PM, 2014. "Smoking revolution": a content analysis of electronic cigarette retail websites. Am. J. Prev. Med 46 (4), 395–403. [PubMed: 24650842]

Hastings G, Angus K, 2008. Forever Cool: The Influence of Smoking Imagery on Young People. British Medical Association

Huang J, Kornfield R, Szczypka G, Emery SL, 2014. A cross-sectional examination of marketing of electronic cigarettes on twitter. Tob. Control 23 (Suppl. 3), iii26–iii30. [PubMed: 24935894]

Huang J, Kornfield R, Emery SL, 2016. 100 million views of electronic cigarette YouTube videos and counting: quantification, content evaluation, and engagement levels of videos. J. Med. Internet Res 18 (3), e67. [PubMed: 26993213]

Jenco M, 2019. Study: Teens more likely to vape after seeing store ads Retrieved from. https://www.aappublications.org/news/2019/08/26/ecigarettemarketing082619.

King JL, Reboussin BA, Spangler J, Ross JC, Sutfin EL, 2018. Tobacco product use and mental health status among young adults. Addict. Behav 77, 67–72. [PubMed: 28965069]

Kirkpatrick MG, Cruz TB, Goldenson NI, Allem J-P, Chu K-H, Pentz MA, Unger JB, 2017. Electronic cigarette retailers use Pokémon go to market products. Tob. Control 26 (e2), e145–e147. [PubMed: 28044010]

Klausner K, 2011. Menthol cigarettes and smoking initiation: a tobacco industry perspective. Tob. Control 20 (Suppl. 2), ii12–ii19. [PubMed: 21504927]

Landrine H, Klonoff EA, Fernandez S, Hickman N, Kashima K, Parekh B, Jensen JA, 2005. Cigarette advertising in black, Latino, and White magazines, 1998–2002: an exploratory investigation. Ethn. Dis 15 (1), 63–67. [PubMed: 15720050]

Lee WB, 2017. E-cigarette marketing targeted to youth in South Korea. Tob. Control 26 (e2), e140–e144. [PubMed: 28062581]

Lenhart A, Duggan M, Perrin A, Stepler R, Rainie H, Parker K, 2015. Teens, Social Media & Technology Overview 2015: Pew Research Center [Internet & American Life Project].

Loukas A, Paddock EM, Li X, Harrell MB, Pasch KE, Perry CL, 2019. Electronic nicotine delivery systems marketing and initiation among youth and Young adults. Pediatrics 144 (3), e20183601. [PubMed: 31451608]

Mackey TK, Miner A, Cuomo RE, 2015. Exploring the e-cigarette e-commerce marketplace: identifying internet e-cigarette marketing characteristics and regulatory gaps. Drug Alcohol Depend 156, 97–103. [PubMed: 26431794]

MacKinnon DP, Krull JL, Lockwood CM, 2000. Equivalence of the mediation, confounding and suppression effect. Prev. Sci 1 (4), 173–181. [PubMed: 11523746]

Makadia LD, Roper PJ, Andrews JO, Tingen MS, 2017. Tobacco use and smoke exposure in children: new trends, harm, and strategies to improve health outcomes. Curr Allergy Asthma Rep 17 (8), 55. [PubMed: 28741144]

Mantey DS, Cooper MR, Clendennen SL, Pasch KE, Perry CL, 2016. E-cigarette marketing exposure is associated with e-cigarette use among US youth. J. Adolesc. Health 58 (6), 686–690. [PubMed: 27080732]

Margolis KA, Donaldson EA, Portnoy DB, Robinson J, Neff LJ, Jamal A, 2018. E-cigarette openness, curiosity, harm perceptions and advertising exposure among US middle and high school students. Prev. Med 112, 119–125. [PubMed: 29673886]

Meyers ML, 2019. New Facebook/Instagram Policy on Tobacco Marketing Turns Blind Eye to Biggest Problem: Influencer Marketing Retrieved from. https://www.tobaccofreekids.org/press-releases/2019_07_25_facebook.

Moran MB, Heley K, Baldwin K, Xiao C, Lin V, Pierce JP, 2019. Selling tobacco: a comprehensive analysis of the US tobacco advertising landscape. Addict. Behav 96, 100–109. [PubMed: 31071602]

Nicksic NE, Snell LM, Barnes AJ, 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. J. Appl. Res. Child 8 (2), 3.

Padon AA, Maloney EK, Cappella JN, 2017. Youth-targeted e-cigarette marketing in the US. Tob. Regul. Sci 3 (1), 95–101. [PubMed: 28083545]

Patthi B, Singla A, Gupta R, Dhama K, Muchhal M, 2018. Glorified marketing influence among adolescents results in experimentation of tobacco use-systematic review. J Indian Association Public Health Dentistry 16 (3), 188.

Pepper JK, Emery SL, Ribisl KM, Rini CM, Brewer NT, 2015. How risky is it to use e-cigarettes? Smokers' beliefs about their health risks from using novel and traditional tobacco products. J. Behav. Med 38 (2), 318–326. [PubMed: 25348584]

Pepper JK, Squiers LB, Peinado SC, Bann CM, Dolina SD, Lynch MM, McCormack LA, 2019. Impact of messages about scientific uncertainty on risk perceptions and intentions to use electronic vaping products. Addict. Behav 91, 136–140. 10.1016/j.addbeh.2018.10.025. [PubMed: 30389200]

Pierce JP, Lee L, Gilpin EA, 1994. Smoking initiation by adolescent girls, 1944 through 1988: an association with targeted advertising. Jama 271 (8), 608–611. [PubMed: 8301793]

Pierce JP, Sargent JD, White MM, Borek N, Portnoy DB, Green VR, Strong DR, 2017. Receptivity to tobacco advertising and susceptibility to tobacco products. Pediatrics 139 (6).

Pokhrel P, Fagan P, Kehl L, Herzog TA, 2015. Receptivity to e-cigarette marketing, harm perceptions, and e-cigarette use. Am. J. Health Behav 39 (1), 121–131. [PubMed: 25290604]

Prochaska JJ, Das S, Young-Wolff KC, 2017. Smoking, mental illness, and public health. Annu. Rev. Public Health 38, 165–185. [PubMed: 27992725]

Riehm KE, Feder KA, Tormohlen KN, Crum RM, Young AS, Green KM, Mojtabai R, 2019. Associations between time spent using social media and internalizing and externalizing problems among US youth. JAMA Psychiatry 76 (12), 1266–1273. 10.1001/jamapsychiatry.2019.2325. [PubMed: 31509167]

Schisterman EF, Cole SR, Platt RW, 2009. Overadjustment bias and unnecessary adjustment in epidemiologic studies. Epidemiology 20 (4), 488. [PubMed: 19525685]

Singh T, Marynak K, Arrazola RA, Cox S, Rolle IV, King BA, 2016. Vital signs: exposure to electronic cigarette advertising among middle school and high school students—United States, 2014. Morb. Mortal. Wkly Rep 64 (52), 1403–1408.

Soneji S, Knutzen KE, Moran MB, 2019. Reasons for engagement with online tobacco marketing among US adolescents and young adults. Tob. Induc. Dis 17.

Sterling KL, Fryer CS, Pagano I, Fagan P, 2016. Little cigars and cigarillos use among young adult cigarette smokers in the United States: understanding risk of concomitant use subtypes. Nicotine Tob. Res 18 (12), 2234–2242. [PubMed: 27613889]

Thrasher JF, Swayampakala K, Cummings KM, Hammond D, Anshari D, Krugman DM, Hardin JW, 2016. Cigarette package inserts can promote efficacy beliefs and sustained smoking cessation attempts: a longitudinal assessment of an innovative policy in Canada. Prev. Med 88, 59–65. [PubMed: 26970037]

Tucker-Seeley RD, Bezold CP, James P, Miller M, Wallington SF, 2016. Retail pharmacy policy to end the sale of tobacco products: what is the impact on disparity in neighborhood density of tobacco outlets? Cancer Epidemiol. Prevent. Biomarkers 25 (9), 1305–1310.

USDHHS, 2012. Preventing Tobacco Use among Youth and Young Adults: A Report of the Surgeon General: Atlanta, GA: US Department of Health and Human Services, Centers for Disease.

USDHHS, 2016. E-Cigarette Use among Youth and Young Adults A report of the Surgeon General. Atlanta, GA.

USDHHS, 2018. Population Assessment of Tobacco and Health (PATH) Study [United States] Public-Use Files.

Vogel EA, Ramo DE, Rubinstein ML, Delucchi KL, Darrow S, Costello C, Prochaska JJ, 2020. Effects of social media on adolescents' willingness and intention to use e-cigarettes: an experimental investigation. Nicotine Tob. Res 23 (4), 694–701.

Table 1

Characteristics among youth (12–17 years old) by P30D tobacco ads exposure (Yes/No) (PATH Wave 4, 2016–2018, N = 12,016).

| | Overall (N = 12,016) | Has noticed any tobacco products being advertised within P30D[*] | | | |
	N (weighted %)	No (ref) (*N* = 3754)	Yes (*N* =8262)	OR, 95% CI	AOR, 95% CI
Gender					
Female	6225 (51.0)	2069 (54.0)	4156 (49.6)	Ref (1.0)	Ref (1.0)
Male	5791 (49.0)	1685 (46.0)	4106 (50.4)	**1.19 (1.09, 1.30)**	1.07 (0.98, 1.17)
Age range					
12–14 years old	5924 (49.4)	1939 (51.6)	3985 (48.4)	Ref (1.0)	Ref (1.0)
15–17 years old	6092 (50.6)	1815 (48.4)	4277 (51.6)	**1.14 (1.05, 1.23)**	1.03 (0.94, 1.12)
Race					
White	8162(69.9)	2486 (67.5)	5676 (70.9)	Ref (1.0)	Ref (1.0)
Black	1926 (15.2)	654 (16.3)	1272 (14.8)	**0.86 (0.76, 0.97)**	1.00 (0.87, 1.15)
Others	1928 (14.9)	614 (16.2)	1314 (14.3)	**0.84 (0.73, 0.96)**	0.90 (0.79, 1.03)
Ethnicity					
Not Hispanic	8880 (80.0)	2646 (77.4)	6234 (81.1)	Ref (1.0)	Ref (1.0)
Hispanic	3136 (20.0)	1108 (22.6)	2028 (18.9)	**0.80 (0.69, 0.93)**	0.95 (0.83, 1.08)
Household annual income ($)					
<25,000	2791 (20.4)	1053 (24.2)	1738 (18.7)	Ref (1.0)	Ref (1.0)
25,000 – 50,000	2750 (21.4)	883 (22.5)	1867 (20.9)	**1.20 (1.04, 1.38)**	**1.16 (1.01, 1.33)**
>50,000	6475 (58.2)	1818 (53.3)	4657 (60.4)	**1.46 (1.30, 1.64)**	**1.41 (1.26, 1.57)**
Lives with a smoker[1]					
No	8045 (67.6)	2767 (74.3)	5278 (64.6)	Ref (1.0)	Ref (1.0)
Yes	3971 (32.4)	987 (25.7)	2984 (35.4)	**1.58 (1.43, 1.75)**	**1.54 (1.39, 1.71)**
Tobacco use[2]					
Never	9544 (79.7)	3073 (82.1)	6471 (78.6)	Ref (1.0)	Ref (1.0)
Ever (tried)	1603 (13.0)	433 (11.2)	1170 (13.8)	**1.29 (1.11,1.50)**	0.90 (0.77, 1.05)
Current (used within P30D)	869 (7.3)	248 (6.8)	621 (7.6)	**1.17 (1.01, 1.36)**	**0.68 (0.58, 0.80)**
Ever used substances[3]					
Never	7758 (64.0)	2840 (75.3)	4918 (58.9)	Ref (1.0)	Ref (1.0)
1	3063 (26.1)	668 (18) 2395	(29.7)	**2.11 (1.88, 2.37)**	**1.82 (1.82, 2.04)**
2+	1195 (10.0)	246 (6.7)	949 (11.4)	**2.20 (1.88, 2.57)**	**1.84 (1.54, 2.21)**
Internalizing disorder within P12M					
No / Low	5804 (48.1)	2220 (58.5)	3584 (43.4)	Ref (1.0)	Ref (1.0)
Moderate	3355 (28.3)	876 (24.1)	2479 (30.2)	**1.68 (1.54, 1.85)**	**1.28 (1.15, 1.42)**
Severe	2857 (23.6)	658 (17.4)	2199 (26.4)	**2.04 (1.82, 2.29)**	**1.25 (1.08, 1.45)**
Externalizing disorder within P12M					
No / Low	4727 (38.6)	1944 (50.3)	3783 (33.3)	Ref (1.0)	Ref (1.0)
Moderate	3474 (29.6)	976 (27.3)	2498 (30.6)	**1.70 (1.51, 1.90)**	**1.39 (1.23, 1.57)**
Severe	3815 (31.8)	834 (22.4)	2981 (36.0)	**2.44 (2.19, 2.71)**	**1.77 (1.56, 2.01)**

ENDS: Electronic nicotine delivery system (products); P30D: Past 30-day, P12M: Past 12-month AOR: Adjusted odds ratio, CI: Confidence interval

Bold indicates statistically significant.

*
Noticed ENDS or cigarettes being advertised at following locations: 1) at gas stations, convenience stores or other retail stores; 2) on billboards; 3) in newspapers or magazines; 4) on radio; 5) on television 6) at events such as fairs, festivals, or sporting events 7) at nightclubs, bars, or music concerts; 8) on websites or social media sites; 9) somewhere else;

1
Long description of question: Does anyone who lives with you now do any of the following: Smoke cigarettes, use smokeless tobacco, smoke cigars, cigarillos or filtered cigars or use any other form of tobacco?

2
Tobacco products include: Cigarettes, ENDS, traditional cigars, cigarillos, filtered cigars, pipes, hookah, smokeless tobacco (i.e., loose snus, moist snuff, dip, spit, or chewing tobacco), snus pouches, dissolvable tobacco, bidis, and kreteks.

3
Substances include: marijuana (including blunts), alcohol and other illicit drugs (including prescription drugs (i.e., Ritalin, Adderall, painkillers, sedatives, and tranquilizers), cocaine, crack, stimulants (i.e., methamphetamine or speed), heroin, inhalants, solvents, and hallucinogens.

Table 2

Associations between tobacco ads exposure (by tobacco product) and tobacco use susceptibilities among never tobacco users (PATH wave 4, 2016–2018, N = 9544).

	Tobacco use susceptibilities (ref: No)	Have you ever been curious about using a [tobacco product]* (ref: Not at all curious)	Would you smoke a [tobacco product]* if one of your best friends offered you one (ref: Definitely not)	Do you think that you will try a [tobacco product]* soon (ref: Definitely not)	Do you think you will smoke a [tobacco product]* in the next year (ref: Definitely not)
	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI
Have noticed tobacco product being advertised in P30D[1]					
Haven't seen any advertisement (ref)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Seen **ENDS ads only** (or other electronic nicotine products)	**1.43 (1.18, 1.74)**	**1.48 (1.21, 1.82)**	**1.27 (1.00, 1.61)**	**1.31 (1.04, 1.65)**	**1.40 (1.10, 1.78)**
Seen **cigarettes/other non-ENDS tobacco product ads only**	**1.64 (1.31, 2.05)**	**1.66 (1.30, 2.11)**	**1.52 (1.16, 1.99)**	**1.51 (1.15, 1.99)**	**1.49 (1.14, 1.96)**
Have seen ENDS **AND** cigarette/other non-ENDS tobacco product ads	**1.61 (1.45, 1.80)**	**1.73 (1.53, 1.94)**	**1.47 (1.29, 1.68)**	**1.44 (1.25, 1.67)**	**1.38 (1.19, 1.61)**
Gender					
Female	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Male	**0.89 (0.81, 0.98)**	**0.87 (0.78, 0.97)**	1.01 (0.90, 1.13)	**0.87 (0.78, 0.98)**	0.89 (0.78, 1.00)
Age range					
12–14 year	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
15–17 year	**1.45 (1.32, 1.59)**	**1.4 (1.26, 1.56)**	**1.51 (1.35, 1.69)**	**1.55 (1.37, 1.75)**	**1.83 (1.61, 2.07)**
Race					
White	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Black	**1.32 (1.15, 1.52)**	**1.16 (1.00, 1.34)**	**1.39 (1.19, 1.63)**	**1.37 (1.17, 1.61)**	**1.42 (1.24, 1.63)**
Others	**1.34 (1.14, 1.58)**	**1.28 (1.08, 1.53)**	1.16 (0.97, 1.37)	1.09 (0.89, 1.33)	1.08 (0.91, 1.29)
Ethnicity					
Not Hispanic	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Hispanic	**1.25 (1.10, 1.42)**	1.11 (0.98, 1.26)	**1.22 (1.06, 1.41)**	**1.5 (1.31, 1.73)**	**1.37 (1.19, 1.58)**
Household annual income ($)					
<25,000	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
25,000 – 50,000 0	93 (0.79, 1.09)	1.05 (0.90, 1.21)	0.93 (0.78, 1.10)	0.94 (0.78, 1.13)	0.90 (0.75, 1.09)

	Tobacco use susceptibilities (ref: No)	Have you ever been curious about using a [tobacco product]* (ref: Not at all curious)	Would you smoke a [tobacco product]* if one of your best friends offered you one (ref: Definitely not)	Do you think that you will try a [tobacco product]* soon (ref: Definitely not)	Do you think you will smoke a [tobacco product]* in the next year (ref: Definitely not)
	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI
>50,000	0.97 (0.84, 1.12)	1.12 (0.98, 1.29)	0.99 (0.84, 1.16)	**0.79 (0.67, 0.93)**	0.88 (0.75, 1.03)
Ever used substances[2]					
0	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
1	**2.76 (2.46, 3.10)**	**2.75 (2.42, 3.12)**	**2.60 (2.32, 2.92)**	**2.33 (2.03, 2.68)**	**2.44 (2.12, 2.82)**
2+	**3.75 (2.87, 4.91)**	**3.70 (2.89, 4.73)**	**4.21 (3.24, 5.46)**	**4.18 (3.25, 5.38)**	**4.08 (3.21, 5.19)**
Lives with a smoker					
No	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Yes	**1.35 (1.21, 1.52)**	**1.3 (1.16, 1.45)**	**1.25 (1.09, 1.42)**	**1.33 (1.15, 1.53)**	**1.40 (1.20, 1.62)**
Internalizing disorder within P12M					
No / Low	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Moderate	**1.34 (1.20, 1.50)**	**1.40 (1.24, 1.59)**	**1.30 (1.13, 1.49)**	**1.25 (1.07, 1.46)**	**1.31 (1.12, 1.53)**
Severe	**1.44 (1.24, 1.66)**	**1.55 (1.33, 1.81)**	**1.29 (1.10, 1.52)**	**1.37 (1.15, 1.64)**	**1.48 (1.25, 1.75)**
Externalizing disorder within P12M					
No / Low	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Moderate	**1.67 (1.48, 1.89)**	**1.65 (1.45, 1.89)**	**1.68 (1.42, 1.98)**	**1.42 (1.20, 1.68)**	**1.40 (1.18, 1.65)**
Severe	**2.59 (2.28, 2.94)**	**2.55 (2.19, 2.96)**	**2.42 (2.03, 2.87)**	**1.9 (1.57, 2.3)**	**2.00 (1.71, 2.34)**

Bold indicates statistically significant.

ENDS: Electronic nicotine delivery system (products); P30D: Past 30-day, P12M: Past 12-month AOR: Adjusted odds ratio, CI: Confidence interval.

*
Tobacco products assessed in tobacco use susceptibilities include: Cigarette, ENDS, filtered cigar, hookah, snus pouches, and smokeless tobacco.

[1]
Assessed locations include: 1) at gas stations, convenience stores or other retail stores; 2) on billboards; 3) in newspapers or magazines; 4) on radio; 5) on television 6) at events such as fairs, festivals, or sporting events; 7) at nightclubs, bars, or music concerts; 8) on websites or social media sites; 9) somewhere else.

[2]
Substances include: Marijuana (including blunts), alcohol and other illicit drugs for non-medical use (including prescription drugs (i.e., Ritalin, Adderall, painkillers, sedatives, and tranquilizers), cocaine, crack, stimulants (i.e., methamphetamine or speed), heroin, inhalants, solvents, and hallucinogens.

Table 3

Associations between tobacco ads exposure (by exposure venue: Online and/or social media sites/traditional venues) and tobacco use susceptibilities never tobacco users (PATH wave 4, 2016–2018, N = 9544).

	Tobacco use susceptibilities (ref: No)		Have you ever been curious about using a [tobacco product]* (ref: Not at all curious)		Would you smoke a [tobacco product]* if one of your best friends offered you one (ref: Definitely not)		Do you think that you will try a [tobacco product]* soon (ref: Definitely not)		Do you think you will smoke a [tobacco product]* in the next year (ref: Definitely not)	
	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI
Have noticed ENDS (or other electronic nicotine products) being advertised in P30D										
Haven't seen any advertisements	Ref (1.0)		Ref (1.0)		Ref (1.0)		Ref (1.0)		Ref (1.0)	
Only on social media sites (or websites)	1.87 (1.25, 2.81)		2.18 (1.44, 3.31)		1.52 (0.96, 2.4)		1.31 (0.73, 2.35)		1.27 (0.74, 2.17)	
Only on traditional locations [1]	1.27 (1.13, 1.42)		1.34 (1.19, 1.51)		1.13 (0.99, 1.3)		1.09 (0.95, 1.27)		1.09 (0.94, 1.27)	
On **both** social media and traditional locations [1]	1.97 (1.75, 2.22)		2.03 (1.79, 2.31)		1.82 (1.59, 2.09)		1.83 (1.58, 2.11)		1.72 (1.49, 1.99)	
Have noticed cigarette/non-ENDS tobacco product being advertised in P30D										
Haven't seen any advertisements		Ref (1.0)		Ref (1.0)		Ref (1.0)		Ref (1.0)		Ref (1.0)
Only on social media sites (or websites)		2.25 (1.43, 3.55)		2.44 (1.61, 3.69)		2.10 (1.20, 3.66)		2.48 (1.40, 4.39)		1.88 (1.05, 3.39)
Only on traditional locations [1]		1.37 (1.24, 1.52)		1.46 (1.31, 1.62)		1.26 (1.12, 1.41)		1.23 (1.07, 1.41)		1.20 (1.05, 1.37)
On **both** social media and traditional locations [1]		1.84 (1.60, 2.11)		1.87 (1.62, 2.16)		1.76 (1.50, 2.07)		1.66 (1.40, 1.98)		1.48 (1.23, 1.79)
Gender										
Female	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Male	0.88 (0.81, 0.97)	0.89 (0.81, 0.98)	0.87 (0.78, 0.96)	0.87 (0.79, 0.97)	1.00 (0.89, 1.12)	1.01 (0.90, 1.13)	0.86 (0.77, 0.96)	0.87 (0.78, 0.98)	0.88 (0.78, 0.99)	0.89 (0.79, 1.00)
Age range										

	Tobacco use susceptibilities (ref: No)		Have you ever been curious about using a [tobacco product]* (ref: Not at all curious)		Would you smoke a [tobacco product]* if one of your best friends offered you one (ref: Definitely not)		Do you think that you will try a [tobacco product]* soon (ref: Definitely not)		Do you think you will smoke a [tobacco product]* in the next year (ref: Definitely not)	
	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI
12–14 year	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
15–17 year	1.43 (1.30, 1.58)	1.43 (1.31, 1.57)	1.39 (1.25, 1.55)	1.39 (1.25, 1.55)	1.50 (1.34, 1.69)	1.51 (1.35, 1.69)	1.54 (1.36, 1.75)	1.54 (1.36, 1.74)	1.82 (1.60, 2.06)	1.82 (1.60, 2.06)
Race										
White	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Black	1.33 (1.15, 1.53)	1.33 (1.16, 1.53)	1.17 (1.01, 1.35)	1.17 (1.01, 1.35)	1.41 (1.20, 1.65)	1.41 (1.20, 1.65)	1.39 (1.18, 1.64)	1.38 (1.17, 1.63)	1.44 (1.25, 1.65)	1.43 (1.25, 1.64)
Others	1.33 (1.13, 1.57)	1.34 (1.14, 1.57)	1.27 (1.07, 1.51)	1.28 (1.08, 1.52)	1.15 (0.97, 1.37)	1.16 (0.97, 1.37)	1.08 (0.89, 1.32)	1.09 (0.89, 1.32)	1.08 (0.91, 1.28)	1.08 (0.91, 1.28)
Ethnicity										
Not Hispanic	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Hispanic	1.24 (1.09, 1.42)	1.25 (1.10, 1.42)	1.11 (0.98, 1.25)	1.11 (0.98, 1.25)	1.22 (1.05, 1.41)	1.22 (1.06, 1.41)	1.50 (1.30, 1.73)	1.50 (1.30, 1.73)	1.37 (1.19, 1.58)	1.37 (1.19, 1.58)
Household annual income ($)										
<25,000	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
25,000 – 50,000	0.94 (0.80, 1.1)	0.93 (0.80, 1.1)	1.06 (0.91, 1.23)	1.05 (0.91, 1.23)	0.94 (0.78, 1.12)	0.94 (0.78, 1.12)	0.95 (0.79, 1.14)	0.95 (0.79, 1.14)	0.91 (0.76, 1.1)	0.91 (0.75, 1.09)
>50,000	0.99 (0.85, 1.14)	0.98 (0.85, 1.13)	1.14 (1, 1.31)	1.14 (0.99, 1.3)	1.01 (0.86, 1.19)	1.01 (0.85, 1.18)	0.80 (0.68, 0.95)	0.8 (0.68, 0.94)	0.9 (0.76, 1.05)	0.89 (0.76, 1.04)
Ever used substance[2]										
0	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
1	2.74 (2.44, 3.08)	2.78 (2.48, 3.12)	2.73 (2.4, 3.1)	2.77 (2.44, 3.15)	2.57 (2.29, 2.89)	2.61 (2.33, 2.93)	2.30 (2.00, 2.64)	2.34 (2.04, 2.70)	2.41 (2.09, 2.78)	2.46 (2.14, 2.83)
2+	3.73 (2.84, 4.9)	3.75 (2.86, 4.92)	3.68 (2.86, 4.73)	3.70 (2.88, 4.74)	4.15 (3.21, 5.38)	4.20 (3.23, 5.45)	4.10 (3.20, 5.27)	4.19 (3.25, 5.4)	4.01 (3.15, 5.11)	4.09 (3.21, 5.21)
Lives with a smoker										
No	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Yes	1.36 (1.21, 1.52)	1.35 (1.20, 1.51)	1.30 (1.16, 1.46)	1.29 (1.15, 1.45)	1.25 (1.09, 1.43)	1.24 (1.08, 1.42)	1.33 (1.15, 1.53)	1.32 (1.14, 1.52)	1.39 (1.20, 1.63)	1.39 (1.20, 1.63)
Internalizing disorder within P12M										

	Tobacco use susceptibilities (ref: No)		Have you ever been curious about using a [tobacco product]* (ref: Not at all curious)		Would you smoke a [tobacco product]* if one of your best friends offered you one (ref: Definitely not)		Do you think that you will try a [tobacco product]* soon (ref: Definitely not)		Do you think you will smoke a [tobacco product]* in the next year (ref: Definitely not)	
	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI	AOR, 95% CI
No / Low	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Moderate	**1.33 (1.19, 1.48)**	**1.34 (1.20, 1.49)**	**1.39 (1.23, 1.58)**	**1.40 (1.24, 1.59)**	**1.28 (1.11, 1.48)**	**1.29 (1.12, 1.48)**	**1.24 (1.06, 1.45)**	**1.25 (1.07, 1.46)**	**1.30 (1.11, 1.52)**	**1.31 (1.12, 1.53)**
Severe	**1.39 (1.21, 1.61)**	**1.42 (1.23, 1.64)**	**1.51 (1.29, 1.75)**	**1.54 (1.32, 1.79)**	**1.25 (1.06, 1.47)**	**1.27 (1.08, 1.49)**	**1.33 (1.11, 1.59)**	**1.36 (1.13, 1.62)**	**1.43 (1.21, 1.70)**	**1.47 (1.24, 1.74)**
Externalizing disorder within P12M										
No / Low	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)	Ref (1.0)
Moderate	**1.67 (1.48, 1.89)**	**1.66 (1.47, 1.88)**	**1.66 (1.45, 1.89)**	**1.65 (1.44, 1.89)**	**1.68 (1.42, 1.98)**	**1.67 (1.42, 1.97)**	**1.41 (1.19, 1.68)**	**1.41 (1.19, 1.67)**	**1.39 (1.18, 1.64)**	**1.39 (1.18, 1.64)**
Severe	**2.59 (2.28, 2.94)**	**2.57 (2.26, 2.92)**	**2.55 (2.2, 2.96)**	**2.54 (2.18, 2.95)**	**2.41 (2.02, 2.87)**	**2.39 (2.01, 2.84)**	**1.88 (1.55, 2.29)**	**1.88 (1.55, 2.28)**	**1.98 (1.69, 2.32)**	**1.99 (1.70, 2.33)**

Bold indicates statistically significant

ENDS: Electronic nicotine delivery system (products); P30D: Past 30-day, P12M: Past 12-month AOR: Adjusted odds ratio, CI: Confidence interval.

*
Tobacco products assessed in tobacco use susceptibilities include: Cigarette, ENDS, filtered cigar, hookah, snus pouches, and smokeless tobacco.

[1]
Traditional exposures include: 1) at gas stations, convenience stores or other retail stores; 2) on billboards; 3) in newspapers or magazines; 4) on radio; 5) on television 6) at events such as fairs, festivals, or sporting events; 7) at nightclubs, bars, or music concerts; 8) somewhere else.

[2]
Substances includes: Marijuana (including blunts), alcohol and other illicit drugs (including prescription drugs (i.e., Ritalin, Adderall, painkillers, sedatives, and tranquilizers), cocaine, crack, stimulants (i.e., methamphetamine or speed), heroin, inhalants, solvents, and hallucinogens.