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## Convenience Store Access and E-cigarette Advertising Exposure Is Associated With Future E-cigarette Initiation Among Tobacco-Naïve Youth in the PATH Study (2013–2016)

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### Abstract

**Purpose:** The association between e-cigarette marketing exposure and youth e-cigarette initiation is not well understood. This study examines whether convenience store access, exposure to retail e-cigarette marketing, and having a favorite e-cigarette ad before e-cigarette use is associated with susceptibility to use and future e-cigarette initiation in a national longitudinal study of youth.

**Methods:** A nationally representative longitudinal cohort of youth in the Population Assessment of Tobacco and Health study (12–17 years) was followed up over three waves of annual data collection (2013–2016). Tobacco-naïve (wave 1) and e-cigarette-naïve (wave 2) youth (n = 6,470) were included. Marketing exposure at wave 2 was examined in association with e-cigarette susceptibility (wave 2) and e-cigarette initiation (wave 3) using adjusted logistic regression models. Analysis occurred in 2019.

**Results:** Youth visiting convenience stores at least weekly (vs. never) had 1.51 times the odds of e-cigarette susceptibility (95% confidence interval [CI]: 1.25, 1.81) and 1.79 times the odds of e-cigarette initiation (95% CI: 1.29, 2.48). Noticing a retail e-cigarette ad (vs. not noticing) was associated with e-cigarette susceptibility (adjusted odds ratio [AOR] 1.36, 95% CI: 1.18, 1.57), but not initiation. Youth reporting a favorite branded e-cigarette ad had greater odds of both susceptibility (AOR 1.31, 95% CI, 1.10, 1.56) and e-cigarette initiation (AOR 1.60, 95% CI: 1.18, 2.17) compared to youth without a favorite ad.

**Conclusions:** Tobacco-naïve youth with frequent convenience store access and exposure to e-cigarette marketing were at greater risk of e-cigarette susceptibility and progression to e-cigarette initiation over a 2-year period. Policies to restrict retailer locations and e-cigarette marketing could enhance youth e-cigarette use prevention efforts.

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## Keywords

E-cigarettes; Youth e-cigarette initiation; E-cigarette marketing; Point-of-sale tobacco marketing

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Youth e-cigarette use has increased dramatically, and more youth now currently use e-cigarettes than cigarettes [1]. Between 2011 and 2018, current e-cigarette use among youth rose from 1.5% to 20.8% [2]. Retail e-cigarette sales [3,4] and marketing expenditures have also increased, with e-cigarette marketing expenditures increasing from \$12 million in 2011 [5] to \$110 million in 2018 [6]. These trends coincide with increased domination of the e-cigarette market by major tobacco companies. By 2013, R.J. Reynolds and Philip Morris had acquired or created e-cigarette brands (e.g., Vuse) [1]. Along with these acquisitions came the expansion of e-cigarettes into convenience stores and pharmacies [7–9], increased e-cigarette retail marketing [7], and flavored e-cigarette products [7,10] which appeal to youth [11]. Further, most e-cigarette products sold in retail outlets in 2015 contained nicotine [12], which is highly addictive and can harm adolescent brain development [13]. Despite potential harms to youth, little is currently known about the influence of retail e-cigarette marketing on youth e-cigarette initiation.

Between 2014 and 2016, the proportion of youth exposed to retail e-cigarette advertising increased from 54.8% to 68% [14]. Tobacco marketing has been found to be more common in stores where youth shop frequently [15], and in a longitudinal study, youth visiting convenience, liquor, or small grocery stores at least twice per week had over 2.5 times the odds of cigarette initiation compared to those visiting stores less than twice per month [16]. Further, exposure to point-of-sale tobacco marketing has been associated with youth tobacco use susceptibility and smoking initiation [16,17]. E-cigarette susceptibility has been associated with e-cigarette initiation among youth in longitudinal studies [18,19]; however, given the recent expansion of the e-cigarette market, few studies have examined longitudinal associations between retail e-cigarette marketing exposure and youth e-cigarette susceptibility and initiation using a nationally representative sample [20].

Studies examining e-cigarette marketing exposure and youth susceptibility or initiation, most have been either cross-sectional [21–23], did not specifically investigate retail marketing [24–26], or were not national studies [27]. A longitudinal study among e-cigarette-naïve youth and young adults in Texas found that exposure to retail e-cigarette marketing was associated with significantly higher odds of future e-cigarette initiation [27]. One previous cross-sectional study using data from the Population Assessment of Tobacco and Health (PATH) found that youth who reported seeing an e-cigarette ad were more likely to be current e-cigarette users or susceptible to using e-cigarettes [21]. However, the measure of e-cigarette ad exposure was not assessed specifically within the retail environment. Another cross-sectional study in New Jersey found that e-cigarette retailer density and marketing near high schools was associated with ever and current e-cigarette use [23]. Studies such as these are important to inform policies to restrict the location of tobacco retailers and the display of tobacco and e-cigarette marketing at retail stores [28]. However, longitudinal, nationally representative studies measuring exposure to retail marketing before

e-cigarette initiation are needed to strengthen the argument for more restrictive tobacco retail policies.

While peer, family/household, and individual level risk factors for e-cigarette susceptibility and initiation among youth have been examined [22,29], factors in the retail environment that might influence e-cigarette are less understood. Given the rapid growth in the retail availability of e-cigarettes and in youth use, it is critical to identify policy-relevant determinants of youth susceptibility to use e-cigarettes and e-cigarette initiation. This study examines whether youth exposure to e-cigarette retail marketing before e-cigarette use is associated with susceptibility to use e-cigarettes and e-cigarette initiation among a longitudinal cohort of youth (12–17 years) followed up over a 2-year period using three waves of data from the PATH study.

## Methods

### Data source and sample

Data were drawn from the PATH study Public-Use Files for waves 1, 2, and 3 [30]. The sample included respondents who completed Youth interviews at wave 1 (2013–2014) and wave 2 (2014–2015) and either Youth or Adult interviews at wave 3 (2015–2016) if they turned 18 between waves 2 and 3. Data were analyzed in 2019. The PATH study is a nationally representative, longitudinal cohort study of noninstitutionalized youth (12–17 years) and adult residents of the United States (U.S.). Information on tobacco use and associated health behaviors were collected with Audio-Computer Assisted Self-Interviews in English and Spanish. Recruitment utilized address-based, area-probability sampling, using a household screener to select participants. Weighting procedures adjusted for oversampling and nonresponse. Additional details regarding the PATH study design and methods are described elsewhere [31]. Westat's Institutional Review Board approved the study design and protocol. The sample was restricted to youth who had not used any tobacco products at wave 1, and who had heard of, but never used e-cigarettes at both waves 1 and 2 because e-cigarette susceptibility was only assessed among youth who had heard of e-cigarettes. The final sample included 6,470 participants with nonmissing data on the analytic variables.

### Measures

E-cigarette susceptibility was measured by three items assessed at waves 1 and 2 for e-cigarette-naïve youth who had heard of, but never used e-cigarettes. Youth were coded as nonsusceptible if they reported either “not at all” or “definitely not” to each of three items: “Have you ever been curious about using an e-cigarette?,” “Do you think you will try e-cigarettes soon?,” and “If one of your best friends were to offer you an e-cigarette, would you use it?” Otherwise youth were coded as susceptible. E-cigarette initiation was measured by a “yes” response to one item assessed at wave 3, “In the past 12 months, have you used an electronic nicotine product, even one or two times?” Other tobacco product use at wave 2 was measured for cigarettes and non-cigarette tobacco products (any use in the past 12 months of cigarillos, traditional cigars, filtered cigars, hookah, smokeless tobacco, snus, dissolvable, bidis and kreteks).

Marketing exposure was measured at wave 2 by (1) convenience store, small market, or liquor store (“convenience store”) visit frequency; (2) noticing a retail e-cigarette ad; and (3) having a favorite e-cigarette ad. Measures 1 and 2 were not assessed in the wave 1 Youth or in the Adult Interview; therefore, all three measures were derived using responses at wave 2. Convenience store visit frequency was assessed by one item “In the past 30 days, how often did you visit a convenience store, small market, or liquor store?” Responses (never, once a month, 2–3 times per month, once a week, 2–3 times per week, almost every day) were collapsed into three levels: never, 1–3 times per month, and weekly or more often, following prior work examining the association between visits to convenience store, small market, or liquor stores and youth smoking initiation [15]. Noticing a retail e-cigarette ad was assessed by one item “In the past 30 days, when you visited convenience stores, small markets, or liquor stores, how often did you see ads for e-cigarettes?” Responses of “sometimes” or “often” were coded as noticing an ad. Youth who did not visit a store or who responded “never” or “rarely” were coded as not noticing an ad, similar to prior work [32]. Having a favorite e-cigarette ad was measured by one item at: “What is the brand of your favorite e-cigarette advertisement?” Youth who reported, “I do not have a favorite e-cigarette advertisement” were coded as not having a favorite ad, otherwise they were coded as having a favorite ad.

To address potential confounding with store visits and/or marketing exposure and outcomes, peer e-cigarette use and household member tobacco use at wave 2 were included as covariates. Such factors have been significantly associated with e-cigarette or cigarette use in similar studies examining marketing exposure on adolescent tobacco use [23]. Peer e-cigarette use was assessed by “How many of your best friends use e-cigarettes?” Responses were dichotomized into “any” (responded “A few”, “Some”, Most” or All”) or “none.” Household member tobacco use was assessed by, “Does anyone who lives with you now do any of the following?” Responses were dichotomized into “any” if a household member used any form of tobacco, or “none” if the response was, “No one who lives with me now uses any form of tobacco.”

Sensation seeking was examined as a proxy for risk-taking propensity, which has been significantly associated with shopping frequency and smoking initiation [16]. A sensation-seeking score was created from three items assessed at wave 1 from the Brief Sensation Seeking Scale: (1) “I like to do frightening things,” (2) “I like new and exciting experiences even if I have to break the rules,” and (3) “I prefer friends who are exciting and unpredictable” following prior work [33]. A mean score (range 0–4) was created by summing the response options for each item (strongly agree = 4 to strongly disagree = 0).

Demographics assessed at wave 1 included parent reported education level (less than high school, high school, some college, bachelor’s degree or more), sex (male, female), and age (12–14, 15–17). Race and ethnicity were combined into a 6-level variable (non-Hispanic white, Hispanic white, non-Hispanic black, Hispanic black, non-Hispanic other race, Hispanic other race). Region of the U.S. where the participant lived was coded as North, Midwest, South, or West. For each recoded variable, “don’t know” and “refused” responses were recoded to missing.

## Statistical analysis

Analyses were conducted using Stata/SE 16.0. The PATH study all-wave replicate weights were used to obtain weighted estimates and confidence intervals of population totals using the SVYSET and SVY commands. Missing, don't know, and refused responses were recoded to missing. Analyses were completed on the analytic sample with complete data for all variables ( $n = 6,470$ ). Chi-square tests or t-tests were performed to find differences in marketing exposure and in peer, family, and individual factors by wave 2 e-cigarette susceptibility status and wave 3 e-cigarette initiation. Multivariable logistic regression analyses examined associations between wave 2 marketing exposure and (1) e-cigarette susceptibility at wave 2 and (2) e-cigarette initiation at wave 3. Eight respondents were missing wave 3 e-cigarette use data leaving a sample of 6,462 for that model. Models were adjusted for wave 1 e-cigarette susceptibility; the e-cigarette initiation model additionally adjusted for wave 2 e-cigarette susceptibility. Covariates included peer and family factors (best friend uses e-cigarettes, household tobacco user) and individual factors (sensation-seeking score, sex, race/ethnicity, parent education, region, wave 2 cigarette and other tobacco product initiation).

## Results

Characteristics of this nationally representative sample of youth who had not used any tobacco products at wave 1 and had not used e-cigarettes at wave 2 are displayed in Table 1. The sample was 49.5% female and 36.9% had a parent with at least a Bachelor's degree. At wave 1, 36.3% of tobacco-naïve youth were e-cigarette susceptible. At wave 2, 33.9% reported visiting a convenience store at least weekly, 38.8% reported noticing a retail ad for e-cigarettes, and 10.7% had a favorite e-cigarette ad. E-cigarette use was initiated at wave 3 by 7.1% of youth.

There were significant differences in marketing exposure variables by e-cigarette susceptibility status at wave 2 in bivariate analyses (Table 2). A significantly greater proportion of e-cigarette susceptible compared with nonsusceptible youth reported visiting convenience stores at least weekly (41.8% vs. 30.4%,  $p < .0001$ ) at wave 2. Similarly, susceptible youth reported noticing a retail e-cigarette ad (49.6% vs. 33.9%,  $p < .0001$ ), and having a favorite branded e-cigarette ad (14.4% vs. 9.0%,  $p < .0001$ ) more frequently than non-susceptible youth. A greater proportion of susceptible youth also had at least one best friend who used e-cigarettes (30.0% vs. 11.1%,  $p < .0001$ ). Rates of cigarette and other tobacco product initiation between waves 1 and 2 were also significantly higher in e-cigarette susceptible youth. Less than 1% of nonsusceptible youth initiated use of cigarettes and other tobacco products by wave 2 compared with 3.0% and 4.8% of susceptible youth, respectively ( $p < .0001$ ). There were no significant differences in e-cigarette susceptibility at wave 2 by race/ethnicity, gender, parent education level, or region of the country.

In bivariate analyses examining youth characteristics by wave 3 e-cigarette initiation status (Table 3), 61.9% of youth who initiated e-cigarette use were susceptible to e-cigarette use at wave 2, while 28.9% of youth who did not initiate use were susceptible at wave 2 ( $p < .0001$ ). A greater proportion of youth who initiated e-cigarette use at wave 3 compared with youth that did not initiate use reported visiting convenience stores at least weekly

(47.6% vs. 33.9%,  $p < .0001$ ) at wave 2. Youth who initiated e-cigarette use at wave 3 reported noticing a retail e-cigarette ad (52.2% vs. 37.8%,  $p < .0001$ ), having a favorite e-cigarette ad (19.2% vs. 10.1%,  $p < .0001$ ), and having a best friend that uses e-cigarettes (38.9% vs. 15.3%,  $p < .0001$ ) more frequently than youth that did not initiate use. E-cigarette initiation status varied by region of the country, with a greater proportion of youth initiating use residing in the Northeast (22.7% vs. 16.6%,  $p = .0007$ ) and a lower proportion of youth initiating use residing in the West (16.6% vs. 24.3%,  $p = .0007$ ) compared with youth that did not initiate use.

Table 4 shows adjusted multivariable logistic regression models examining associations between wave 2 marketing exposure and e-cigarette susceptibility, adjusting for baseline susceptibility, cigarette initiation, other tobacco product initiation, peer, family, and individual factors. All three measures of marketing exposure were significantly associated with greater odds of e-cigarette susceptibility. Visiting a convenience store one to three times per month was associated with 1.35 times the odds of e-cigarette susceptibility compared to not visiting a convenience store at all (95% confidence interval [CI]: 1.13, 1.61). Further, visiting a store at least weekly was associated with 1.51 times the odds of e-cigarette susceptibility compared to not visiting a convenience store at all (95% CI: 1.25, 1.81). Noticing an e-cigarette ad in a store was associated with a 1.36 times the odds of e-cigarette susceptibility (95% CI: 1.18, 1.57) compared with noticing a retail ad. Having a favorite branded e-cigarette ad was associated with 1.31 times the odds of being susceptible (95% CI: 1.10, 1.56) compared not having a favorite ad. Peer and family factors were also associated with e-cigarette susceptibility. Having a best friend who used e-cigarettes versus not having a best friend who used e-cigarettes was associated with over twice the odds of being susceptible to using e-cigarettes (adjusted odds ratio [AOR] 2.69 [2.32–3.12]). Living with a tobacco user was associated with 1.34 times the odds of e-cigarette susceptibility compared with not living with a tobacco use (95% CI: 1.15, 1.56). Individual tobacco use behavior was also associated with e-cigarette susceptibility. Both cigarette (AOR = 6.28, 95% CI: 3.19, 12.38) and other tobacco product initiation (not including e-cigarettes) (AOR = 3.31, 95% CI: 2.25, 4.87) at wave 2 were associated with higher odds of e-cigarette susceptibility compared with not initiating those products (Table 4).

The results of the adjusted logistic regression model examining longitudinal associations between wave 2 marketing exposure and e-cigarette initiation between waves 2 and 3 are shown in Table 4. Visiting a convenience store one to three times per month at wave 2 was associated with 1.48 times the odds of future e-cigarette initiation at wave 3 (95% CI: 1.03, 2.12) compared with not visiting a convenience store. Similarly, visiting a store at least weekly was associated with 1.79 times the odds of future e-cigarette initiation (95% CI: 1.29, 2.48) compared with not visiting a store. Having a favorite e-cigarette branded ad was associated with 1.60 times the odds of future e-cigarette initiation compared with not having a favorite ad (95% CI: 1.18, 2.17). Similar to the e-cigarette susceptibility model, peer and family factors and individual tobacco use were also associated with e-cigarette initiation. Having a best friend who used e-cigarettes was associated with over twice the odds of e-cigarette initiation compared with not having a best friend who used e-cigarettes (AOR 2.19, 95% CI: 1.76, 2.74). Cigarette initiation (AOR = 3.94, 95% CI: 1.95, 7.96) and other tobacco product initiation (not including e-cigarettes) at wave 2 (AOR = 1.9, 95% CI: 1.16,

3.13) were each associated with greater odds of wave 3 e-cigarette initiation, compared with not initiating those products at wave 2.

## Discussion

Among this nationally representative sample of tobacco-naïve youth, retail exposure to e-cigarette ads was associated with e-cigarette susceptibility, while frequent convenience store visits and having a favorite e-cigarette ad was associated with increased odds of both e-cigarette susceptibility and progression to e-cigarette initiation over a 2-year period. Capitalizing on the longitudinal cohort design of the PATH study, this study identified policy-relevant factors in the retail environment that could be targeted to prevent youth e-cigarette use, by addressing a likely link between e-cigarette susceptibility and initiation.

Policies to restrict e-cigarette availability and marketing may be an important addition to the current policy landscape aimed to curb youth initiation. The recent federal legislation passed to raise the minimum age to 21 for tobacco product sales [34] can help reduce and prevent e-cigarette use among youth. However, enforcement of the federal law and existing state Tobacco 21 laws is critical, as early evidence from California found little impact of the state Tobacco 21 law on e-cigarette purchasing [35]. Tobacco 21 policies are not necessarily sufficient and may be strengthened by comprehensive state or local policies to impose taxes on e-cigarettes, enact tobacco retailer licensing laws, and ban the sale of flavored e-cigarette products.

Policies to restrict e-cigarette availability and point-of-sale marketing have the same rationale as those proposed to limit other tobacco products. Licensing laws that restrict the number or location of tobacco retailers can reduce youth exposure to e-cigarettes and marketing in addition to other tobacco products [36], particularly near schools [37]. A nationally representative survey of adolescents found that 48% of youth visited a convenience store at least weekly [38]. In this study of tobacco-naïve youth, 33% of all youth and nearly 42% of e-cigarette susceptible youth reported visiting a convenience store at least weekly.

Youth who visited convenience stores had a greater likelihood of being both susceptible to and initiating e-cigarette use, and the odds of susceptibility and initiation increased as the store visit frequency increased. These associations held, even accounting for cigarette and other tobacco product use initiation, which were strong predictors of e-cigarette initiation in this and other longitudinal studies [39,40]. Given the large number of adolescents who visit convenience stores and that nearly all convenience stores display tobacco marketing [41], licensing laws to restrict tobacco retailer density are likely to reduce youth exposure to e-cigarette marketing. Additionally, recent policies to restrict flavored e-cigarettes in retailers such as convenience stores may have an added benefit of reducing e-cigarette advertising exposure.

Other dimensions of e-cigarette marketing exposure were also associated with e-cigarette susceptibility and future use. Youth having a favorite e-cigarette ad were at risk for both susceptibility and future use of e-cigarettes, while youth noticing an ad in a convenience

store were at risk only for e-cigarette susceptibility but not future use. Store visit frequency and having a favorite ad might be stable behaviors that persist over time to influence future e-cigarette initiation in the following year. However, noticing an ad in a retail store is environment and situation dependent and could have happened at only one point in time. The experience of noticing an ad even once may be sufficient to influence current e-cigarette susceptibility, but may not be sufficient to influence e-cigarette use up to one year later. Another PATH study found that youth e-cigarette ad receptivity was associated with susceptibility and future use, but did not examine exposure to ads in retail stores [26]. A systematic review examining e-cigarette marketing studies found that exposure to e-cigarette marketing was associated with lower e-cigarette harm perceptions and e-cigarette initiation, but cited a lack of longitudinal studies [20]. This study expands upon current research by following youth who were e-cigarette naïve and examining the relationship between retail marketing exposure and future use, building the evidence for policies to restrict e-cigarette marketing at the point of sale.

Retail marketing is one of many marketing types associated with future e-cigarette and other tobacco product use. For example, coupons and digital marketing have been associated with future e-cigarette and other tobacco product use [25]. Given the strong association found between cigarette and other tobacco product initiation and future e-cigarette initiation in this study and others [39,40], strong local and state policies are needed to restrict youth access and exposure to all tobacco products and marketing.

### Strengths and limitations

Strengths of this study include a nationally representative youth sample and a longitudinal study design that follows up youth from 2013 to 2016, an important period that captures responses to a rapidly changing e-cigarette retail environment. This study is limited in that measures for convenience store visit frequency and noticing retail e-cigarette ads were not assessed in wave 1 of the PATH Study, or in the Adult Interview, which excludes youth who were 17 at wave 1. Additionally, because the question combined store types, it was not possible to stratify by the type of store frequented, which may be important for future research on policy implementation. However, analyses were limited to tobacco-naïve youth who remained e-cigarette naïve at wave 2 to strengthen the study design and account for limitations inherent in the items that were asked regarding e-cigarette marketing at each wave.

In conclusion, this nationally representative, longitudinal study has implications for policies to restrict exposure to e-cigarette and tobacco marketing at the point of sale to prevent future uptake of e-cigarettes. Preventing youth from using e-cigarettes could also prevent cigarette initiation and the long-term health impacts and nicotine addiction that may occur from smoking and vaping.

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### IMPLICATIONS AND CONTRIBUTION

Tobacco-naïve youth exposed to retail e-cigarette marketing (vs. not exposed) had greater odds of initiating e-cigarette use within 2 years in this nationally representative, longitudinal study. Policies to restrict exposure to e-cigarette and tobacco marketing at the point of sale could prevent future e-cigarette use, and the long-term health impacts that may occur from vaping.

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**Table 1**

Weighted estimates of characteristics of PATH study youth who were tobacco naïve at wave 1 (2013–2014), and e-cigarette naïve at wave 2 (2014–2015), n = 6,470

	Unweighted N	Weighted % or mean	95% CI
Age at wave 1			
12–14	4,313	66.2	65.5–67.0
15–17	2,157	33.8	33.0–34.6
Sex			
Female	3,204	49.5	48.8–50.2
Male	3,266	50.5	49.8–51.2
Race/ethnicity			
Non-Hispanic white	3,109	54.6	53.8–55.4
Hispanic white	1,359	15.8	15.0–16.6
Non-Hispanic black	937	14.4	13.9–15.0
Hispanic black	103	1.3	1.0–1.6
Non-Hispanic other race	580	9.4	9.0–9.9
Hispanic other race	382	4.5	4.0–5.1
Parent education			
Less than high school	1,290	16.7	15.3–18.1
High school graduate	1,120	16.5	15.3–17.9
Some college	1,952	29.9	28.0–31.8
Bachelor's degree or more	2,108	36.9	34.4–39.4
Region of U.S.			
Northeast	927	17.1	16.6–17.6
Midwest	1,418	21.4	20.8–22.1
South	2,451	37.8	36.9–38.7
West	1,674	23.7	23.0–24.4
E-cigarette susceptibility at wave 1	2,382	36.3	34.9–37.8
E-cigarette initiation at wave 3	439	7.1	6.5–7.9
Cigarette initiation at wave 2	75	1.2	1.0–1.6
Other tobacco product <sup>a</sup> initiation at wave 2	128	2.1	1.7–2.5
Convenience store visits			
None in past 30 days	1,965	30.1	28.7–31.5
1–3 times per month	2,270	36.0	34.7–37.2
1 × week or more often	2,235	33.9	32.6–35.3
Noticed retail e-cigarette ad	2,515	38.8	37.4–40.2
Has favorite e-cigarette ad	704	10.7	10.0–11.5
Best friends use e-cigarettes	1,134	17.0	15.8–18.3
Household member uses tobacco product	1,742	26.0	24.4–27.7
Sensation-seeking score (mean)	6,470	1.43	1.40–1.46

Data are weighted.

CI = confidence interval; NA = not applicable; PATH = Population Assessment of Tobacco and Health.

<sup>a</sup>Other tobacco products included cigars (cigarillos, traditional and filtered), hookah, smokeless, snus, dissolvable, bidis, and kreteks).

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**Table 2**

Characteristics of PATH study youth who were tobacco naïve at wave 1 (2013–2014), and e-cigarette naïve at wave 2 (2014–2015) by wave 2 e-cigarette susceptibility status, n = 6,470

	E-cigarette susceptibility (wave 2)		p value
	Susceptible (n = 2,042)	Not susceptible (n = 4,428)	
	% or mean (95% CI)	% or mean (95% CI)	
Age at wave 1			
12 to 14	61.2 (59.0–63.3)	68.5 (67.5–69.5)	<.0001
15 to 17	38.8 (36.7–41.0)	31.5 (30.5–32.5)	
Sex			
Female	50.1 (47.9–52.2)	49.2 (48.1–50.4)	.60
Male	50.0 (47.8–52.1)	50.8 (50.1–52.0)	
Race/ethnicity			
Non-Hispanic white	52.4 (50.2–54.5)	55.6 (54.1–57.1)	.07
Hispanic white	17.1 (15.9–18.4)	15.2 (14.1–16.4)	
Non-Hispanic black	14.8 (13.3–16.5)	14.2 (13.3–15.1)	
Hispanic black	1.4 (1.0–2.0)	1.6 (.9–1.5)	
Non-Hispanic other race	9.0 (7.6–10.5)	9.6 (8.9–10.4)	
Hispanic other race	5.3 (4.4–6.4)	4.2 (3.7–4.8)	
Parent education			
Less than high school	16.7 (14.6–19.0)	16.7 (15.2–18.3)	.59
High school graduate	16.8 (15.0–18.8)	16.4 (14.9–18.0)	
Some college	30.9 (28.3–33.7)	29.5 (27.5–31.5)	
Bachelor's degree or more	35.6 (32.8–38.4)	37.5 (34.6–40.3)	
Region of U.S.			
Northeast	17.7 (16.2–19.3)	16.8 (16.0–17.7)	.35
Midwest	20.4 (19.2–21.6)	21.9 (20.9–22.8)	
South	37.3 (35.3–39.3)	38.1 (36.8–39.4)	
West	24.6 (23.0–26.3)	23.3 (22.0–24.6)	
Cigarette initiation at wave 2	3.0 (2.3–3.9)	0.4 (.3–.7)	<.0001
Other tobacco product <sup>a</sup> initiation at wave 2	4.8 (3.8–6.0)	0.8 (.6–1.1)	<.0001
Convenience store visits			
None in past 30 days	21.1 (19.1–23.2)	34.2 (32.6–35.8)	<.0001
1–3 times per month	37.1 (34.7–37.3)	35.5 (33.8–37.2)	
1 × week or more often	41.8 (32.6–35.3)	30.4 (29.0–31.8)	
Noticed retail e-cigarette ad	49.6 (47.3–51.8)	33.9 (32.3–35.6)	<.0001
Has favorite e-cigarette ad	14.4 (13.0–15.9)	9.0 (8.2–10.0)	<.0001
Best friends use e-cigarettes	30.0 (27.9–32.2)	11.1 (9.9–12.4)	<.0001
Household member tobacco use	31.8 (30.0–34.1)	23.4 (21.6–25.4)	<.0001
Sensation-seeking score (mean)	1.75 (1.71–1.79)	1.25 (1.25–1.31)	<.0001

Data are weighted.

CI = confidence interval; NA = not applicable; PATH = Population Assessment of Tobacco and Health.

<sup>a</sup>Other tobacco products included cigars (cigarillos, traditional and filtered), hookah, smokeless, snus, dissolvable, bidis and kreteks). *p* values reflect results of chi-square test or t-test.

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**Table 3**

Characteristics of PATH study youth who were tobacco naïve at wave 1 (2013–2014), and e-cigarette naïve at wave 2 (2014–2015) by wave 3 e-cigarette initiation status, n = 6,462

	E-Cigarette initiation (wave 3)		<i>p</i> value
	Initiated use (n = 439)	Did not initiate use (n = 6,023)	
	% or mean (95% CI)	% or mean (95% CI)	
Age at wave 1			
12–14	58.2 (52.8–63.3)	66.8 (66.0–67.7)	<.0019
15–17	41.8 (36.7–47.2)	33.2 (32.3–34.0)	
Sex			
Female	50.0 (44.4–55.5)	49.4 (48.6–50.2)	.86
Male	50.1 (44.4–55.6)	50.6 (49.8–51.4)	
Race/ethnicity			
Non-Hispanic white	61.4 (56.8–65.9)	54.1 (53.2–55.0)	.03
Hispanic white	14.1 (11.7–16.9)	15.9 (15.1–16.8)	
Non-Hispanic black	9.9 (7.3–13.4)	14.7 (14.2–15.3)	
Hispanic black	1.3 (.5–3.1)	1.3 (1.0–1.6)	
Non-Hispanic other race	9.1 (6.8–12.1)	9.4 (9–1.0)	
Hispanic other race	4.2 (2.8–6.4)	4.6 (4.0–5.2)	
Parent education			
Less than high school	15.4 (12.0–19.5)	16.8 (15.4–18.2)	.50
High school graduate	18.2 (14.4–22.7)	16.4 (15.1–17.8)	
Some college	32.1 (27.7–36.8)	29.8 (27.8–31.7)	
Bachelor's degree or more	34.4 (29.3–39.8)	37.0 (34.5–39.7)	
Region of U.S.			
Northeast	22.7 (16.0–17.7)	16.6 (16.2–19.3)	.0007
Midwest	24.0 (20.9–22.8)	21.2 (19.2–21.6)	
South	36.6 (36.8–39.4)	37.9 (35.3–39.3)	
West	16.6 (22.0–24.6)	24.3 (23.0–26.3)	
Cigarette initiation (wave 2)	6.2 (4.4–8.7)	0.9 (.6–1.2)	<.0001
Other tobacco product <sup>a</sup> initiation (wave 2)	7.9 (5.7–10.9)	1.6 (1.3–2.0)	<.0001
E-cigarette susceptible (wave 2)	61.9 (57.3–66.3)	28.9 (27.7–30.1)	<.0001
Convenience store visits			
None in past 30 days	16.5 (12.7–21.1)	31.1 (29.7–32.5)	<.0001
1–3 times per month	35.9 (31.1–41.1)	36.0 (34.7–37.4)	
1 × week or more often	47.6 (42.9–52.3)	33.9 (31.5–34.4)	
Noticed retail e-cigarette ad	52.2 (46.5–57.9)	37.8 (36.3–39.3)	<.0001
Has favorite e-cigarette ad	19.2 (15.8–23.1)	10.1 (9.2–10.9)	<.0001
Best friends use e-cigarettes	38.9 (34.5–43.6)	15.3 (14.2–16.5)	<.0001
Household member tobacco use	37.4 (31.9–43.2)	25.2 (23.6–26.8)	<.0001
Sensation-seeking score (mean)	1.79 (1.69–1.88)	1.40 (1.38–1.43)	<.0001

Data are weighted.

CI = confidence interval; NA = not applicable; PATH = Population Assessment of Tobacco and Health.

<sup>a</sup>Other tobacco products included cigars (cigarillos, traditional and filtered), hookah, smokeless, snus, dissolvable, bidis, and kreteks). *p* values reflect results of chi-square test or t-test.

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Associations between e-cigarette marketing exposure and e-cigarette susceptibility and future e-cigarette initiation among youth in the PATH study who were tobacco naïve at wave 1 (2013–2014), and e-cigarette naïve at wave 2 (2014–2015)

**Table 4**

	E-Cigarette susceptibility wave 2 (n = 6,470)		E-Cigarette initiation wave 3 (n = 6,462)	
	AOR	95% CI	AOR	95% CI
Marketing exposure <sup>a</sup>	-	-	-	-
Convenience store visit frequency (past 30 days)				
Never (ref)				
1–3 times in 30 days	1.35	1.13–1.61	1.48	1.03–2.12
Once per week or more often	1.51	1.25–1.81	1.79	1.29–2.48
Noticed retail e-cigarette ads (ever vs. never, ref)	1.36	1.18–1.57	1.03	.78–1.36
Has a favorite branded e-cigarette ad (yes vs. no, ref)	1.31	1.10–1.56	1.60	1.18–2.17
Peer and family factors <sup>a</sup>				
Best friend(s) use e-cigarettes (any vs. none, ref)	2.69	2.32–3.12	2.19	1.76–2.74
Household tobacco user (any vs. none, ref)	1.34	1.15–1.56	1.34	1.01–1.79
E-cigarette susceptibility and tobacco product use				
E-cigarette susceptible at wave 1 (vs. not susceptible, ref)	2.91	2.59–3.28	1.27	1.00–1.62
E-cigarette susceptible at wave 2 (vs. not susceptible, ref)	NA	NA	2.38	1.88–3.00
Cigarette initiation at wave 2	6.28	3.19–12.38	3.94	1.95–7.96
Other tobacco product <sup>b</sup> initiation at wave 2	3.31	2.25–4.87	1.90	1.16–3.13

Data are weighted.

Models additionally adjusted for sex, age, parent education, race/ethnicity, region, and sensation-seeking score.

AOR = adjusted odds ratio; NA = not applicable to model.

<sup>a</sup>Measured at wave 2.

<sup>b</sup>Other tobacco products include cigars (cigarillos, traditional and filtered), hookah, smokeless, snus, dissolvable, bidis, and kreteks).