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Correlates of tobacco product initiation among youth and adults in the USA: findings from the PATH Study Waves 1–3 (2013–2016)

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Abstract

OBJECTIVE: To report on demographic and tobacco product use correlates of tobacco product initiation (cigarettes, electronic nicotine delivery systems [ENDS], cigars, hookah, and smokeless tobacco) among the U.S. population.

DESIGN: Data were from the first three waves (2013–2016) of the Population Assessment of Tobacco and Health (PATH) Study, a nationally representative, longitudinal cohort study of youth (ages 12–17) and adults (ages 18+) in the U.S. Never users of at least one type of tobacco product at Wave 1 (W1, 2013/14) or Wave 2 (W2, 2014/15) were included (N=12,987 youth; N=25,116 adults). Generalized estimating equations were used to evaluate the association between demographic and tobacco product use characteristics at baseline, and tobacco product initiation at follow-up (ever, past 30-day [P30D], frequent [use on 20 or more of the past 30 days]) over two 1-year periods (W1-W2 and W2-W3).

RESULTS: Youth ages 15–17 were more likely than youth ages 12–14 and adults ages 18–24 were more likely than older adults to initiate P30D tobacco use across products; non-heterosexuals were more likely than heterosexuals to initiate P30D cigarette and ENDS use. Older adults were more likely than young adults, and males were more likely than females, to be frequent users of

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ENDS upon initiation. Ever use of another tobacco product predicted P30D initiation of each tobacco product.

DISCUSSION: Other tobacco product use and age predict P30D tobacco initiation across products whereas associations with other demographic characteristics vary by product. Continued contemporary evaluation of initiation rates within the changing tobacco product marketplace is important.

INTRODUCTION

Reducing tobacco initiation is one of a triad of strategies—along with increasing cessation among current tobacco users and reducing relapse among former tobacco users—that will improve population health.¹ It is well-established that most cigarette smoking initiation occurs by age 18 and nearly all adult cigarette smokers (99%) smoke their first cigarette by age 26.² In 2013–2016, past 30-day (P30D) initiation rates were highest among young adults (ages 18–24) followed by youth (ages 12–17) for cigarettes, hookah, and cigars, and were similar between youth and young adults for electronic nicotine delivery systems (ENDS).³ Understanding correlates of ever, P30D, and frequent use initiation across tobacco products can help in targeting prevention efforts and can enable researchers to make better population-level predictions of the potential impacts of regulatory actions and other public health efforts.

Demographic characteristics associated with tobacco product initiation rates are often inferred by cross-sectional data that report on characteristics of tobacco product users at a single point in time (prevalence). Males, those who are not heterosexual, and those of low socioeconomic status generally have higher tobacco use prevalence than their counterparts.^{4–10} However, correlates of use sometimes differ by tobacco product type. For example, adults with higher household income tend to have lower prevalence of cigarette use but higher prevalence of traditional cigar use compared to those with lower incomes. Those who are non-Hispanic white tend to have lower prevalence of cigarette use but higher prevalence of ENDS use compared to those who are non-Hispanic black.⁴

The role that one type of tobacco product may play in initiation of another type of tobacco product is an important consideration as the scope of tobacco products available to consumers has expanded and concurrent use of multiple tobacco products has become common among tobacco users in the U.S.^{4,11–12} Among youth and young adults, use of ENDS has been found to predict ever cigarette initiation,^{13–17} with one study also finding that ENDS use predicts P30D cigarette initiation.¹⁸ Evaluating the transition to P30D use or frequent use focuses on initiation rates more likely to contribute to subsequent nicotine addiction and health effects if maintained.¹⁹

The purpose of this paper is to report on demographic and tobacco product use correlates of ever, P30D, and frequent tobacco product use initiation across types of tobacco products (cigarettes, ENDS, cigars, hookah, and smokeless tobacco), among the U.S. population of youth (ages 12–17) and adults (ages 18+) using data from Waves 1, 2, and 3 (W1, W2, and W3, respectively) of the Population Assessment of Tobacco and Health (PATH) Study.

METHODS

Data Source and Participants

The PATH Study is an ongoing, nationally representative, longitudinal cohort study of youth and adults in the U.S. Data were collected September 2013-December 2014 (W1); October 2014-October 2015 (W2); and October 2015-October 2016 (W3) using audio computer-assisted self-interviews administered in English or Spanish. The overall weighted response rate was 78.4% for youth and 74.0% for adults at W1, 87.3% for youth and 83.2% for adults at W2, and 83.3% for youth and 78.4% for adults at W3. Further details regarding the PATH Study design and W1 methods are published elsewhere.²⁰ Details on interviewing procedures, questionnaires, sampling, weighting, response rates, and accessing the data are described in the PATH Study Restricted Use Files User Guide at <https://doi.org/10.3886/Series606>.²¹ The study was conducted by Westat and approved by the West at Institutional Review Board. All respondents ages 18 and older provided informed consent, with youth respondents ages 12 to 17 providing assent and each youth's parent/legal guardian providing consent. Data in this paper were drawn from respondents in W1, W2, and W3 of the PATH Study, which includes 25,384 adults at W1 or W2, and 12,993 youth at W1 or W2. See Supplemental Table 1 for additional details.

This paper describes correlates of tobacco product initiation over two one-year periods in a single analysis, so the analytic sample was restricted to respondents who *never used at least one type* of tobacco product at W1 or W2, which includes 24,432 adults and 12,938 youth. W1 and W2 are each considered the “baseline” wave to the subsequent wave, such that W1 is the baseline to W2, and W2 is the baseline to W3. Inclusion in the youth analyses versus the adult analyses was determined based on age at baseline wave.* The weighted estimates presented in this paper represent the resident non-incarcerated population of the U.S. at the time of W3 who were in the civilian, noninstitutionalized population ages 9 years and older at W1, through application of population and replicate weights that adjust for complex study design characteristics and nonresponse at W1, W2, and W3.

Measures

Tobacco product use—Tobacco products were grouped into five types: cigarettes, ENDS (e-cigarettes at W1 and e-cigarettes, e-cigars, e-pipes, and e-hookah at W2 and W3), cigars (traditional cigars, cigarillos, and filtered cigars), hookah, and smokeless tobacco (loose snus, moist snuff, dip, spit, chewing tobacco, and snus pouches). For each of these five types of tobacco products and for any tobacco product, tobacco use statuses—never use, ever use, past 30-day (P30D) use, and frequent use (smoked/used the product on 20 or more of the past 30 days)[†]—were assessed at each wave, defined in Table 1.

*That is, youth never users who aged into the adult cohort at W2 were included in the youth analyses between W1 and W2 (N=1,687) and in the adult analyses between W2 and W3 (N=1,669). “Shadow youth”, who aged into the youth cohort at W2 and were youth never users at W2 (N=1,946), were included in the youth analyses between W2 and W3.

[†]Consistent with the reporting of “frequent use” for cigarettes by the U.S. Centers for Disease Control and Prevention along with that of various other publications^{4,22–23}

Outcomes—The following thresholds of initiation were assessed at follow-up, as defined in Table 1: (1) initiating ever use (i.e., never product user at baseline and ever product user at follow-up), (2) initiating P30D use (i.e., never product user at baseline and P30D product user at follow-up), and (3) initiating frequent use among those who initiated P30D use (i.e., never product user at baseline who initiated P30D use at follow-up and used the product on 20 or more of the past 30 days at follow-up).

Demographic characteristics—Demographic characteristics were assessed at the baseline wave and categorized as shown in the tables. Missing data on age, sex, race, and Hispanic ethnicity were imputed at W1 as described in the PATH Study Restricted Use Files User Guide at <https://doi.org/10.3886/Series606.24>[‡]

Statistical Analyses

For each type of tobacco product, generalized estimating equations (GEE) were used to evaluate the association between correlates assessed at baseline and initiation assessed at follow-up, over two 1-year periods (W1-W2 and W2-W3). This statistical method allows for the inclusion of transitions from both periods in a single analysis while statistically controlling for interdependence among observations contributed by the same individuals.^{25,26} Specifically, GEE logistic regression models specified unstructured covariance and within-person correlation matrices and the binomial distribution of the dependent variable using the logit link function. Analyses were weighted using the W3 “all-waves” weights to produce nationally representative estimates, and variances were computed using the balanced repeated replication (BBR) method²⁷ with Fay’s adjustment set to 0.3.²⁸ All analyses were conducted using SAS 9.4 software (SAS Institute, Inc., Cary, NC). See Supplemental Material for the SAS macro code used to run weighted GEE analyses and calculate adjusted odds ratios (aORs) and confidence intervals (CIs). Analyses were run on the W1-W3 Restricted Use Files (<https://doi.org/10.3886/ICPSR36231.v18>).

For each type of tobacco product, initiation was evaluated with respect to the given tobacco product. Demographic correlates, never/ever tobacco use correlates, and wave were included in each model. All analyses were conducted among adults and youth (defined at baseline) separately. For the youth analyses, separate models were run to evaluate sexual orientation because only youth aged 14–17 years were asked about sexual orientation. Estimates with a relative standard error greater than 30 or with a denominator less than 50 are suppressed since these estimates may provide unreliable precision and to protect respondent confidentiality.

RESULTS

Ever Tobacco Product Use Initiation

Correlates of ever tobacco product initiation are reported among youth in Supplemental Table 2 and among adults in Supplemental Table 3. Given the similarity in significant correlates of ever use initiation and P30D initiation, we focus on P30D initiation here in text.

[‡]Imputed sex and race/ethnicity were carried forward to also represent these characteristics at W2; however, age at W2 was used since the time between interviews may not have yielded one additional year in all instances.

P30D Initiation

Youth

Any tobacco product: Among youth, older age (aOR = 3.2, 95% confidence interval [CI]: 2.6–3.8) and not identifying as heterosexual/straight (aOR = 1.6, 95% CI: 1.2–2.2) were associated with higher odds of initiating P30D use of any tobacco product compared to younger age and identifying as heterosexual/straight, respectively. Non-Hispanic Black (aOR = 0.7, CI: 0.5–0.9) and non-Hispanic Other (aOR = 0.6, 95% CI: 0.4–0.8) race/ethnicity were each associated with lower odds of initiating P30D use than non-Hispanic white race/ethnicity (Table 2).

Cigarettes: Among youth, older age (aOR = 2.4, 95% CI: 1.8–3.3), not identifying as heterosexual/straight (aOR = 1.9, 95% CI: 1.3–2.9), and ever use of ENDS (aOR = 3.4, 95% CI: 2.4–4.7), cigars (aOR = 2.0, 95% CI: 1.1–3.7), hookah (aOR = 2.2, 95% CI: 1.5–3.2) or smokeless tobacco (aOR = 2.7, 95% CI: 1.5–4.7) were each associated with higher odds of initiating P30D cigarette use compared to younger age, identifying as heterosexual/straight, and never use of these tobacco products, respectively. Non-Hispanic Black (aOR = 0.6, 95% CI: 0.4–0.9) and Hispanic (aOR = 0.8, 95% CI: 0.6–1.0) race/ethnicity were each associated with lower odds of initiating P30D cigarette use than non-Hispanic white race/ethnicity (Table 2).

ENDS: Among youth, older age (aOR = 2.4, 95% CI: 1.9–3.0), not identifying as heterosexual/straight (aOR = 1.9, 95% CI: 1.3–2.6), and ever use of cigarettes (aOR = 2.9, 95% CI: 2.1–4.0), cigars (aOR = 2.5, 95% CI: 1.8–3.5), or hookah (aOR = 2.6, 95% CI: 1.9–3.7) were each associated with higher odds of initiating P30D ENDS use compared to younger age, identifying as heterosexual/straight, and never use of these tobacco products, respectively. Non-Hispanic Black (aOR = 0.5, 95% CI: 0.3–0.6), non-Hispanic Other (aOR = 0.6, 95% CI: 0.4–0.8), and Hispanic (aOR = 0.7, 95% CI: 0.5–0.8) race/ethnicity were each associated with lower odds of initiating P30D ENDS use than non-Hispanic white race/ethnicity (Table 2).

Cigars: Among youth, older age (aOR = 5.7, 95% CI: 3.9–8.3), male sex (aOR = 2.3, 95% CI: 1.7–3.0), and ever use of cigarettes (aOR = 2.7, 95% CI: 1.9–3.7), ENDS (aOR = 2.4, 95% CI: 1.7–3.5), hookah (aOR = 1.6, 95% CI: 1.2–2.3) or smokeless tobacco (aOR = 1.6, 95% CI: 1.1–2.3) were each associated with higher odds of initiating P30D use of cigars compared to younger age, female sex, and never use of these tobacco products, respectively (Table 2).

Hookah: Among youth, older age (aOR = 4.1, 95% CI: 2.9–5.9), Hispanic ethnicity (aOR = 1.5, 95% CI: 1.1–2.0), and ever use of ENDS (aOR = 3.1, 95% CI: 2.0–4.7) or cigars (aOR = 2.3, 95% CI: 1.4–3.7) were each associated with higher odds of initiating P30D hookah use compared to younger age, non-Hispanic white race/ethnicity, and never use of ENDS or cigars, respectively (Table 2).

Smokeless tobacco: Among youth, older age (aOR = 2.1, 95% CI: 1.3–3.3), male sex (aOR = 4.6, 95% CI: 2.7–7.9), and ever use of cigarettes (aOR = 3.4, 95% CI: 2.0–5.8) or ENDS

(aOR = 2.1, 95% CI: 1.1–3.9) were each associated higher odds of initiating P30D use of smokeless tobacco compared to younger age, female sex, and never use of cigarettes or ENDS, respectively. Hispanic ethnicity (aOR = 0.4, 95% CI: 0.2–0.8) was associated with lower odds of initiating P30D smokeless tobacco use compared to non-Hispanic white race/ethnicity (Table 2).

Adults

Any tobacco product: Among adults, age 25–39 (aOR = 0.4, 95% CI: 0.3–0.6) was associated with lower odds of initiating P30D tobacco product use compared to age 18–24. Male sex (aOR = 1.5, 95% CI: 1.0–2.3) and non-Hispanic Black race/ethnicity (aOR = 1.8, 95% CI: 1.2–2.7) were each associated with higher odds of initiating P30D use compared to female sex or non-Hispanic white race/ethnicity, respectively (Table 3).

Cigarettes: Among adults, age 25–39 (aOR = 0.6, 95% CI: 0.4–0.9) and age 40–54 (aOR = 0.1, 95% CI: 0.1–0.3) were each associated with lower odds of initiating P30D cigarette smoking compared to age 18–24, and having some college/associate degree (aOR = 0.5, 95% CI: 0.3–0.8) was associated with lower odds of initiating P30D cigarette smoking compared to having less than high school/some high school/GED. Hispanic race/ethnicity (aOR = 1.8, 95% CI: 1.2–2.9), identifying as bisexual (aOR = 2.4, 95% CI: 1.2–4.5), and ever use of ENDS (aOR = 3.2, 95% CI: 2.1–4.9) or cigars (aOR = 2.1, 95% CI: 1.3–3.2) were each associated with higher odds of initiating P30D cigarette smoking compared to non-Hispanic white race/ethnicity, identifying as heterosexual/straight, and never use of ENDS or cigars, respectively (Table 3).

ENDS: Among adults, age 25–39 (aOR = 0.4, 95% CI: 0.3–0.5), age 40–54 (aOR = 0.3, 95% CI: 0.2–0.4), and age 55+ (aOR = 0.1, 95% CI: 0.1–0.2) were each associated with lower odds of initiating P30D ENDS use compared to age 18–24, having a bachelor's degree or more (aOR = 0.3, 95% CI: 0.2–0.4) or having some college/associate's degree (aOR = 0.8, 95% CI: 0.6–1.0) were each associated with lower odds of initiating P30D ENDS use than having less than high school/some high school/GED, and household income \geq \$75,000 (aOR = 0.6, 95% CI: 0.4–0.7) was associated with lower odds compared to income $<$ \$25,000. Identifying as bisexual (aOR = 2.0, 95% CI: 1.3–2.9), and ever use of cigarettes (aOR = 3.1, 95% CI: 2.4–4.0) cigars (aOR = 2.1, 95% CI: 1.6–2.6), hookah (aOR = 1.7, 95% CI: 1.4–2.1) or smokeless tobacco (aOR = 1.3, 95% CI: 1.0–1.6) were each associated with higher odds of initiating P30D ENDS use compared to identifying as heterosexual/straight, and never use of these tobacco products, respectively (Table 3).

Cigars: Among adults, older age (e.g., aOR = 0.1, 95% CI: 0.1–0.2 for those aged 55+ years) and higher household income (e.g., aOR = 0.6, 95% CI: 0.4–0.8 for those with household income \geq \$75,000) were each associated with lower odds of initiating P30D cigar use compared to age 18–24 and household income $<$ \$25,000, respectively. Male sex (aOR = 2.1, 95% CI: 1.6–2.8), non-Hispanic Black race/ethnicity (aOR = 2.4, 95% CI: 1.8, 3.1), and ever use of cigarettes (aOR = 3.3, 95% CI: 2.4–4.6), ENDS (aOR = 1.8, 95% CI: 1.5–2.2), or hookah (aOR = 1.6, 95% CI: 1.2–2.0) were each associated with higher odds of initiating

P30D cigar use compared to female sex, non-Hispanic white race/ethnicity, and never use of these tobacco products, respectively (Table 3).

Hookah: Among adults, older age (e.g., aOR = 0.0, 95% CI: 0.0–0.1 for those aged 55+ years) and household income \$25,000 – \$74,999 (aOR = 0.6, 95% CI: 0.4–0.8) were each associated with lower odds of initiating P30D hookah use compared to age 18–24 and household income < \$25,000, respectively. Non-Hispanic Black race/ethnicity (aOR = 3.0, 95% CI: 2.0–4.6), Hispanic ethnicity (aOR = 1.8, 95% CI: 1.1–3.0), and non-Hispanic other race/ethnicity (aOR = 1.8, 95% CI: 1.0–3.2), were each associated with higher odds of initiating P30D hookah use compared to non-Hispanic white race/ethnicity. Ever use of ENDS (aOR = 2.1, 95% CI: 1.5–3.1) or cigars (aOR = 1.6, 95% CI: 1.2–2.3) were each associated with higher odds of initiating P30D hookah use compared to never use of these tobacco products (Table 3).

Smokeless tobacco: Among adults, age 55 or older (aOR = 0.3, 95% CI: 0.2–0.7), and household income > \$75,000 (aOR = 0.5, 95% CI: 0.3–1.0) were each associated with lower odds of initiating P30D smokeless tobacco use compared to age 18–24 and household income < \$25,000, respectively. Male sex (aOR = 2.7, 95% CI: 1.8–4.1) and ever use of ENDS (aOR = 2.4, 95% CI: 1.7–3.4) were each associated with higher odds of initiating P30D smokeless tobacco use compared to female sex and never use of ENDS, respectively (Table 3).

Frequent Use Upon Initiation

We also evaluated rates and correlates of initiating frequent use (use on 20 or more days in the past 30 days) among those who initiated P30D use (hereafter referred to as frequent use upon initiation; data shown in-text only).

Youth

Among youth, 18.6% (95% CI: 15.3–22.5) were frequent users of at least one type of tobacco product upon initiation of any tobacco product, with rates of frequent use upon initiation by product type as follows: 15.9% (95% CI: 12.4–20.2) for cigarettes, 16.5% (95% CI: 13.0–20.8) for ENDS, 4.4% (95% CI: 2.3–8.2) for cigars, 14.8% (95% CI: 9.0–23.4) for hookah, and 29.7% (95% CI: 21.0–40.1) for smokeless tobacco.

Any tobacco product—Among youth, age 15–17 (aOR = 1.8, 95% CI: 1.0–3.1) and not identifying as heterosexual/straight (aOR = 3.0, 95% CI: 1.3–6.8) were each associated with higher odds of frequent use upon initiation of any tobacco product use compared to age 12–14 and identifying as heterosexual/straight, respectively.

Cigarettes—Among youth, Hispanic ethnicity was associated with lower odds of frequent use upon initiation of cigarette use (aOR = 0.4, 95% CI: 0.2–0.9) compared to non-Hispanic white race/ethnicity.

ENDS—Among youth, age 15–17 (aOR = 2.3, 95% CI: 1.1–4.6), male sex (aOR = 2.4, 95% CI: 1.2–4.9), and ever use of smokeless tobacco (aOR = 3.3, 95% CI: 1.2–9.5) were each

associated with higher odds of frequent use upon initiation of ENDS use compared to age 12–14, female sex, and never use of ENDS, respectively.

Findings for correlates of frequent use upon initiation of cigars, hookah, and smokeless tobacco had relative standard errors >30% or were not statistically significant (data not shown).

Adults

Among adults, 19.2% (95% CI: 12.4–28.5) were frequent users of at least one type of tobacco product upon initiation of any tobacco product, with rates of frequent use upon initiation by product type as follows: 27.1% (95% CI: 18.6–37.7) for cigarettes, 24.6% (95% CI: 20.9–28.6) for ENDS, 20.2% (95% CI: 13.7–28.8) for cigars, 22.0% (95% CI: 14.8–31.3) for hookah, and 29.9% (95% CI: 21.7–39.6) for smokeless tobacco.

ENDS—Among adults, age 18–24 (aOR= 2.8, 95%CI: 1.2–6.6) and male sex (aOR= 1.9, 95% CI: 1.1–3.4) were each associated with higher odds of frequent use upon initiation of ENDS use compared to age 55 or older and female sex, respectively. Non-Hispanic Black race/ethnicity (aOR= 0.4, 95% CI: 0.2–0.8) and having a bachelor’s degree or more educational attainment (aOR = 0.3, 95% CI: 0.1–0.8) were each associated with lower odds of frequent use upon initiation of ENDS use compared to non-Hispanic white race/ethnicity and having less than high school/some high school/GED educational attainment, respectively (data not shown).

Findings for correlates of frequent use upon initiation of any tobacco product, cigarettes, cigars, hookah, and smokeless tobacco were had relative standard errors >30% or were not statistically significant (data not shown).

DISCUSSION

PATH Study W1-W3 data show that, among the U.S. population of youth and adult never users of each type of tobacco product examined here (cigarettes, ENDS, cigars, hookah, and smokeless tobacco), age consistently predicted tobacco product initiation, with older youth (ages 15–17) more likely than younger youth (ages 12–14) and younger adults (ages 18–24) more likely than older adults to be P30D tobacco product initiators. Other predictors, however, differed somewhat across types of tobacco products. For example, among youth and adults, males were more likely than females to be P30D cigar and smokeless tobacco use initiators, while among those ages 14–17 years, non-heterosexuals were more likely than heterosexuals to initiate P30D cigarette use and to initiate P30D ENDS use.

Our results also show that for initiation of each type of tobacco product, ever use of another type of tobacco product consistently predicted tobacco product initiation, among both youth and adults. Some studies have found that ENDS use predicts cigarette initiation among youth/young adults.^{14–17} In 2018, the National Academies of Sciences, Engineering, and Medicine published a consensus report *Public Health Consequences of E-cigarettes* and concluded that there is substantial evidence that ENDS use increases the risk of ever smoking cigarettes among youth and young adults.¹³ Other studies have shown that cigarette

predictions of the potential impacts of regulatory actions and other interventions on tobacco product use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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WHAT THIS PAPER ADDS:

- Previous research that is focused on ever use initiation may be missing important correlates of tobacco product use initiation related to negative health outcomes due to more consistent use.
- This study uses nationally representative longitudinal data from youth and adults to evaluate correlates of past 30-day (P30D) use initiation and more frequent use initiation across multiple tobacco products.
- Ever use of another type of tobacco product consistently predicted tobacco product initiation, among both youth and adults, whereas demographic correlates showed more product-specific findings, consistent with previous literature.
- Our findings also identify some differences in correlates of P30D initiation versus correlates of frequent use upon initiation.
- Adults ages 55 or older were far less likely than young adults to be P30D ENDS initiators but were nearly three times more likely than young adults to be frequent ENDS users upon initiation.
- Demographic correlates of P30D initiation underscore tobacco use disparities in the U.S., and tobacco use correlates of initiation suggest that use of another tobacco product is a common risk factor for initiation across products.

Table 1:

Definitions.

Initiation Behaviors	Baseline Tobacco Use Group (W1 or W2)	Follow-up Outcome (W2 or W3)
Initiating ever use (Supplemental Tables 2 & 3)	Never users ¹ : never smoked/used the product/any tobacco product (even one or two times) Never users as defined above	Initiating ever use: Ever smoked/used the product/any tobacco product (even one or two times)
Initiating past 30-day (P30D) use (Tables 2 & 3)	Never users who initiated P30D use at follow-up as defined above	Initiating P30D use: Smoked/used the product/any tobacco product in the past 30 days
Initiating frequent use among those who initiated P30D use (results in-text only)		Frequent use upon initiation ² : Smoked/used the product on 20 or more of the past 30 days

Notes:

Abbreviations: W1 = Wave 1; W2 = Wave 2; W3 = Wave 3

¹ Respondents who indicated ever use of a given tobacco product at a previous wave and never use of that same product at the current wave were coded as “ever” users and excluded from the baseline sample. The percentage of those who met this definition at W2 ranged from 1.4% for hookah to 12.9% for ENDS.

² For any tobacco product use, frequent use upon initiation was defined as having used at least one type of tobacco product on 20 or more of the past 30 days.

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Table 2:

Correlates of Initiating P30D Use Among Never Users (Youth 12–17) at Baseline.

	P30D use at follow-up																	
	Any tobacco			Cigarettes			ENDS			Cigars			Hookah			Smokeless		
	%	95% CI	aOR	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI
Correlates at baseline																		
Overall	4.4	(4.0–4.7)	N/A	N/A	2.0	(1.8–2.2)	3.1	(2.8–3.4)	N/A	N/A	1.7	(1.5–1.9)	N/A	N/A	0.8	(0.7–0.9)	N/A	N/A
DEMOGRAPHIC CHARACTERISTICS																		
Age group																		
12–14	2.3	(2.0–2.7)	--	--	1.0	(0.7–1.3)	1.6	(1.3–1.9)	--	--	0.4	(0.3–0.6)	--	--	0.4	(0.3–0.5)	--	--
15–17	7.1	(6.4–7.8)	3.2	(2.6–3.8)	3.2	(2.9–3.6)	4.9	(4.3–5.5)	2.4	(1.9–3.0)	3.2	(2.8–3.5)	5.7	(3.9–8.3)	2.5	(2.2–2.9)	4.1	(2.9–5.9)
Sex																		
Female	4.3	(3.7–4.9)	--	--	2.0	(1.7–2.3)	2.8	(2.4–3.4)	--	--	1.2	(1.0–1.4)	--	--	0.3	(0.2–0.4)	--	--
Male	4.5	(4.0–5.0)	1.0	(0.9–1.3)	2.0	(1.7–2.3)	3.3	(2.9–3.8)	1.2	(1.0–1.5)	2.3	(2.0–2.6)	2.3	(1.7–3.0)	1.4	(1.2–1.6)	0.8	(0.6–1.0)
Race/ethnicity																		
Non-Hispanic White	4.9	(4.5–5.5)	--	--	2.4	(2.1–2.7)	3.8	(3.3–4.3)	--	--	1.8	(1.6–2.1)	--	--	1.1	(0.9–1.4)	--	--
Non-Hispanic Black	3.4	(2.6–4.5)	0.7	(0.5–0.9)	1.4	(1.0–2.0)	1.8	(1.3–2.6)	0.5	(0.3–0.6)	2.0	(1.5–2.8)	1.3	(0.9–1.9)	1.4	(1.1–2.0)	1.2	(0.8–1.7)
Non-Hispanic Other (includes two or more races)	2.9	(2.1–4.0)	0.6	(0.4–0.8)	1.5	(0.9–2.3)	2.4	(1.7–3.2)	0.6	(0.4–0.8)	1.3	(0.9–2.0)	0.9	(0.5–1.4)	1.5	(1.0–2.2)	1.2	(0.8–2.0)
Hispanic	4.4	(3.8–5.1)	0.9	(0.8–1.1)	1.8	(1.5–2.2)	2.6	(2.2–3.1)	0.7	(0.5–0.8)	1.4	(1.2–1.8)	0.8	(0.7–1.1)	1.7	(1.4–2.2)	1.5	(1.1–2.0)
Sexual orientation (ages 14+)																		
Straight/Heterosexual	5.9	(5.3–6.4)	--	--	2.5	(2.2–2.8)	3.9	(3.4–4.4)	--	--	2.5	(2.2–2.8)	--	--	2.0	(1.7–2.3)	--	--
Other (includes gay, lesbian, bisexual, other)	9.1	(7.1–11.7)	1.6	(1.2–2.2)	5.1	(3.5–7.2)	8.0	(6.1–10.4)	1.9	(1.3–2.6)	3.3	(2.3–4.7)	1.4	(0.9–2.2)	3.1	(2.1–4.7)	1.2	(0.7–1.9)
TOBACCO USE CORRELATES																		
Use of cigarettes																		
Never use	N/A	N/A	N/A	N/A	N/A	N/A	2.5	(2.2–2.8)	--	--	1.2	(1.1–1.4)	--	--	0.5	(0.4–0.6)	--	--

		P30D use at follow-up																																			
		Any tobacco						Cigarettes						ENDS						Cigars						Hookah						Smokeless					
Correlates at baseline		%	95% CI	aOR	95% CI		%	95% CI	aOR	95% CI		%	95% CI	aOR	95% CI		%	95% CI	aOR	95% CI		%	95% CI	aOR	95% CI		%	95% CI	aOR	95% CI							
		Ever use	N/A	N/A	N/A	N/A	N/A	13.6	(11.0-16.7)	2.9	(2.1-4.0)	N/A	N/A	7.5	(6.3-9.0)	2.7	(1.9-3.7)	N/A	4.8	(3.7-6.1)	1.1	(0.6-2.0)	3.3	(2.6-4.2)	3.4	(2.0-5.8)											
Use of ENDS																																					
Never use	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2	(1.0-1.4)	--	--	N/A	1.0	(0.9-1.2)	--	--	0.5	(0.4-0.7)	--	--													
Ever use	N/A	N/A	N/A	N/A	N/A	N/A	(6.9-10.3)	3.4	(2.4-4.7)	N/A	N/A	6.4	(5.3-7.7)	2.4	(1.7-3.5)	N/A	4.9	(3.9-6.1)	3.1	(2.0-4.7)	2.7	(2.1-3.4)	2.1	(1.1-3.9)													
Use of cigars																																					
Never use	N/A	N/A	N/A	N/A	N/A	2.8	(2.5-3.1)	--	--	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2	(1.0-1.4)	--	--	0.6	(0.5-0.8)	--	--													
Ever use	N/A	N/A	N/A	N/A	N/A	18.3	(14.5-22.8)	2.5	(1.8-3.5)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.5	(5.6-10.1)	2.3	(1.4-3.7)	3.7	(2.7-5.1)	1.3	(0.7-2.4)													
Use of hookah																																					
Never use	N/A	N/A	N/A	N/A	N/A	2.7	(2.4-3.0)	--	--	N/A	N/A	1.5	(1.3-1.6)	--	--	N/A	N/A	N/A	N/A	N/A	0.7	(0.6-0.8)	--	--													
Ever use	N/A	N/A	N/A	N/A	N/A	16.3	(13.0-20.3)	2.6	(1.9-3.7)	N/A	N/A	7.0	(5.5-9.0)	1.6	(1.2-2.3)	N/A	N/A	N/A	N/A	N/A	2.4	(1.7-3.5)	1.1	(0.6-2.0)													
Use of smokeless																																					
Never use	N/A	N/A	N/A	N/A	N/A	2.9	(2.6-3.2)	--	--	N/A	N/A	1.5	(1.4-1.7)	--	--	N/A	1.3	(1.2-1.5)	--	--	N/A	N/A	N/A	N/A													
Ever use	N/A	N/A	N/A	N/A	N/A	12.8	(8.8-18.3)	1.6	(1.0-2.6)	N/A	N/A	8.2	(6.1-11.0)	1.6	(1.1-2.3)	N/A	4.8	(3.2-7.1)	1.2	(0.7-2.1)	N/A	N/A	N/A	N/A													

Notes:

Abbreviations: P30D = past 30-day; ENDS = electronic nicotine delivery system; aOR = adjusted odds ratio; CI = confidence interval; N/A = not applicable

The percentages and odds ratios in the table are based on weighted data.

Denominator N (unweighted number of observations) for aOR in "Any tobacco" = 15,922 (without sexual orientation), 9,494 (with sexual orientation)

Denominator N (unweighted number of observations) for aOR in "Cigarettes" = 18,184 (without sexual orientation), 11,338 (with sexual orientation)

Denominator N (unweighted number of observations) for aOR in "ENDS" = 17,782 (without sexual orientation), 11,000 (with sexual orientation)

Denominator N (unweighted number of observations) for aOR in "Cigars" = 19,257 (without sexual orientation), 12,216 (with sexual orientation)

Denominator N (unweighted number of observations) for aOR in "Hookah" = 19,338 (without sexual orientation), 12,276 (with sexual orientation)

Denominator N (unweighted number of observations) for aOR in "Smokeless" = 19,662 (without sexual orientation), 12,713 (with sexual orientation)

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Tobacco product types were categorized into five groups: cigarettes, ENDS (e-cigarettes, e-pipes, and e-hookah at Wave 1, and e-cigarettes at Waves 2 & 3), cigars (i.e., traditional cigars, cigarillos, filtered cigars), hookah, and smokeless tobacco (i.e., loose snus, moist snuff, dip, spit, chewing tobacco, and snus pouches)

For each of the five tobacco products, and for any tobacco product, use is defined with respect to the given tobacco product/any tobacco product:

Never use is defined as never having used the product, even 1 or 2 times.

P30D use is defined as use in the past 30 days.

The outcome 'initiating P30D' is defined as P30D use at follow-up (vs. no P30D use at follow-up) among never users at baseline.

Since never use at baseline is defined with respect to each tobacco product, never/ever use of 'other' tobacco products at baseline are considered as correlates of initiating P30D use of the given tobacco product at follow-up.

GEE logistic regression analyses were used to assess correlates of initiating P30D use at follow-up among never users at baseline over a one-year period of time (i.e., Wave 1-Wave 2 and Wave 2-Wave 3), including up to two change data points per individual and statistically controlling for the correlation among observations from the same individuals.

All correlates reflect baseline measurement for each wave pair (e.g., when evaluating change between Wave 1 and Wave2, the age correlate reflects a person's age at Wave 1, and when evaluating change between Wave 2 and Wave 3, the age correlate reflects a person's age at Wave 2).

Data consist of those who are youth at all three waves, youth who age into the adult cohort at Wave 3, shadow youth who age into the youth cohort at Wave 2, and Wave 1-Wave 2 data only from youth who age into the adult cohort at Wave 2 (their Wave 2-Wave 3 data is included in adult tables).

† Analyses adjusted for age group, sex, race/ethnicity, each tobacco use correlate, and wave. Sexual orientation (asked only of those 14 and older) was run separately and not included as a covariate in the other aORs.

Estimates with RSE >30 or denominator < 50 are suppressed.

* p <0.05

** p <0.01

*** p <0.001

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Table 3:

Correlates of Initiating F30D Use Among Never Users (Adults 18+) at Baseline.

	F30D use at follow-up																			
	Any tobacco			Cigarettes			ENDS			Cigars			Hookah			Smokeless				
	%	95% CI	aOR	95% CI	%	95% CI	I aOR	95% CI	%	95% CI	I aOR	95% CI	%	95% CI	I aOR	95% CI	%	95% CI	I aOR	95% CI
Correlates at baseline																				
Overall	2.2	(1.9–2.7)	N/A	N/A	1.4	(1.2–1.7)	N/A	N/A	1.5	(1.3–1.6)	N/A	N/A	1.4	(1.2–1.7)	N/A	N/A	0.3	(0.3–0.4)	N/A	N/A
DEMOGRAPHIC CHARACTERISTICS																				
Age group																				
18–24	7.0	(6.0–8.3)	--	--	3.6	(3.1–4.2)	--	--	4.5	(3.9–5.1)	--	--	3.9	(3.4–4.5)	--	--	0.8	(0.6–1.0)	--	--
25–39	2.7	(1.9–3.8)	0.4	(0.3–0.6)	1.6	(1.1–2.4)	0.6	(0.4–0.9)	1.8	(1.5–2.1)	0.4	(0.3–0.5)	2.0	(1.5–2.6)	0.5	(0.4–0.7)	0.5	(0.3–0.7)	0.7	(0.4–1.0)
40–54	#	#	#	#	0.6	(0.3–1.1)	0.1	(0.1–0.3)	1.4	(1.2–1.7)	0.3	(0.2–0.4)	1.0	(0.8–1.4)	0.2	(0.1–0.3)	0.2	(0.1–0.5)	0.5	(0.2–1.1)
55+	#	#	#	#	#	#	#	#	0.6	(0.5–0.8)	0.1	(0.1–0.2)	0.6	(0.4–0.9)	0.1	(0.1–0.2)	0.2	(0.1–0.3)	0.3	(0.2–0.7)
Sex																				
Female	1.8	(1.3–2.4)	--	--	1.2	(0.9–1.6)	--	--	1.2	(1.1–1.4)	--	--	1.0	(0.8–1.2)	--	--	0.5	(0.4–0.7)	--	--
Male	3.1	(2.4–3.9)	1.5	(1.0–2.3)	1.7	(1.4–2.2)	1.2	(0.8–1.8)	1.8	(1.5–2.0)	1.0	(0.8–1.2)	2.3	(1.8–2.9)	2.1	(1.6–2.8)	0.8	(0.6–0.9)	1.2	(0.9–1.7)
Race/ethnicity																				
Non-Hispanic White	1.7	(1.3–2.2)	--	--	1.0	(0.7–1.3)	--	--	1.4	(1.2–1.6)	--	--	1.1	(0.9–1.3)	--	--	0.4	(0.3–0.5)	--	--
Non-Hispanic Black	3.5	(2.6–4.6)	1.8	(1.2–2.7)	1.8	(1.3–2.5)	1.4	(0.9–2.1)	1.7	(1.4–2.1)	0.9	(0.7–1.1)	2.9	(2.3–3.6)	2.4	(1.8–3.1)	1.5	(1.2–1.9)	3.0	(2.0–4.6)
Non-Hispanic Other (includes two or more races)	1.4	(0.8–2.7)	0.8	(0.4–1.4)	0.8	(0.4–1.6)	0.9	(0.5–1.8)	1.4	(1.0–2.1)	1.3	(0.9–1.9)	0.9	(0.5–1.5)	0.6	(0.4–1.0)	0.8	(0.5–1.3)	1.8	(1.0–3.2)*
Hispanic	3.0	(2.0–4.3)	1.5	(0.9–2.4)	2.3	(1.7–3.2)	1.8	(1.2–2.9)	1.7	(1.4–2.1)	0.9	(0.7–1.2)	1.7	(1.2–2.3)	1.0	(0.6–1.5)	1.0	(0.7–1.3)	1.8	(1.1–3.0)*
Sexual orientation																				
Straight/Heterosexual	2.2	(1.8–2.7)	--	--	1.3	(1.1–1.6)	--	--	1.4	(1.3–1.6)	--	--	1.4	(1.2–1.6)	--	--	0.6	(0.5–0.7)	--	--
Gay or Lesbian	#	#	#	#	#	#	#	#	2.2	(1.2–4.0)	1.1	(0.6–1.8)	#	#	#	#	#	#	#	#
Bisexual	#	#	#	#	4.5	(2.6–7.7)	2.4	(1.2–4.5)**	4.6	(3.2–6.5)	2.0	(1.3–2.9)	2.3	(1.3–3.9)	0.9	(0.5–1.4)	1.6	(0.9–2.7)	1.2	(0.6–2.1)

F30D use at follow-up

	Any tobacco				Cigarettes				ENDS				Cigars				Hookah				Smokeless				
	%	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI	%	95% CI	aOR	95% CI	
Correlates at baseline																									
Something else	#	#	#	#	1.7	(0.9-3.4)	1.0	(0.5-1.9)	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Educational attainment																									
Less than high school or some high school (no diploma) or GED	3.0	(2.0-4.5)	--	--	2.0	(1.6-2.4)	--	--	2.1	(1.7-2.5)	--	--	2.1	(1.7-2.5)	--	--	0.8	(0.6-1.1)	--	--	0.6	(0.4-0.8)	--	--	
High school graduate—diploma	3.1	(2.3-4.2)	1.0	(0.6-1.7)	1.8	(1.5-2.1)	0.9	(0.7-1.1)	2.0	(1.6-2.5)	1.1	(0.8-1.5)	2.0	(1.6-2.5)	1.1	(0.8-1.5)	0.8	(0.7-1.1)	1.1	(0.8-1.6)	0.3	(0.2-0.5)	0.7	(0.4-1.2)	
Some college (no degree) or associate degree	2.1	(1.5-2.8)	0.6	(0.4-1.0)	1.9	(1.6-2.2)	0.8	(0.6-1.0)*	1.3	(1.1-1.6)	0.7	(0.5-1.0)	1.3	(1.1-1.6)	0.7	(0.5-1.0)	0.7	(0.5-1.0)	0.9	(0.7-1.4)	0.3	(0.2-0.5)	0.6	(0.3-1.2)	
Bachelor's degree or more	#	#	#	#	0.6	(0.5-0.8)	0.3	(0.2-0.4)***	0.6	(0.4-1.0)	0.6	(0.3-1.1)	0.6	(0.4-1.0)	0.6	(0.3-1.1)	0.3	(0.2-0.5)	0.8	(0.5-1.4)	#	#	#	#	
Annual household income																									
<\$25,000	3.0	(2.3-4.0)	--	--	2.3	(2.0-2.6)	--	--	2.4	(2.0-2.8)	--	--	2.4	(2.0-2.8)	--	--	1.2	(1.0-1.4)	--	--	0.5	(0.4-0.7)	--	--	
\$25,000-\$74,999	2.1	(1.5-3.0)	1.1	(0.7-1.6)	1.5	(1.2-1.7)	0.8	(0.6-1.0)	1.0	(0.8-1.3)	0.6	(0.5-0.8)***	1.0	(0.8-1.3)	0.6	(0.5-0.8)***	0.4	(0.3-0.6)	0.6	(0.4-0.8)***	0.3	(0.2-0.5)	0.8	(0.4-1.3)	
\$75,000	1.1	(0.7-1.8)	0.7	(0.4-1.3)	0.9	(0.7-1.1)	0.6	(0.4-0.7)***	0.7	(0.5-1.1)	0.6	(0.4-0.8)***	0.7	(0.5-1.1)	0.6	(0.4-0.8)***	0.3	(0.2-0.6)	0.7	(0.4-1.4)	0.2	(0.1-0.3)	0.5	(0.3-1.0)*	
Not reported	2.9	(1.9-4.2)	1.1	(0.7-1.9)	1.1	(0.8-1.6)	0.7	(0.5-0.9)*	1.5	(0.9-2.4)	0.8	(0.4-1.3)	1.5	(0.9-2.4)	0.8	(0.4-1.3)	#	#	#	#	#	#	#	#	
TOBACCO USE CORRELATES																									
Use of cigarettes																									
Never use	N/A	N/A	N/A	N/A	0.6	(0.5-0.8)	--	--	0.9	(0.6-1.2)	--	--	0.9	(0.6-1.2)	--	--	0.6	(0.5-0.8)	--	--	0.2	(0.1-0.4)	--	--	
Ever use	N/A	N/A	N/A	N/A	2.0	(1.8-2.2)	3.1	(2.4-4.0)***	2.0	(1.8-2.4)	3.3	(2.4-4.6)***	2.0	(1.8-2.4)	3.3	(2.4-4.6)***	0.6	(0.5-0.8)	1.3	(0.8-2.1)	0.4	(0.3-0.5)	1.5	(0.8-2.8)	
Use of ENDS																									
Never use	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ever use	N/A	N/A	N/A	N/A	8.9	(6.9-11.5)	3.2	(2.1-4.9)***	N/A	N/A	1.8	(1.5-2.2)***	4.4	(3.8-5.1)	1.8	(1.5-2.2)***	1.7	(1.4-2.0)	2.1	(1.5-3.1)***	0.9	(0.7-1.1)	2.4	(1.7-3.4)***	
Use of cigars																									
Never use	N/A	N/A	N/A	N/A	0.9	(0.7-1.0)	--	--	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	(0.4-0.7)	--	--	0.2	(0.2-0.3)	--	--	
Ever use	N/A	N/A	N/A	N/A	3.3	(2.5-4.3)	2.1	(1.3-3.2)***	2.8	(2.5-3.1)	2.1	(1.6-2.6)***	N/A	N/A	2.1	(1.6-2.6)***	0.9	(0.8-1.1)	1.6	(1.2-2.3)***	0.5	(0.4-0.7)	1.0	(0.7-1.5)	

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All correlates reflect baseline measurement for each wave pair (e.g., when evaluating change between Wave 1 and Wave 2, the age correlate reflects a person's age at Wave 2), and when evaluating change between Wave 2 and Wave 3, the age correlate reflects a person's age at Wave 2).

Analyses adjusted for age group, sex, sexual orientation, race/ethnicity, each tobacco use correlate, educational attainment, income, and wave.

Estimates with RSE >30 or denominator < 50 are suppressed.

* p < 0.05

** p < 0.01

*** p < 0.001