HHS Public Access

Author manuscript

Tob Control. Author manuscript; available in PMC 2020 September 28.

Published in final edited form as:

Tob Control. 2020 May ; 29(Suppl 3): s203–s215. doi:10.1136/tobaccocontrol-2019-055255.

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

Karin Kasza[1], **Kathryn C. Edwards**[2], **Zhiqun Tang**[2], **Cassandra A. Stanton**[2,3], **Eva Sharma**[2], **Michael J. Halenar**[2], **Kristie A. Taylor**[2], **Elisabeth A. Donaldson**[4], **Lynn C. Hull**[4], **Maansi Bansal-Travers**[1], **Jean Limpert**[4], **Izabella Zandberg**[4], **Lisa D. Gardner**[4], **Hoda T. Hammad**[4], **Nicolette Borek**[4], **Heather L. Kimmel**[5], **Wilson M. Compton**[5], **Andrew Hyland**[1]

[1]Department of Health Behavior, Roswell Park Comprehensive Cancer Center, Buffalo, NY, USA

[2]Behavioral Health and Health Policy Practice, Westat, Rockville, MD, USA

[3]Department of Oncology, Georgetown University Medical Center, Washington, DC, USA

[4]Office of Science, Center for Tobacco Products, Food and Drug Administration, Silver Spring, MD, USA

[5]National Institute on Drug Abuse, National Institutes of Health, Bethesda, MD, USA

Abstract

OBJECTIVE—To report on demographic and tobacco use correlates of cessation behaviors across tobacco products (cigarettes, electronic nicotine delivery systems [ENDS], cigars, hookah, and smokeless tobacco) among the U.S. population.

DESIGN—Data were drawn from the first three waves (2013–2016) of the Population Assessment of Tobacco and Health Study, a nationally representative, longitudinal cohort study of youth (ages 12–17) and adults (ages 18+) in the U.S. Past 30-day (P30D) tobacco users at Wave 1 (W1) or Wave 2 (W2) were included (N = 1,374 youth; N = 14,389 adults). Generalized estimating equations were used to evaluate the association between demographic and tobacco use characteristics at baseline, with cessation behaviors at follow-up (discontinuing use, attempting to quit, quitting), over two 1-year periods (W1-W2, W2-W3).

RESULTS—Among adult users of each type of tobacco product, frequency of use was negatively associated with discontinuing use. Among adult cigarette smokers, non-Hispanic white smokers, those with lower educational attainment, and those with lower household income were less likely to discontinue cigarette use; ENDS use was positively associated with making quit attempts but was not associated with cigarette quitting among attempters; smokeless tobacco use was positively associated with quitting among attempters; tobacco dependence was negatively associated with

Corresponding Author: Dr Karin A Kasza, Department of Health Behavior, Roswell Park Comprehensive Cancer Center, Buffalo, NY 14263, USA; karin.kasza@roswellpark.org.

Disclaimer: The views and opinions expressed in this article are those of the authors only and do not necessarily represent the views, official policy, or position of the U.S. Department of Health and Human Services or any of its affiliated institutions or agencies.

Financial disclosure: Wilson Compton reports long-term stock holdings in General Electric Company, 3M Company, and Pfizer Incorporated, unrelated to this manuscript. No financial disclosures were reported by the other authors of this paper.

quitting among attempters. Among youth cigarette smokers, tobacco dependence was negatively associated with making quit attempts.

DISCUSSION—Demographic correlates of tobacco cessation behaviors underscore tobacco use disparities in the U.S. Use of ENDS and use of smokeless tobacco products are positively associated with some adult cigarette cessation behaviors.

INTRODUCTION

In 2013–2016, tobacco product cessation rates among youth and adults were lowest for cigarettes,[1] followed by smokeless tobacco,[2] electronic nicotine delivery systems (ENDS) among youth[3] and cigars among adults,[4] and were highest for hookah among youth and adults.[5] Understanding correlates of cessation behaviors across tobacco products can help in targeted intervention efforts and can enable researchers to better predict the potential impacts of regulatory actions and other public health efforts.

Population level tobacco cessation rates depend on the fraction of tobacco users who make a quit attempt and the fraction of those who quit when they try.[6] For cigarette smoking, there are similarities and differences in factors associated with quit attempt and quit success rates.[7] Two nationally representative longitudinal studies prospectively evaluated cigarette cessation behaviors among adults: the International Tobacco Control 4-Country survey (ITC-4)[8,9] and the Tobacco Use Supplement to the Current Population Survey (TUS-CPS)[10] evaluated discontinuing cigarette smoking (i.e., from use to nonuse),[8,10] attempting to quit cigarette smoking,[8,9] and quitting among attempters.[8,9] These studies found that adults who are younger,[8] have higher educational attainment,[9] and have lower tobacco dependence[8] are more likely to attempt to quit cigarette smoking than their counterparts. Further, lower tobacco dependence[8] and higher income[9] are positively associated with quitting among attempters.

As the scope of tobacco products has expanded and concurrent use of multiple tobacco products has become common among tobacco users in the U.S.,[11–15] large-scale prospective studies are beginning to evaluate how ENDS may impact cigarette cessation. Using the Population Assessment of Tobacco and Health (PATH) Study, Coleman et al.[16] found that, among adult cigarette smokers, daily ENDS use and lower tobacco dependence were positively associated with cigarette smoking “not at all” one year later. Also using PATH Study data, Buu et al.[17] found that exclusive cigarette smokers who started using ENDS and used ENDS more frequently had lower cigarette consumption and tobacco dependence one year later than those who used ENDS less frequently. Benmarhnia et al.[18] found that cigarette smokers who used ENDS to quit cigarette smoking had higher rates of not smoking for at least the past 30 days at one-year follow-up than those who did not use ENDS. Using data from the National Health Interview Survey (NHIS) and the TUS-CPS, Johnson et al.[19] found that, among cigarette smokers, ENDS use was associated with greater likelihood of making a quit attempt and with higher rates of not smoking for at least the past 90 days at one-year follow-up. On the other hand, a meta-analysis of 38 studies concluded that e-cigarette use was associated with 28% lower odds of quitting cigarettes, though these studies varied in design and in how e-cigarette use was defined.[20]

Using the TUS-CPS, Messer et al.[21] found that cigarette smokers who also used smokeless tobacco were more likely to make a cigarette quit attempt but were less likely to quit when they tried compared to those who did not use smokeless tobacco. Nationally representative data on cessation of noncigarette tobacco products is limited; Coleman et al.[16] found that nondaily ENDS use, nonuse of combustible tobacco products, and use of noncustomizable ENDS devices were positively associated with using ENDS "not at all" one year later.

Understanding factors associated with the transition from tobacco product use to nonuse is important to efforts aimed at decreasing tobacco use prevalence in the population.[22] The purpose of this study is to report on demographic and tobacco use correlates of the following cessation behaviors among the U.S. population of youth (ages 12–17) and adult (ages 18+) tobacco users, for different types of tobacco products, using the PATH Study: (1) discontinuing tobacco product use overall, (2) attempting to quit tobacco product use, and (3) quitting tobacco product use among those who attempted to quit.

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 from September 12, 2013, through December 14, 2014 (Wave 1 [W1]); from October 23, 2014, through October 30, 2015 (Wave 2 [W2]); and from October 19, 2015, through October 23, 2016 (Wave 3 [W3]). The study uses audio computer-assisted self-interviews (ACASI) administered in English or Spanish to collect self-reported information on tobacco-use patterns and associated health behaviors. At W1, the overall weighted response rate was 78.4% for the youth interview and 74.0% for the adult interview; at W2, it was 87.3% for the youth interview and 83.2% for the adult interview; and at W3, it was 83.3% for the youth interview and 78.4% for the adult interview. Further details regarding the PATH Study design and W1 methods are published elsewhere.[23] Details on interview procedures, questionnaires, sampling, weighting, response rates, and accessing the data are described in the PATH Study Restricted Use Files (RUF) User Guide, and Nonresponse Bias Analysis Reports for W1-W3 are available at https://doi.org/10.3886/Series606.[24] The study was conducted by Westat and approved by the Westat 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 present 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.

This paper describes tobacco product cessation behaviors over two 1-year periods. The analytic sample was restricted to respondents who were past 30-day (P30D) users of at least one type of tobacco product at W1 *or* W2, which includes 14,389 adults and 1,374 youth. W1 and W2 are each considered the "baseline" wave to the subsequent wave, such that W1 is the baseline wave to W2, and W2 is the baseline wave to W3. Inclusion in the youth analyses versus the adult analyses was determined based on age at the respective baseline wave.* See Supplemental Table 1 for additional details. The weighted estimates presented in this paper represent the civilian, noninstitutionalized population of the U.S. at the time of

W3 who were age 9 or older at W1, through application of population and replicate weights that adjust for the complex study design characteristics (e.g., oversampling at W1) 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, P30D use, current established use (adults only), and P30D nonlight cigarette smoking (youth only) were defined, as shown in Table 1. Current established use and P30D nonlight cigarette smoking were additionally categorized according to frequency of use (Table 1).

Cessation behaviors—The following cessation behaviors were assessed at follow-up (Table 1): (1) discontinuing use (P30D use to no P30D use), (2) making a quit attempt, and (3) quitting among quit attempters (current established use to no current established use among quit attempters [adults], and P30D nonlight cigarette smoking to no P30D cigarette smoking among quit attempters [youth]).

Tobacco dependence—Sixteen items assessing symptoms of tobacco dependence were included in the PATH Study; responses to these items were combined and scaled to produce an overall tobacco dependence score as described and validated by Strong and colleagues.[25]

Demographic characteristics—Demographic characteristics were assessed at baseline wave and categorized as shown in the tables. Missing data on age, sex, race, and Hispanic ethnicity at W1 were imputed as described in the PATH Study Restricted Use Files User Guide.[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 cessation behaviors 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.[26,27] 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-wave” weights (including full-sample and 100 replicate weights) to produce nationally representative estimates. Variances were computed using the balanced repeated replication

*That is, youth who aged into the adult cohort at W2 were included in the youth analyses between W1 and W2 (N = 352 current users) and were included in the adult analyses between W2 and W3 (N = 334 current users). “Shadow youth” who aged into the youth cohort at W2 (N = 14 current users) were included in the youth analyses only between W2 and W3.

*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

(BRR) method[28] with Fay's adjustment set to 0.3 to increase estimate stability.[29] All analyses were conducted using SAS 9.4 software (SAS Institute, Inc., Cary, NC). See Supplemental Material for the SAS macro code created to run weighted GEE analyses and calculate adjusted odds ratios (aORs) and confidence intervals (CIs). Analyses were run on the W1-W3 Restricted Use File (https://doi.org/10.3886/ICPSR36231.v18).

For each type of tobacco product, cessation behaviors were evaluated with respect to the given tobacco product regardless of other products used.* All analyses were conducted among adults and youth at baseline separately, and were adjusted for all correlates plus wave (some significant wave effects were observed). Estimates with a relative standard error > 30 or with a denominator < 50 are supressed since these estimates may provide unreliable precision and to protect respondent confidentiality.

RESULTS

Discontinuing Use

Adults—Among adult P30D users of each type of tobacco product at baseline, rates of discontinuing use of each product at approximately one year follow-up were 13.4% (95% CI: 12.8–14.1) for cigarettes, 52.6% (95% CI: 50.9–54.4) for ENDS, 48.6% (95% CI: 47.0–50.2) for cigars, 63.8% (95% CI: 61.6–66.0) for hookah, and 25.9% (95% CI: 24.2–27.7) for smokeless tobacco (Table 2).*

Cigarettes: Those ages 25–39 or 40–54 had lower odds of discontinuing cigarette use than those ages 18–24 (aOR = 0.7, 95% CI: 0.6–0.9; aOR = 0.6, 95% CI: 0.5–0.7, respectively); Hispanic smokers had higher odds than non-Hispanic white smokers (aOR = 1.3, 95% CI: 1.1–1.6), those with some college or associate degree (aOR = 1.4, 95% CI: 1.1–1.6) or bachelor's degree or more (aOR = 1.5, 95% CI: 1.2–1.8) had higher odds than those with less than a high school diploma, those with income $25,000-$74,999 (aOR = 1.3, 95% CI: 1.1–1.5) or $75,000+ (aOR = 1.5, 95% CI: 1.3–1.9) had higher odds than those with income < $25,000, and frequent cigarette smokers had much lower odds than infrequent smokers (aOR = 0.2, 95% CI: 0.2–0.2), of discontinuing cigarette use (Table 2).

ENDS: Non-Hispanic black ENDS users had higher odds than non-Hispanic white users (aOR = 1.3, 95% CI: 1.0–1.8), those with income $75,000+ had lower odds than those with income < $25,000 (aOR = 0.8, 95% CI: 0.6–1.0), those who used cigarettes had higher odds than those who did not use cigarettes (aOR = 1.5, 95% CI: 1.2–1.8), those who used hookah had lower odds than those who did not use hookah (aOR = 0.8, 95% CI: 0.6–1.0), and those who were frequent ENDS users had much lower odds than infrequent users (aOR = 0.3, 95% CI: 0.3–0.4), of discontinuing ENDS use (Table 2).

*However, depending on whether respondents were exclusive or multiple product users, they may have been asked about their cessation behavior regarding the specific product, or tobacco products generally (see Table 1 for more details)

*Rates of discontinuing use among those who were current established users of each type of tobacco product at baseline were lower than rates among P30D users as expected: 8.5% (95% CI: 8.0–9.0) for cigarettes, 37.3% (95% CI: 35.2, 39.4) for ENDS, 33.9% (95% CI: 31.9, 36.0) for cigars, 59.9% (95% CI: 56.5, 63.2) for hookah, and 18.3% (95% CI: 16.7, 20.2) for smokeless tobacco (data not shown)

Cigars: Those ages 40–54 or 55+ had lower odds than those ages 18–24 (aOR = 0.7, 95% CI: 0.6–1.0; aOR = 0.4, 95% CI: 0.3–0.6, respectively), male users had lower odds than female users (aOR = 0.8, 95% CI: 0.7–1.0), non-Hispanic black users had lower odds than non-Hispanic white users (aOR = 0.7, 95% CI: 0.5–0.8), with those who identified as gay or lesbian had higher odds than those who identified as straight/heterosexual (aOR = 1.6, 95% CI: 1.0–2.6), those who used hookah had lower odds than those who did not use hookah (aOR = 0.8, 95% CI: 0.6–0.9), and those who were frequent cigar users had much lower odds than infrequent users (aOR = 0.4, 95% CI: 0.3–0.5), of discontinuing cigar use (Table 2).

Hookah: Non-Hispanic other users had lower odds than non-Hispanic white users (aOR = 0.5, 95% CI: 0.3–1.0), and those who were frequent hookah users had lower odds than infrequent users (aOR = 0.7, 95% CI: 0.4–1.0), of discontinuing hookah use (Table 2).

Smokeless tobacco: Male users had lower odds than female users (aOR = 0.7, 95% CI: 0.4–1.0), those who smoked cigarettes had higher odds than those who did not smoke cigarettes (aOR = 1.9, 95% CI: 1.5–2.5), and those who were frequent smokeless tobacco users had much lower odds than infrequent users (aOR = 0.2, 95% CI: 0.2–0.3), of discontinuing smokeless tobacco use (Table 2).

Youth—Among youth P30D users of each type of tobacco product at baseline, rates of discontinuing use of each product at approximately one year follow-up were 32.5% (95% CI: 29.0–36.1) for cigarettes, 55.6% (95% CI: 51.5–59.6) for ENDS, 54.8% (95% CI: 49.1–60.3) for cigars, 70.8% (95% CI: 65.4–75.6) for hookah, and 36.3% (95% CI: 29.2–44.1) for smokeless tobacco (Supplemental Table 2). For youth, GEE models failed to converge for discontinuing use of cigars, hookah, and smokeless tobacco; thus, correlates for discontinuing use of these products are not reported, though rates of discontinuing use for these products, stratified by correlate, are shown in Supplemental Table 2. Significant correlates were age, with older youth less likely than younger youth, sexual orientation, with those who did not identify as straight/heterosexual less likely than those who did identify as straight/heterosexual, and frequency of cigarette use, with those who used 20–30 days less likely than those who used 1–19 days, to discontinue cigarette use (Supplemental Table 2).

Making a Quit Attempt

Adults—Among adult current established users of each type of tobacco product at baseline, rates of making a quit attempt at follow-up were 35.6% (95% CI: 34.6–36.7) for cigarettes, 45.8% (95% CI: 43.8–47.8) for ENDS, 56.2% (95% CI: 53.6–58.7) for cigars, 61.5% (95% CI: 58.6–64.3) for hookah, and 39.2% (95% CI: 36.5–42.0) for smokeless tobacco (Table 3).

Cigarettes: Similar to correlates of discontinuing cigarette use, young adults (18–24 years), Hispanic smokers, those with more education, and those who were not daily smokers at baseline all had higher odds of making a quit attempt than their counterparts (Table 3). Additionally, those who used ENDS had higher odds of making a quit attempt than those who did not use ENDS (aOR = 1.2, 95% CI: 1.1–1.3, Table 3).

ENDS: Similar to correlates of discontinuing ENDS use, non-Hispanic black users, those who used cigarettes, and those who were not daily ENDS users all had higher odds of making a quit attempt than their counterparts (Table 3). Additionally, those with higher tobacco dependence scores had higher odds of making a quit attempt than those with lower scores (aOR = 1.1, 95% CI: 1.0–1.3, Table 3; not assessed for discontinuing use outcome).

Cigars: Somewhat similar to correlates of discontinuing cigar use, young adults (ages 18–24 years, compared to those ages 40–54 years or 55+ years) and those who were not daily cigar users (compared to daily users) had higher odds of making a quit attempt (Table 3). Additionally, Hispanic users had higher odds than non-Hispanic white users (aOR = 1.6, 95% CI: 1.1–2.3), those with a bachelor's degree had lower odds than those with less than a high school diploma (no diploma) or GED (aOR = 0.6, 95% CI: 0.4–0.9), those with household income $75,000+ had lower odds than those with household income < $25,000 (aOR = 0.7, 95% CI: 0.5–1.0), those who used cigarettes had higher odds than those who did not use cigarettes (aOR = 1.4, 95% CI: 1.0–1.9), and those with higher tobacco dependence scores had higher odds than those with lower scores (aOR = 1.3, 95% CI: 1.1–1.5, not assessed for discontinuing use outcome) of making a quit attempt (Table 3).

Hookah: Somewhat similar to correlates of discontinuing hookah use, non-Hispanic other users had lower odds than non-Hispanic white users of making a quit attempt (Table 3). Additionally, those who used cigarettes had higher odds of making a quit attempt than those who did not use cigarettes (aOR = 1.6, 95% CI: 1.1–2.4, Table 3).

Smokeless tobacco: Somewhat similar to correlates of discontinuing smokeless tobacco use, those who were daily users had lower odds of making a quit attempt than those who were not daily users (Table 3). Additionally, those ages 40–54 and those ages 55+ had lower odds than those ages 18–24 (aOR = 0.6, 95% CI: 0.5–0.9; aOR = 0.6, 95% CI: 0.4–0.9, respectively), and those with income $25,000-$74,999 had lower odds than those with income < $25,000 (aOR = 0.8, 95% CI: 0.6–1.0) of making a quit attempt (Table 3).

Youth—Among youth P30D nonlight cigarette smokers at baseline, 57.8% (95% CI: 53.4–62.0) made a quit attempt at follow-up (Supplemental Table 3). The only significant correlate of making a quit attempt was tobacco dependence, with those with higher tobacco dependence having lower odds of making a quit attempt than those with lower tobacco dependence.

Quitting Among Quit Attempters

Adults—Among adult current established users of each type of tobacco product at baseline who made a quit attempt at follow-up, rates of quitting (i.e., no everyday/someday use) at follow-up were 32.9% (95% CI: 31.4–34.3) for cigarettes (Table 4), 85.4% (95% CI: 82.7–87.7) for ENDS, 62.5% (95% CI: 59.7–65.2) for cigars, 84.2% (95% CI: 81.2–86.9) for hookah, and 51.6% (95% CI: 47.7–55.5) for smokeless tobacco. GEE models failed to converge for ENDS, cigars, and hookah; thus, correlates of quitting for these products are not reported, although percentages for quitting for these products, stratified by correlate, are shown in Table 4.

Cigarettes: Somewhat similar to correlates of discontinuing cigarette smoking/making a quit attempt, young adults, those with higher educational attainment, those with higher income, and those who were not daily smokers all had higher odds than their counterparts of quitting when they attempted to do so (Table 4). In addition, non-Hispanic black smokers had lower odds than non-Hispanic white smokers (aOR = 0.7, 95% CI: 0.5–0.9), those who used smokeless tobacco had higher odds than those who did not use smokeless tobacco (aOR = 1.5, 95% CI: 1.1–1.9), and those with higher tobacco dependence had lower odds than those with lower dependence (aOR = 0.6, 95% CI: 0.6–0.7), of quitting when they attempted to do so (Table 4).

Smokeless tobacco: Similar to correlates of discontinuing smokeless tobacco use/making a quit attempt, those with income $25,000-$74,999 had lower odds than those with income < $25,000, those who used smokeless tobacco daily had lower odds than those who used less than daily, and those who smoked cigarettes had higher odds than those who did not smoke cigarettes, of quitting when they attempted to do so (Table 4). In addition, those with higher tobacco dependence had lower odds than those with lower dependence (aOR = 0.7, 95% CI: 0.6–0.9), of quitting when they attempted to do so (Table 4).

Youth—Among youth P30D nonlight cigarette smokers at baseline who made a quit attempt at follow-up, 38.9% (95% CI: 32.9–45.3) did not smoke in the past 30 days at follow-up (Supplemental Table 4). GEE models failed to converge; thus, correlates for quitting among attempters are not reported, although percentages, stratified by correlate, are shown in Supplemental Table 4.

DISCUSSION

PATH Study W1-W3 data show that, among the U.S. population of adult P30D users of each type of tobacco product examined here (cigarettes, ENDS, cigars, hookah, and smokeless tobacco), frequent users were less likely to discontinue use at approximately one year follow-up than infrequent users. Among cigarette smokers, non-Hispanic white smokers (compared to Hispanic smokers), those with lower educational attainment, and those with lower household income were less likely to discontinue cigarette use, whereas among ENDS users, those with lower income were more likely to discontinue ENDS use than those with higher income, and among cigar smokers, non-Hispanic white smokers were more likely to discontinue cigar use than non-Hispanic black smokers.

For cigarette cessation behaviors, tobacco dependence was associated with a lower likelihood of cigarette quitting among those who attempted to quit, as shown before.[8] Additionally, use of ENDS was associated with a greater likelihood of attempting to quit, which is consistent with prior research showing that some cigarette smokers use ENDS to help them quit smoking.[19,30,31] However, we did not see an association between ENDS use and discontinuing cigarette smoking or quitting among attempters as others have found,[18] though this is not surprising given that our descriptive analysis did not consider features of ENDS use that would be important when assessing ENDS use as a potential cessation aid, such as daily versus nondaily ENDS use.[32]

We did, however, find that smokeless tobacco use was associated with greater cigarette quitting among attempters, which differs from the Messer et al.[21] finding and may reflect substitution of cigarette use with smokeless tobacco use.[33,–35] However, here we also found that cigarette smoking was associated with greater smokeless tobacco quitting among quit attempters. Future research can investigate possible explanations for these results by considering whether use of one type of tobacco product is intended to help quit use of another type.

While demographic correlates of cessation behaviors found here generally align with the limited prior national data on cigarette cessation behaviors among adults,[8–10] the PATH Study data additionally show that age, sex, race/ethnicity, and sexual orientation are significant correlates of discontinuing tobacco use among youth. Further, these data show that youth cigarette smokers with higher tobacco dependence were less likely to attempt to quit than those with lower tobacco dependence, though this finding may reflect those with lower dependence being less established smokers/experimental smokers who are no longer smokers at follow-up rather than those with lower dependence being more likely to attempt to quit per se.

Limitations

The findings reported here cover broad cessation behaviors across a range of tobacco products, but this necessarily limits the depth of correlates that could be examined. Future studies can build on these foundational data; for example, studies can consider previous quit attempts, mental health and other substance use correlates, motivations for product use, intentions to quit product use, device features of ENDS, features of quit attempts such as use of cessation medications, and future studies can consider more stringent definitions of quitting such as abstinence for 12+ months.

Another limitation is the way in which quit attempts were queried; those who used multiple tobacco products are sometimes asked whether they tried to quit “tobacco” rather than whether they tried to quit specific types of tobacco products, so in some cases, we were unable to attribute a quit attempt to a specific product. Indeed, we find that about 36% of adult cigarette smokers made a past-year quit attempt, while the NHIS data show that about 55% of adult cigarette smokers (defined the same way) made a past-year quit attempt in 2015.[36] As with survey designs in general, it is also possible that some participants failed to recall having made a quit attempt.[37]

Despite these limitations, and taken together with correlates of tobacco product initiation[38] and tobacco product relapse behaviors,[39] findings underscore tobacco use disparities in the U.S. For example, adults with low income are less likely to quit cigarette smoking when they try and are more likely to relapse after they quit.[39] We also see that a history of tobacco product use predicts transitions both toward and away from using another tobacco product, and additional waves of data will track the stability/transience of tobacco use behaviors over longer periods of time.[1–5,40]

Summary and Implications

Demographic correlates of tobacco cessation behaviors underscore tobacco use disparities in the U.S., such as socioeconomic disparities in cigarette use, which calls for renewed efforts to reduce tobacco use disparities. Further, findings show that use of ENDS and use of smokeless tobacco products are positively related to some adult cigarette cessation behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding: This manuscript is supported with Federal funds from the National Institute on Drug Abuse, National Institutes of Health, and the Center for Tobacco Products, Food and Drug Administration, Department of Health and Human Services, under a contract to Westat (Contract No. HHSN271201100027C).

REFERENCES

1. Taylor KA Sharma E Edwards KC et al. Longitudinal pathways of exclusive and polytobacco cigarette use among youth, young adults, and adults in the United States: findings from the PATH Study Waves 1–3 (2013–2016). Tob Control 2020;29:s139–46. [PubMed: 32321847]
2. Sharma E Edwards KC Halenar MJ et al. Longitudinal pathways of exclusive and polytobacco smokeless use among youth, young adults, and adults in the United States: findings from the PATH Study Waves 1–3 (2013–2016). Tob Control 2020;29:s170–7. [PubMed: 32321851]
3. Stanton CA Sharma E Edwards KC et al. Longitudinal pathways of exclusive and polytobacco electronic nicotine delivery systems (ENDS) use among youth, young adults, and adults in the United States: findings from the PATH Study Waves 1–3 (2013–2016). Tob Control 2020;29:s147–54. [PubMed: 32321848]
4. Edwards KC Sharma E Halenar MJ et al. Longitudinal pathways of exclusive and polytobacco cigar use among youth, young adults, and adults in the United States: findings from the PATH Study Waves 1–3 (2013–2016). Tob Control 2020;29:s163–9. [PubMed: 32321850]
5. Sharma E Bansal-Travers M Edwards KC et al. Longitudinal pathways of exclusive and polytobacco hookah use among youth, young adults, and adults in the United States: findings from the path study waves 1–3 (2013–2016). Tob Control 2020;29:s155–62. [PubMed: 32321849]
6. Zhu S-H, Zhuang Y-L, Wong S, Cummins SE, Tedeschi GJ. E-cigarette use and associated changes in population smoking cessation: evidence from US current population surveys. BMJ. 2017; 358 :j3262. [PubMed: 28747333]
7. Vangeli E, Stapleton J, Smit ES, et al. Predictors of attempts to stop smoking and their success in adult general population samples: a systematic review. Addiction. 2011;106:2110–2121. doi:10.1111/j.1360-0443.2011.03565.x [PubMed: 21752135]
8. Hyland A, Borland R, Li Q, et al. Individual-level predictors of cessation behaviours among participants in the International Tobacco Control (ITC) Four Country Survey International Tobacco Control Policy Evaluation Project. Tobacco Control. 2006;15:iii83–iii94. [PubMed: 16754952]
9. Reid JL, Hammond D, Boudreau C, et al. Socioeconomic disparities in quit intentions, quit attempts, and smoking abstinence among smokers in four western countries: Findings from the International Tobacco Control Four Country Survey. Nicotine & Tobacco Research. 2010;12: S20–S33. [PubMed: 20889477]
10. Yi Z, Mayorga ME, Lich KH, et al. Changes in cigarette smoking initiation, cessation, and relapse among U.S. adults: a comparison of two longitudinal samples. Tobacco Induced Diseases. 2017;15:17. [PubMed: 28316562]
11. Kasza KA, Ambrose BK, Conway KP, et al. Tobacco product use by adults and youths in the United States in 2013 and 2014. N Engl J Med. 2017;376:342–35. [PubMed: 28121512]

12. Lee YO, Hebert CJ, Nonnemaker JM, et al. Multiple tobacco product use among adults in the United States: Cigarettes, cigars, electronic cigarettes, hookah, smokeless tobacco, and snus. Prev Med. 2014;62:14–19. [PubMed: 24440684]
13. Rath JM, Villanti AC, Abrams DB, et al. Patterns of Tobacco Use and Dual Use in US Young Adults: The Missing Link between Youth Prevention and Adult Cessation. Journal of Environmental and Public Health. 2012, Article ID 679134, 9 pages, 2012. 10.1155/2012/679134.
14. Gentzke AS, Creamer M, Cullen KA, et al. Vital Signs: Tobacco product use among middle and high school students — United States, 2011–2018. MMWR Morb Mortal Wkly Rep. 2019;68:157–164. DOI: 10.15585/mmwr.mm6806e1. [PubMed: 30763302]
15. Wang TW, Asman K, Gentzke AS, et al. Tobacco product use among adults — United States, 2017. MMWR Morb Mortal Wkly Rep. 2018;67:1225–1232. DOI: 10.15585/mmwr.mm6744a2. [PubMed: 30408019]
16. Coleman B, Rostron B, Johnson SE, et al. Transitions in electronic cigarette use among adults in the Population Assessment of Tobacco and Health (PATH) Study, Waves 1 and 2 (2013–2015). Tobacco Control Published Online First: 25 4 2018. doi: 10.1136/tobaccocontrol-2017-054174
17. Buu A, Hu Y-H, Piper ME, et al. The association between e-cigarette use characteristics and combustible cigarette consumption and dependence symptoms: Results from a national longitudinal study. Addictive Behaviors. 2018;84: 69–74. [PubMed: 29627636]
18. Benmarhnia T, Pierce JP, Leas E, et al. Can e-cigarettes and pharmaceutical aids increase smoking cessation and reduce cigarette consumption? Findings from a nationally representative cohort of American smokers. American Journal of Epidemiology. 2018;187(11):2397–2404. [PubMed: 29955810]
19. Johnson L, Ma Y, Fisher SL, et al. E-cigarette usage is associated with increased past-12-month quit attempts and successful smoking cessation in two US population-based surveys. Nicotine Tob Res. 2018. doi: 10.1093/ntr/nty211 [Epub ahead of print].
20. Kalkhoran S, Glantz SA. E-cigarettes and smoking cessation in real-world and clinical settings: a systematic review and meta-analysis. Lancet Respir Med. 2016;4(2):116–128. doi:10.1016/S2213-2600(15)00521-4. [PubMed: 26776875]
21. Messer K, Vijayaraghavan M, White MW, et al. Cigarette smoking cessation attempts among current US smokers who also use smokeless tobacco. Addict Behav. 2015;51:113–119. doi:10.1016/j.addbeh.2015.06.045. [PubMed: 26253939]
22. Hyland et al. (under review). Overview of Tobacco Use Transitions for Population Health
23. Hyland A, Ambrose BK, Conway KP, et al. Design and methods of the Population Assessment of Tobacco and Health (PATH) Study. Tob Control. 2017;26:371–378. doi:10.1136/tobaccocontrol-2016-052934. [PubMed: 27507901]
24. Population Assessment of Tobacco and Health (PATH) Study. 10.3886/Series606.
25. Strong DR, Pearson J, Ehlkeb S, et al. Indicators of dependence for different types of tobacco product users: Descriptive findings from Wave 1 (2013–2014) of the Population Assessment of Tobacco and Health (PATH) study. Drug Alcohol Depen. 2017;178, 257–266.
26. Liang K-Y, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika. 1986;73(1):13–22.
27. Hardin JW, Hilbe JM. Generalized estimating equations. Boca Raton, FL: Chapman and Hall/CRC; 2003.
28. McCarthy PJ. Pseudoreplication: further evaluation and applications of the balanced half-sample technique. 1969.
29. Judkins DR. Fay's method for variance estimation. Journal of Official Statistics. 1990;6(3):223.
30. Delnevo CD, Giovenco DP, Steinberg MB, et al. Patterns of electronic cigarette use among adults in the United States. Nicotine & Tobacco Research. 2016;18(5):715–719. [PubMed: 26525063]
31. Richardson A, Pearson J, Xiao H, et al. Prevalence, harm perceptions, and reasons for using noncombustible tobacco products among current and former smokers. Am J Public Health. 2014; 104:1437–1444. doi:10.2105/AJPH.2013.301804. [PubMed: 24922154]
32. Hitchman SC, Brose LS, Brown J, et al. Associations between e-cigarette type, frequency of use, and quitting smoking: Findings from a longitudinal online panel survey in Great Britain. Nicotine & Tobacco Research. 2015;1187–1194. [PubMed: 25896067]

33. Ramström LM, Foulds J. Role of snus in initiation and cessation of tobacco smoking in Sweden. Tobacco Control. 2006;15:210–214. [PubMed: 16728752]

34. Furberg H, Bulik CM, Lerman C, et al. Is Swedish snus associated with smoking initiation or smoking cessation? Tobacco Control. 2005;14:422–424. [PubMed: 16319367]

35. Schauer GL, Pederson LL, Malarcher AM. Past year quit attempts and use of cessation resources among cigarette-only smokers and cigarette-smokers who use other tobacco products. Nicotine & Tobacco Research. 2016; 18(1), 41–47. [PubMed: 25744953]

36. Babb S, Malarcher A, Schauer G, et al. Quitting smoking among adults — United States, 2000–2015. MMWR Morb Mortal Wkly Rep. 2017;65:1457–1464. DOI: 10.15585/mmwr.mm6552a1. [PubMed: 28056007]

37. Berg CJ, An LC, Kirch M, Guo H, Thomas JL, et al. Failure to report attempts to quit smoking. Addictive Behaviours. 2010;35, 900–904.

38. Kasza KA Edwards KC Tang Z et al. Correlates of tobacco product initiation among youth and adults in the United States: findings from the PATH Study Waves 1–3 (2013–2016). Tob Control 2020;46:s191–202.

39. Edwards KC Kasza KA Tang Z et al. Correlates of tobacco product relapse among youth and adults in the United States: findings from the PATH Study Waves 1–3 (2013–2016). Tob Control 2020;29:s216–26. [PubMed: 32321855]

40. Stanton CA Sharma E Seaman EL et al. Initiation of any tobacco and five tobacco products across 3 years among youth, young adults, and adults in the United States: findings from the path Study waves 1–3 (2013–2016). Tob Control 2020;29:s178–90. [PubMed: 32321852]

WHAT THIS PAPER ADDS

- Among adult cigarette smokers, those who are younger, have higher educational attainment and lower tobacco dependence are more likely to attempt to quit than their counterparts, and lower tobacco dependence is also associated with greater quitting among quit attempters
- Nationally representative longitudinal data on correlates of cessation behaviors across other tobacco products are limited
- This paper reports on demographic and tobacco use correlates of cessation behaviors across cigarettes, electronic nicotine delivery systems (ENDS), cigars, hookah, and smokeless tobacco among the U.S. population of adults and youth
- Findings indicate that among adult users of each type of tobacco product, frequent users were less likely to discontinue use than infrequent users; among adult cigarette smokers, those who used ENDS were more likely to attempt to quit but were not more likely to quit when they attempted compared to those who did not use ENDS, while those who used smokeless tobacco were more likely to quit when they attempted compared to those who did not use smokeless tobacco
- Among adult ENDS users, those with lower income were more likely to discontinue ENDS use than those with higher income; among cigar smokers, non-Hispanic white smokers were more likely to discontinue cigar use than non-Hispanic black smokers
- Among youth cigarette smokers, those with higher tobacco dependence were less likely to attempt to quit than those with lower tobacco dependence

Tob Control. Author manuscript; available in PMC 2020 September 28.

Table 1:

Definitions.

Cessation behaviors	Baseline tobacco use group (W1 or W2)	Follow-up outcome (W2 or W3)
Discontinuing use (Table 2 and Supplemental Table 2)	*Adults & Youth*, Past 30-day users: For each of the five types of tobacco products,[‡] used [product/any tobacco] at least once in the past 30 days	*Adults & Youth*, Discontinuing use: No past 30-day use of the given tobacco product
Making a quit attempt (Table 3 and Supplemental Table 3)	*Adults*, Current established users[†]: For cigarettes, currently smoking every day or some days and smoked at least 100 cigarettes in the lifetime; for other tobacco products, currently using the product every day or some days and ever used the product "fairly regularly;" For each type of tobacco product, current established use was further categorized according to frequency as everyday use versus not everyday use *Youth*, Past 30-day nonlight cigarette smokers[ǂ]: For cigarettes, smoked on at least 10 of the past 30 days, which was further categorized according to frequency as smoked on 20 or more days in the past 30 days versus smoked on 10–19 days in the past 30 days (other tobacco products were not assessed)	*Adults*, Making a quit attempt: Making an attempt to completely quit use of the given tobacco product/tobacco generally,[§] or not using the given tobacco product (i.e., currently using "not at all" at follow-up or did not use in the past 12 months)[†] *Youth*, Making a quit attempt: Making an attempt to completely quit cigarettes or not being a past 30-day cigarette smoker
Quitting among quit attempters (Table 4 and Supplemental Table 4)	*Adults*, Current established users who made a quit attempt as defined above *Youth*, Past 30-day nonlight smokers who made a quit attempt as defined above	*Adults*, Quitting: No everyday/someday use of the given tobacco product *Youth*, Quitting: No past 30-day use of cigarettes

Notes:

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

[†]The current established use definition (adults) was used in analyses because these users were asked about making a quit attempt.

[ǂ]The past 30-day nonlight use definition (youth) for cigarettes was used in analyses because these cigarette smokers were asked about making a quit attempt. Users of other products were not asked about quit attempts.

[§]Respondents who were current established users of the given tobacco product at follow-up and were current established users of any non-ENDS product at follow-up, or were current established users of the given tobacco product at follow-up and were current established users of ENDS and at least one other tobacco product at follow-up, were asked about making an attempt to quit using tobacco generally at follow-up rather than specifically about making an attempt to quit use of the given tobacco product at follow-up.

[‡]Tobacco product categories include 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)

[†]Asked consistently across tobacco products

Tob Control. Author manuscript; available in PMC 2020 September 28.

Table 2:

Correlates of Discontinuing P30D Use Among P30D Users (Adults 18+) at Baseline.

	No P30D use at follow-up																							
	Cigarettes					ENDS					Cigars					Hookah					Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**
Overall	13.4	(12.8–14.1)	N/A	N/A		52.6	(50.9–54.4)	N/A	N/A		48.6	(47.0–50.2)	N/A	N/A		63.8	(61.6–66.0)	N/A	N/A		25.9	(24.2–27.7)	N/A	N/A
DEMOGRAPHIC CHARACTERISTICS																								
Age group																								
18–24	21.6	(20.1–23.3)	--	--		55.6	(52.8–58.4)	--	--		51.7	(49.6–53.9)	--	--		61.4	(59.0–63.9)	--	--		33.7	(30.4–37.2)	--	--
25–39	13.7	(12.6–14.9)	0.7	(0.6–0.9)***		52.2	(49.6–54.9)	1.0	(0.8–1.2)		49.7	(46.9–52.5)	1.0	(0.8–1.1)		67.9	(63.0–72.4)	1.3	(0.9–2.0)		31.9	(28.3–35.8)	1.2	(0.9–1.6)
40–54	9.6	(8.6–10.6)	0.6	(0.5–0.7)***		54.5	(51.0–58.0)	1.1	(0.9–1.4)		47.7	(44.4–51.0)	0.7	(0.6–1.0)*		68.2	(57.2–77.5)	1.7	(0.6–4.4)		18.5	(14.6–23.0)	0.9	(0.6–1.3)
55+	11.9	(10.4–13.5)	0.8	(0.6–1.0)		44.9	(40.4–49.5)	0.8	(0.6–1.1)		42.3	(37.7–46.9)	0.4	(0.3–0.6)***		#	#	#	#		17.7	(13.2–23.2)	1.0	(0.6–1.6)
Sex																								
Female	12.7	(11.8–13.7)	--	--		52.6	(50.0–55.1)	--	--		53.1	(50.5–55.6)	--	--		64.4	(61.2–67.5)	--	--		48.6	(36.6–60.8)	--	--
Male	14.1	(13.2–15.0)	1.0	(0.9–1.2)		52.6	(50.4–54.9)	1.1	(0.9–1.3)		46.8	(44.8–48.8)	0.8	(0.7–1.0)*		63.4	(60.4–66.2)	1.1	(0.8–1.5)		24.2	(22.5–25.9)	0.7	(0.4–1.0)*
Race/ethnicity																								
Non-Hispanic White	11.8	(11.0–12.5)	--	--		50.5	(48.6–52.3)	--	--		52.5	(50.1–54.8)	--	--		67.6	(64.2–70.8)	--	--		23.4	(21.6–25.3)	--	--
Non-Hispanic Black	12.7	(11.4–14.1)	1.0	(0.9–1.2)		62.4	(57.3–67.2)	1.3	(1.0–1.8)*		35.9	(33.0–39.0)	0.7	(0.5–0.8)***		65.8	(61.6–69.7)	1.0	(0.6–1.6)		40.6	(30.1–52.0)	1.1	(0.6–2.0)
Non-Hispanic Other (includes two or more races)	18.0	(15.2–21.1)	1.2	(0.9–1.7)		48.5	(41.6–55.6)	0.9	(0.7–1.3)		50.7	(44.5–56.9)	1.2	(0.8–1.8)		50.5	(41.9–59.0)	0.5	(0.3–1.0)*		32.1	(23.7–41.8)	1.1	(0.7–1.9)
Hispanic	20.5	(18.5–22.6)	1.3	(1.1–1.6)*		60.4	(56.6–64.2)	1.2	(1.0–1.6)		50.2	(46.4–54.0)	1.0	(0.8–1.3)		61.4	(57.6–65.0)	0.8	(0.6–1.1)		50.7	(41.1–60.2)	1.5	(0.9–2.7)
Sexual orientation																								

	No P30D use at follow-up																							
	Cigarettes					ENDS					Cigars					Hookah					Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**
Straight/ Heterosexual	13.3	(12.7–14.0)	--	--		52.5	(50.6–54.4)	--	--		48.6	(46.9–50.4)	--	--		63.6	(61.2–66.0)	--	--		25.0	(23.3–26.8)	--	--
Gay or Lesbian	11.3	(8.4–15.0)	0.7	(0.5–1.1)		51.6	(43.2–59.8)	0.9	(0.6–1.4)		50.2	(43.0–57.5)	1.6	(1.0–2.6)*		62.1	(49.7–73.1)	1.3	(0.6–2.9)		#	#	#	#
Bisexual	14.5	(11.9–17.7)	1.1	(0.8–1.3)		53.3	(47.8–58.7)	0.9	(0.7–1.3)		48.1	(42.3–54.0)	1.3	(0.8–2.0)		65.0	(56.9–72.4)	1.1	(0.7–1.7)		#	#	#	#
Something else	17.1	(12.0–23.9)	0.9	(0.5–1.7)		44.8	(34.3–55.8)	0.6	(0.3–1.1)		39.9	(30.2–50.5)	0.9	(0.4–2.0)		71.8	(58.9–81.8)	1.0	(0.4–2.6)		#	#	#	#
Educational attainment																								
Less than high school or some high school (no diploma) or GED	9.1	(8.0–10.2)	--	--		54.4	(51.4–57.4)	--	--		47.6	(44.4–50.9)	--	--		62.9	(58.1–67.5)	--	--		27.4	(24.0–31.1)	--	--
High school graduate—diploma	12.4	(11.2–13.6)	1.2	(1.0–1.5)		54.3	(51.4–57.1)	1.1	(0.9–1.3)		47.4	(44.1–50.8)	1.0	(0.8–1.3)		64.5	(59.5–69.1)	0.9	(0.6–1.3)		24.4	(21.5–27.6)	1.2	(0.8–1.8)
Some college (no degree) or associate degree	14.5	(13.3–15.8)	1.4	(1.1–1.6)***		50.5	(48.2–52.9)	0.9	(0.8–1.1)		46.8	(44.0–49.6)	1.0	(0.8–1.2)		64.3	(60.4–68.0)	0.7	(0.5–1.1)		26.0	(22.6–29.6)	0.9	(0.6–1.4)
Bachelor's degree or more	22.6	(20.6–24.7)	1.5	(1.2–1.8)**		53.0	(48.3–57.5)	1.0	(0.8–1.4)		54.5	(50.5–58.5)	1.1	(0.8–1.6)		62.6	(56.4–68.3)	0.7	(0.4–1.2)		26.7	(21.7–32.3)	0.9	(0.6–1.5)
Annual household income																								
< $25,000	11.0	(10.2–11.9)	--	--		54.1	(51.8–56.4)	--	--		45.9	(43.7–48.0)	--	--		62.0	(58.6–65.3)	--	--		33.6	(30.2–37.2)	--	--
$25,000– $74,999	13.9	(12.8–15.0)	1.3	(1.1–1.5)**		52.8	(49.8–55.8)	1.0	(0.8–1.2)		50.4	(47.7–53.2)	1.1	(0.9–1.4)		66.4	(62.6–70.1)	1.2	(0.9–1.6)		21.8	(18.6–25.4)	0.8	(0.5–1.1)
≥ $75,000	20.6	(18.6–22.8)	1.5	(1.3–1.9)***		47.4	(43.4–51.6)	0.8	(0.6–1.0)*		51.2	(47.4–55.0)	1.2	(0.9–1.6)		64.0	(57.6–70.0)	1.2	(0.8–1.8)		23.4	(19.2–28.2)	1.1	(0.7–1.8)
Not reported	13.8	(11.8–16.0)	1.2	(0.9–1.6)		54.9	(48.2–61.4)	1.1	(0.7–1.6)		52.1	(46.3–57.8)	0.8	(0.6–1.1)		63.9	(56.1–71.0)	1.0	(0.6–1.7)		24.8	(19.1–31.6)	0.9	(0.5–1.6)
TOBACCO USE CORRELATES																								
Use of cigarettes																								

Tob Control. Author manuscript; available in PMC 2020 September 28.

Tob Control. Author manuscript; available in PMC 2020 September 28.

	No P30D use at follow-up																							
	Cigarettes					ENDS				Cigars				Hookah				Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**
No P30D use	N/A	N/A	N/A	N/A		45.2	(41.7–48.8)	--	--	49.6	(46.5–52.6)	--	--	64.3	(61.2–67.2)	--	--	16.4	(14.5–18.6)	--	--
P30D use	N/A	N/A	N/A	N/A		54.9	(53.1–56.6)	1.5	(1.2–1.8)***	48.0	(46.3–49.8)	1.1	(0.9–1.3)	63.4	(60.4–66.4)	1.1	(0.8–1.5)	38.8	(35.7–42.1)	1.9	(1.5–2.5)***
Use of ENDS																					
No P30D use	13.8	(13.0–14.6)	--	--		N/A	N/A	N/A	N/A	48.2	(46.2–50.2)	--	--	65.0	(62.4–67.6)	--	--	22.0	(20.1–24.0)	--	--
P30D use	12.8	(11.7–13.9)	1.0	(0.8–1.1)		N/A	N/A	N/A	N/A	49.6	(46.9–52.3)	1.0	(0.8–1.2)	60.3	(56.4–64.0)	0.8	(0.6–1.1)	43.7	(38.9–48.7)	1.3	(0.9–1.9)
Use of cigars																					
No P30D use	12.9	(12.2–13.6)	--	--		52.4	(50.3–54.4)	--	--	N/A	N/A	N/A	N/A	65.8	(63.0–68.5)	--	--	22.4	(20.6–24.4)	--	--
P30D use	15.6	(14.3–17.0)	1.0	(0.9–1.2)		53.5	(50.5–56.5)	0.9	(0.7–1.1)	N/A	N/A	N/A	N/A	60.8	(57.0–64.6)	0.8	(0.6–1.1)	38.2	(33.8–42.7)	0.8	(0.6–1.2)
Use of hookah																					
No P30D use	12.9	(12.3–13.6)	--	--		53.0	(51.1–54.9)	--	--	48.9	(47.1–50.7)	--	--	N/A	N/A	N/A	N/A	24.6	(22.8–26.3)	--	--
P30D use	21.3	(18.4–24.4)	1.0	(0.8–1.3)		49.5	(45.2–53.7)	0.8	(0.6–1.0)*	46.2	(42.8–49.7)	0.8	(0.6–0.9)*	N/A	N/A	N/A	N/A	46.7	(39.4–54.2)	1.2	(0.7–1.9)
Use of smokeless																					
No P30D use	13.3	(12.7–14.0)	--	--		52.5	(50.8–54.3)	--	--	48.5	(46.7–50.3)	--	--	63.6	(61.3–66.0)	--	--	N/A	N/A	N/A	N/A
P30D use	15.6	(13.2–18.4)	1.0	(0.7–1.4)		52.5	(46.7–58.2)	1.0	(0.7–1.3)	49.1	(44.8–53.5)	1.0	(0.7–1.3)	64.9	(57.1–72.1)	1.1	(0.7–1.8)	N/A	N/A	N/A	N/A
Frequency of use of the given product (in the past 30 days)																					
1–19 days	28.9	(27.4–30.5)	--	--		57.5	(55.6–59.4)	--	--	44.1	(41.8–46.5)	--	--	51.8	(48.3–55.3)	--	--	42.2	(37.6–46.8)	--	--
20–30 days	5.9	(5.5–6.3)	0.2	(0.2–0.2)***		27.0	(24.3–29.8)	0.3	(0.30–4)***	22.0	(18.9–25.5)	0.4	(0.3–0.5)***	44.2	(35.9–52.8)	0.7	(0.4–1.0)*	10.8	(9.4–12.5)	0.2	(0.2–0.3)***

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 “Cigarettes” = 17,792

Denominator N (unweighted number of observations) for aOR in “ENDS” = 4,350

Denominator N (unweighted number of observations) for aOR in “Cigars” = 3,576

Denominator N (unweighted number of observations) for aOR in “Hookah” = 1,262

Denominator N (unweighted number of observations) for aOR in “Smokeless” = 2,132

Tobacco product types were categorized into five groups: cigarettes, ENDS (e-cigarettes at Wave 1, and e-cigarettes, e-cigars, e-pipes, and e-hookah at Waves 2 & 3), cigars (traditional cigars, cigarillos, filtered cigars), hookah, and smokeless tobacco (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:

P30D use is defined as using the product at least once in the past 30 days.

The outcome ‘discontinuing P30D use’ is defined as no P30D use at follow-up (vs. P30D use at follow-up) among P30D users at baseline. Since no P30D use at baseline is defined with respect to each tobacco product, P30D use of ‘other’ tobacco products are considered as correlates of no P30D use of the given tobacco product at follow-up.

Tobacco dependence was not assessed among all P30D users and thus is not included in these analyses.

GEE logistic regression analyses were used to assess correlates of no P30D use at follow-up among P30D 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 Wave 2, 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).

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

Estimates with either a relative standard error greater than 30 or a corresponding denominator less than 50 have been suppressed.

*** p <0.05

**** p <0.01

***** p <0.001

Tob Control. Author manuscript; available in PMC 2020 September 28.

Table 3:

Correlates of Making a Quit Attempt Among Current Established Users (Adults 18+) at Baseline.

	Quit attempt at follow-up																							
	Cigarettes					ENDS					Cigars					Hookah					Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**
Overall	35.6	(34.6–36.7)	N/A	N/A		45.8	(43.8–47.8)	N/A	N/A		56.2	(53.6–58.7)	N/A	N/A		61.5	(58.6–64.3)	N/A	N/A		39.2	(36.5–42.0)	N/A	N/A
DEMOGRAPHIC CHARACTERISTICS																								
Age group																								
18–24	41.5	(39.3–43.6)	--	--		51.1	(46.9–55.3)	--	--		67.1	(62.7–71.2)	--	--		59.4	(55.8–63.0)	--	--		50.9	(45.9–55.9)	--	--
25–39	36.8	(34.9–38.8)	0.9	(0.8–1.0)*		49.1	(45.8–52.4)	1.0	(0.8–1.3)		60.5	(56.4–64.5)	0.8	(0.6–1.0)		65.4	(59.0–71.2)	1.3	(0.9–1.8)		46.1	(41.4–50.9)	0.9	(0.7–1.2)
40–54	32.1	(30.5–33.7)	0.8	(0.6–0.9)***		41.3	(36.7–46.0)	0.7	(0.5–1.0)		52.3	(47.0–57.5)	0.7	(0.5–0.9)*		#	#	#	#		31.0	(26.8–35.6)	0.6	(0.5–0.9)**
55+	34.9	(32.7–37.2)	0.9	(0.7–1.0)		36.8	(31.7–42.3)	0.8	(0.5–1.1)		44.1	(39.0–49.4)	0.6	(0.4–0.9)**		#	#	#	#		28.8	(22.0–36.6)	0.6	(0.4–0.9)*
Sex																								
Female	35.6	(34.2–37.0)	--	--		45.2	(41.6–48.9)	--	--		65.5	(61.5–69.2)	--	--		59.3	(53.8–64.6)	--	--		44.9	(35.0–55.3)	--	--
Male	35.6	(34.2–37.0)	1.0	(0.9–1.1)		46.3	(43.6–49.1)	1.0	(0.8–1.2)		53.7	(50.8–56.7)	0.9	(0.7–1.1)		62.8	(58.9–66.6)	1.1	(0.8–1.5)		38.9	(35.9–41.9)	0.9	(0.6–1.5)
Race/ethnicity																								
Non-Hispanic White	33.7	(32.4–35.0)	--	--		43.2	(41.0–45.4)	--	--		52.4	(48.9–55.9)	--	--		63.3	(58.9–67.6)	--	--		38.1	(35.0–41.2)	--	--
Non-Hispanic Black	35.5	(33.4–37.7)	1.1	(1.0–1.3)		58.2	(48.3–67.5)	1.7	(1.0–2.8)*		61.6	(56.8–66.1)	1.3	(1.0–1.6)		55.4	(47.6–62.9)	0.7	(0.4–1.1)		48.6	(35.5–62.0)	1.4	(0.7–2.9)
Non-Hispanic Other (includes two or more races)	41.5	(37.9–45.1)	1.3	(1.1–1.5)**		48.1	(41.2–55.1)	1.1	(0.8–1.6)		60.2	(49.6–69.9)	1.3	(0.8–2.0)		50.4	(40.4–60.3)	0.6	(0.4–0.9)*		46.3	(35.6–57.3)	1.0	(0.6–1.7)
Hispanic	44.0	(41.1–46.9)	1.4	(12–1.6)***		54.0	(46.1–61.7)	1.4	(1.0–2.0)		66.6	(59.9–72.6)	1.6	(1.1–2.3)**		66.7	(60.0–72.9)	1.4	(0.9–2.1)		48.1	(36.6–59.9)	0.9	(0.5–1.6)
Sexual orientation																								

	Quit attempt at follow-up																							
	Cigarettes					ENDS					Cigars					Hookah					Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**
Straight/ Heterosexual	35.4	(34.3–36.5)	--	--		45.1	(42.9–47.3)	--	--		54.7	(52.0–57.4)	--	--		61.5	(58.3–64.5)	--	--		38.9	(36.2–41.7)	--	--
Gay or Lesbian	36.1	(30.2–42.4)	1.0	(0.7–1.3)		49.6	(40.3–58.8)	1.1	(0.7–1.7)		69.6	(56.5–80.1)	1.3	(0.7–2.5)		61.8	(46.3–75.3)	1.0	(0.5–2.2)		#	#	#	#
Bisexual	39.1	(35.4–42.8)	1.1	(0.9–1.4)		50.1	(41.1–59.1)	1.1	(0.8–1.6)		74.4	(65.9–81.4)	1.6	(0.9–2.7)		56.0	(45.8–65.7)	0.8	(0.5–1.3)		#	#	#	#
Something else	35.2	(26.3–45.3)	1.0	(0.6–1.5)		#	#	#	#		#	#	#	#		#	#	#	#		#	#	#	#
Educational attainment																								
Less than high school or some high school (no diploma) or GED	32.1	(30.6–33.7)	--	--		48.7	(43.4–54.1)	--	--		64.1	(58.9–68.9)	--	--		62.9	(54.9–70.1)	--	--		38.8	(33.8–43.9)	--	--
High school graduate—diploma	32.4	(30.7–34.1)	1.0	(0.9–1.2)		47.6	(43.5–51.8)	1.1	(0.8–1.5)		60.3	(56.0–64.5)	0.9	(0.6–1.2)		63.1	(57.6–68.3)	1.1	(0.7–1.7)		36.5	(32.8–40.4)	1.1	(0.8–1.4)
Some college (no degree) or associate degree	38.5	(36.9–40.0)	1.3	(1.2–1.4)***		45.1	(41.9–48.3)	1.0	(0.7–1.3)		58.0	(54.6–61.3)	0.9	(0.7–1.3)		61.3	(56.6–65.9)	1.2	(0.8–1.9)		41.8	(37.2–46.5)	1.2	(0.9–1.6)
Bachelor's degree or more	42.9	(40.0–45.8)	1.3	(1.1–1.6)***		39.7	(33.8–45.9)	0.9	(0.6–1.3)		36.4	(30.2–43.1)	0.6	(0.4–0.9)*		59.1	(51.5–66.4)	1.1	(0.6–2.1)		39.7	(33.2–46.6)	1.2	(0.8–1.9)
Annual household income																								
< $25,000	34.5	(33.1–35.9)	--	--		50.0	(46.4–53.6)	--	--		64.1	(61.2–67.0)	--	--		62.9	(58.2–67.3)	--	--		46.3	(42.3–50.3)	--	--
$25,000– $74,999	35.9	(34.2–37.6)	1.0	(0.9–1.2)		43.9	(40.1–47.9)	1.0	(0.8–1.3)		56.7	(52.4–60.9)	0.9	(0.7–1.2)		58.5	(53.5–63.3)	0.8	(0.6–1.1)		35.8	(31.3–40.6)	0.8	(0.6–1.0)*
≥ $75,000	39.3	(36.9–41.7)	1.1	(0.9–1.2)		38.9	(33.8–44.2)	0.9	(0.6–1.2)		37.5	(31.5–43.9)	0.7	(0.5–1.0)*		62.8	(54.2–70.7)	1.0	(0.7–1.6)		36.8	(30.8–43.2)	0.8	(0.6–1.3)
Not reported	35.1	(31.9–38.5)	1.0	(0.9–1.2)		50.4	(41.8–59.0)	1.0	(0.7–1.6)		55.9	(46.3–65.1)	0.7	(0.4–1.0)		62.9	(52.8–72.0)	0.9	(0.5–1.5)		39.2	(30.3–49.0)	0.9	(0.6–1.5)
TOBACCO USE CORRELATES																								
Use of cigarettes																								

Tob Control. Author manuscript; available in PMC 2022 September 28.

Tob Control. Author manuscript; available in PMC 2020 September 28.

	Quit attempt at follow-up																							
	Cigarettes					ENDS				Cigars				Hookah				Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**
No P30D use	N/A	N/A	N/A	NA		28.7	(24.9–32.9)	--	--	39.8	(35.4–44.4)	--	--	53.5	(48.2–58.8)	--	--	30.8	(26.9–35.0)	--	--
P30D use	N/A	N/A	N/A	NA		52.5	(50.1–54.9)	1.9	(1.5–2.4)***	64.5	(61.7–67.1)	1.4	(1.0–1.9)*	67.1	(63.1–70.8)	1.6	(1.1–2.4)*	52.1	(47.4–56.7)	1.3	(0.9–1.7)
Use of ENDS																					
No P30D use	34.4	(33.2–35.6)	--	--		N/A	N/A	N/A	N/A	52.9	(49.9–55.9)	--	--	59.8	(56.1–63.4)	--	--	36.1	(33.0–39.4)	--	--
P30D use	39.1	(37.2–40.9)	1.2	(1.1–1.3)***		N/A	N/A	N/A	N/A	65.9	(61.3–70.2)	1.1	(0.9–1.5)	63.8	(58.7–68.7)	1.0	(0.8–1.4)	56.3	(49.6–62.8)	1.1	(0.8–1.6)
Use of cigars																					
No P30D use	35.2	(34.1–36.4)	--	--		43.0	(40.7–45.4)	--	--	N/A	N/A	N/A	N/A	61.6	(57.8–65.3)	--	--	35.3	(32.4–38.4)	--	--
P30D use	38.0	(36.2–39.7)	1.0	(0.9–1.1)		56.0	(52.2–59.7)	1.1	(0.9–1.4)	N/A	N/A	N/A	N/A	62.1	(57.1–66.9)	0.8	(0.6–1.1)	54.3	(49.6–58.9)	1.2	(0.9–1.6)
Use of hookah																					
No P30D use	35.2	(34.2–36.3)	--	--		45.3	(43.2–47.4)	--	--	55.0	(52.3–57.7)	--	--	N/A	N/A	N/A	N/A	38.0	(35.2–40.9)	--	--
P30D use	43.4	(39.7–47.3)	1.0	(0.9–1.2)		49.8	(43.3–56.2)	0.7	(0.5–1.0)*	66.1	(59.3–72.3)	1.0	(0.7–1.5)	N/A	N/A	N/A	N/A	65.9	(56.6–74.2)	1.6	(1.0–2.6)
Use of smokeless																					
No P30D use	35.6	(34.5–36.7)	--	--		44.9	(42.8–47.1)	--	--	55.0	(52.4–57.7)	--	--	60.6	(57.4–63.7)	--	--	N/A	N/A	N/A	N/A
P30D use	37.0	(33.1–41.2)	0.9	(0.8–1.2)		56.3	(47.5–64.7)	1.4	(0.9–2.0)	64.8	(58.3–70.9)	1.2	(0.9–1.7)	68.8	(60.1–76.3)	1.2	(0.8–1.9)	N/A	N/A	N/A	N/A
Frequency of use of the given product																					
No every day use	53.3	(51.2–55.5)	--	--		59.5	(57.0–61.9)	--	--	58.0	(55.0–60.9)	--	--	62.0	(59.0–64.9)	--	--	57.0	(53.1–60.7)	--	--
Every day use	30.5	(29.4–31.5)	0.4	(0.4–0.5)***		27.3	(24.5–30.4)	0.3	(0.3–0.4)***	48.8	(44.4–53.3)	0.6	(0.5–0.7)***	50.1	(38.0–62.3)	0.7	(0.3–1.4)	27.9	(24.9–31.2)	0.4	(0.3–0.5)***
Mean tobacco dependence score[2]	51.8	(51.1–52.6)	1.0	(1.0–1.1)		44.2	(42.6–45.7)	1.1	(1.0–1.3)*	38.7	(36.7–40.6)	1.3	(1.1–1.5)***	26.4	(24.0–28.8)	1.1	(0.9–1.3)	49.4	(47.8–51.0)	1.1	(1.0–1.3)

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 “Cigarettes” = 14,619

Denominator N (unweighted number of observations) for aOR in “ENDS” = 2,550

Denominator N (unweighted number of observations) for aOR in “Cigars” = 2,355

Denominator N (unweighted number of observations) for aOR in “Hookah” = 1,293

Denominator N (unweighted number of observations) for aOR in “Smokeless” = 2,172

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

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

Current established use is defined for cigarettes as currently smoking every day or some days and having smoked at least 100 cigarettes in the lifetime; current established use is defined for other tobacco products as currently using the product every day or some days and having ever used the product “fairly regularly”;

Making a quit attempt is defined as having tried to quit using the given tobacco product in the past 12 months (or having tried to quit using tobacco products generally in the past 12 months if the respondent was using more than one type of tobacco product at baseline), or indicating not currently using the given tobacco product (or tobacco products generally) at follow-up (i.e., not using every day or somedays at follow-up). The outcome ‘making a quit attempt’ is defined as a quit attempt at follow-up (vs. no quit attempt at follow-up) among current established users at baseline. Since no P30D use at baseline is defined with respect to each tobacco product, P30D use of ‘other’ tobacco products at baseline are considered as correlates of ‘making a quit attempt’ of the given tobacco product at follow-up.

GEE logistic regression analyses were used to assess correlates of making a quit attempt at follow-up among current established 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 Wave 2, 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).

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

[2]Tobacco dependence score was defined as described and validated by Strong et al. (2017). Weighted means are presented with 95% confidence intervals. To estimate odds ratios and 95% confidence intervals, the tobacco dependence variable was scaled to a mean of 0 with standard deviation of 1 for each tobacco product (therefore, ORs indicate the likelihood of the outcome per standard deviation unit increase in the level of tobacco dependence for each tobacco product).

[#]Estimates with either a relative standard error greater than 30 or a corresponding denominator less than 50 have been suppressed.

[*] $p < 0.05$

[**] $p < 0.01$

[***] $p < 0.001$

Table 4:

Correlates of Quitting Among Quit Attempters Who were Current Established Users (Adults 18+) at Baseline and Made a Quit Attempt at Follow-Up.

	Quitting among quit attempters at follow-up																							
	Cigarettes					ENDS					Cigars					Hookah					Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**		**%**	**95% CI**	**aOR[1]**	**95% CI**
Overall	32.9	(31.4–34.3)	N/A	N/A		85.4	(82.7–87.7)	N/A	N/A		62.5	(59.7–65.2)	N/A	N/A		84.2	(81.2–86.9)	N/A	N/A		51.6	(47.7–55.5)	N/A	N/A
DEMOGRAPHIC CHARACTERISTICS																								
Age group																								
18–24	40.5	(37.1–44.0)	--	--		83.2	(78.2–87.3)	--	--		67.5	(63.4–71.4)	--	--		82.6	(78.7–85.9)	--	--		51.9	(45.6–58.2)	--	--
25–39	34.3	(31.6–37.2)	0.8	(0.7–1.0)*		84.1	(79.3–88.0)	.			64.7	(60.2–69.0)	.			87.6	(81.9–91.7)	.			53.5	(46.6–60.2)	1.1	(0.7–1.8)
40–54	27.4	(24.7–30.2)	0.7	(0.5–0.9)**		88.5	(83.8–91.9)	.			63.3	(56.7–69.4)	.			#	#	.			49.6	(41.5–57.8)	1.3	(0.8–2.2)
55+	31.6	(28.2–35.2)	0.9	(0.7–1.3)		88.9	(82.3–93.3)	.			49.7	(42.1–57.3)	.			#	#	.			49.3	(33.4–65.3)	1.3	(0.6–3.0)
Sex																								
Female	30.5	(28.6–32.6)	--	--		87.2	(83.7–90.0)	--	--		65.1	(60.6–69.4)	--	--		85.2	(80.3–89.0)	--	--		57.2	(44.0–69.4)	--	--
Male	34.8	(32.8–36.8)	1.1	(1.0–1.3)		84.0	(79.7–87.5)	.			61.6	(58.0–65.0)	.			83.7	(79.3–87.3)	.			51.4	(47.4–55.4)	0.8	(0.4–1.7)
Race/ethnicity																								
Non-Hispanic White	33.1	(31.4–35.0)	--	--		86.5	(83.3–89.1)	--	--		62.7	(58.7–66.4)	--	--		88.3	(84.3–91.4)	--	--		51.2	(47.0–55.5)	--	--
Non-Hispanic Black	25.5	(21.4–30.1)	0.7	(0.5–0.9)**		78.9	(70.4–85.4)	.			56.7	(50.4–62.8)	.			83.4	(72.8–90.4)	.			#	#	1.2	(0.4–3.4)
Non-Hispanic Other (includes two or more races)	36.8	(30.4–43.6)	1.0	(0.7–1.4)		#	#	.			68.4	(54.8–79.4)	.			74.9	(60.2–85.5)	.			46.4	(31.4–62.0)	0.7	(0.3–1.5)
Hispanic	38.2	(33.9–42.8)	1.0	(0.8–1.3)		85.2	(77.9–90.5)	.			68.3	(61.3–74.6)	.			79.4	(72.2–85.1)	.			#	#	0.9	(0.4–1.9)
Sexual orientation																								

	Quitting among quit attempters at follow-up																			
	Cigarettes				ENDS				Cigars				Hookah				Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**
Straight/ Heterosexual	32.9	(31.3–34.4)	--	--	85.4	(82.5–87.9)	--	--	62.1	(58.9–65.1)	--	--	83.0	(79.6–85.9)	--	--	51.0	(47.0–55.0)	--	--
Gay or Lesbian	29.5	(21.3–39.1)	0.8	(0.5–1.4)	#	#	.		#	#	.		#	#	.		#	#	0.3	(0.0–4.8)
Bisexual	34.1	(27.9–40.9)	1.1	(0.8–1.4)	#	#	.		62.2	(50.6–72.5)	.		#	#	.		#	#	3.0	(0.9–10.4)
Something else	32.5	(21.4–46.0)	1.1	(0.6–2.2)	#	#	.		#	#	.		#	#	.		#	#	2.0	(0.0–91.4)
Educational attainment																				
Less than high school or some high school (no diploma) or GED	24.7	(22.3–27.1)	--	--	86.9	(81.7–90.7)	--	--	65.8	(60.4–70.8)	--	--	77.2	(68.1–84.2)	--	--	54.5	(47.7–61.2)	--	--
High school graduate—diploma	33.3	(30.2–36.6)	1.4	(1.1–1.7)**	82.7	(77.3–86.9)	.		65.6	(57.8–72.6)	.		84.6	(78.3–89.2)	.		51.2	(45.0–57.4)	1.0	(0.7–1.6)
Some college (no degree) or associate degree	33.6	(31.2–36.2)	1.3	(1.1–1.6)*	85.3	(81.0–88.7)	.		59.0	(54.9–63.0)	.		84.6	(79.4–88.7)	.		50.1	(43.8–56.4)	0.9	(0.6–1.4)
Bachelor's degree or more	44.4	(40.3–48.5)	1.5	(1.1–1.9)**	88.4	(81.6–92.8)	.		60.8	(51.1–69.7)	.		#	#	.		52.5	(40.2–64.5)	1.0	(0.4–2.5)
Annual household income																				
< $25,000	27.1	(25.3–29.1)	--	--	84.5	(80.8–87.6)	--	--	60.8	(56.7–64.8)	--	--	81.5	(76.9–85.4)	--	--	59.2	(53.3–64.9)	--	--
$25,000– $74,999	35.7	(33.1–38.3)	1.3	(1.1–1.6)**	88.1	(84.3–91.1)	.		65.7	(60.9–70.2)	.		81.1	(74.9–86.0)	.		47.2	(41.2–53.3)	0.6	(0.4–1.0)*
≥ $75,000	44.1	(40.0–48.2)	1.5	(1.2–1.8)**	83.2	(73.7–89.7)	.		60.1	(51.1–68.5)	.		#	#	.		47.4	(38.0–56.9)	0.7	(0.4–1.4)
Not reported	31.8	(26.8–37.3)	1.1	(0.8–1.6)	#	#	.		66.7	(56.5–75.5)	.		#	#	.		53.3	(35.7–70.0)	0.9	(0.4–2.0)
TOBACCO USE CORRELATES																				
Use of cigarettes																				

Tob Control. Author manuscript; available in PMC 2020 September 28.

	Quitting among quit attempters at follow-up																			
	Cigarettes				ENDS				Cigars				Hookah				Smokeless			
Correlates at baseline	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**	**%**	**95% CI**	**aOR[1]**	**95% CI**
No P30D use	N/A	N/A	N/A	N/A	83.1	(77.5–87.6)	--	--	62.8	(55.7–69.3)	--	--	90.9	(86.6–93.9)	--	--	44.3	(38.1–50.6)	--	--
P30D use	N/A	N/A	N/A	N/A	85.9	(82.8–88.5)	.		62.4	(59.3–65.3)	.		80.6	(76.5–84.1)	.		58.3	(53.4–62.9)	2.0	(1.3–2.9)***
Use of ENDS																				
No P30D use	33.0	(31.3–34.7)	--	--	N/A	N/A	N/A	N/A	61.8	(58.0–65.5)	--	--	86.2	(82.0–89.6)	--	--	51.6	(46.8–56.2)	--	--
P30D use	33.0	(30.3–35.9)	1.0	(0.8–1.2)	N/A	N/A	N/A	N/A	64.1	(59.0–68.9)	.		81.6	(76.8–85.6)	.		53.0	(45.5–60.4)	0.7	(0.5–1.2)
Use of cigars																				
No P30D use	32.6	(31.0–34.3)	--	--	86.3	(83.3–88.8)	--	--	N/A	N/A	N/A	N/A	87.1	(83.3–90.2)	--	--	50.4	(45.4–55.4)	--	--
P30D use	33.5	(30.9–36.2)	1.1	(0.9–1.3)	83.1	(78.0–87.2)	.		N/A	N/A	N/A	N/A	79.6	(73.1–84.8)	.		55.0	(47.9–61.9)	0.7	(0.4–1.1)
Use of hookah																				
No P30D use	32.4	(30.9–33.9)	--	--	85.5	(82.7–87.9)	--	--	62.9	(59.7–66.0)	--	--	N/A	N/A	N/A	N/A	51.5	(47.3–55.7)	--	--
P30D use	39.8	(34.2–45.7)	1.1	(0.8–1.5)	84.9	(78.1–89.8)	.		59.7	(52.9–66.1)	.		N/A	N/A	N/A	N/A	52.9	(40.8–64.7)	1.1	(0.6–2.2)
Use of smokeless																				
No P30D use	32.2	(30.7–33.7)	--	--	86.1	(83.5–88.4)	--	--	62.8	(59.7–65.8)	--	--	84.3	(81.1–87.1)	--	--	N/A	N/A	N/A	N/A
P30D use	41.8	(35.9–47.9)	1.5	(1.1–1.9)**	#	#	.		61.0	(53.7–67.7)	.		83.4	(72.9–90.4)	.		N/A	N/A	N/A	N/A
Frequency of use of the given product																				
No every day use	50.2	(47.2–53.2)	--	--	88.7	(85.7–91.1)	--	--	66.7	(63.6–69.6)	--	--	85.0	(81.9–87.6)	--	--	63.7	(57.3–69.6)	--	--
Every day use	24.0	(22.5–25.6)	0.5	(0.4–0.6)***	75.7	(69.9–80.8)	.		45.1	(38.1–52.2)	.		#	#	.		36.8	(30.6–43.6)	0.4	(0.2–0.6)***
Mean tobacco dependence score[2]	48.5	(47.4–49.5)	0.6	(0.6–0.7)***	48.3	(46.1–50.6)	.		44.4	(42.1–46.7)	.		28.6	(26.2–31.1)	.		49.6	(47.0–52.1)	0.7	(0.6–0.9)**

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 “Cigarettes” = 5,208

Denominator N (unweighted number of observations) for aOR in “ENDS” = 1,183

Denominator N (unweighted number of observations) for aOR in “Cigars” = 1,369

Denominator N (unweighted number of observations) for aOR in “Hookah” = 785

Denominator N (unweighted number of observations) for aOR in “Smokeless” = 859

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

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

Current established use is defined for cigarettes as currently smoking every day or some days and having smoked at least 100 cigarettes in the lifetime; current established use is defined for other tobacco products as currently using the product every day or some days and having ever used the product “fairly regularly”;

Making a quit attempt is defined as having tried to quit using the given tobacco product in the past 12 months (or having tried to quit using tobacco products generally in the past 12 months if the respondent was using more than one type of tobacco product at baseline), or not currently using the given tobacco product (or tobacco products generally) at follow-up (i.e., not using every day or somedays at follow-up);

P30D use is defined as using the product at least once in the past 30 days.

The outcome ‘quitting’ is defined as no everyday/someday use at follow-up (vs. everyday/someday use at follow-up) among current established users at baseline who made a quit attempt at follow-up. Since no P30D use at baseline is defined with respect to each tobacco product, P30D use of ‘other’ tobacco products at baseline are considered as correlates of ‘quitting’ for the given tobacco product at follow-up.

GEE logistic regression analyses were used to assess correlates of no everyday/someday use at follow-up among current established users at baseline who made a quit attempt at follow-up using two wave pairs (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 Wave 2, 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).

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

[2]Tobacco dependence score was defined as described and validated by Strong et al. (2017). Weighted means are presented with 95% confidence intervals. To estimate odds ratios and 95% confidence intervals, the tobacco dependence variable was scaled to a mean of 0 with standard deviation of 1 for each tobacco product (therefore, ORs indicate the likelihood of the outcome per standard deviation unit increase in the level of tobacco dependence for each tobacco product).

[#]Estimates with either a relative standard error greater than 30 or a corresponding denominator less than 50 have been suppressed.

GEE models failed to converge for ENDS, cigars, hookah, and smokeless tobacco.

[*] $p < 0.05$

[**] $p < 0.01$

[***] $p < 0.001$

“.” Indicates the adjusted GEE model was not able to converge, likely due to small cell sizes.