Factors associated with changes in flavored tobacco products used: Findings from wave 2 and wave 3 (2014–2016) of the population assessment of tobacco and health (PATH) study

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Abstract

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Introduction: Flavored non-cigarette tobacco product use is widespread in the U.S. The availability of flavor options could be playing a role in recent increases in use, especially for non-cigarette tobacco products, among youth and young adults. Little is known about specific flavor preferences of youth and adult flavored tobacco product users, as well as how preferences may change over time.

Methods: This study analyzes PATH Study data from completed Wave 2 (2014–2015) and Wave 3 (2015–2016) youth (12–17 years), and adult (18 + years) interviews to estimate the prevalence of flavored non-cigarette tobacco product use. We assess flavor switching by examining changes between flavors and characteristics of those who changed flavors between waves.

Results: Across age groups, and at both waves, fruit-flavored products were the most frequently used flavor by past 30-day electronic nicotine delivery systems (ENDS), cigar, cigarillo, and hookah users. In the past 30 days, a higher proportion of youth and young adults used candy/ sweets-flavored ENDS than adults. Among adult ENDS users, the odds of changing flavors were highest among younger users and decreased with increasing age.

Conclusions: Flavored tobacco product use is prevalent across non-cigarette tobacco products. Stability in the number of flavors used, as well as specific flavors, is higher among adult tobacco users, while the use of multiple flavors, and change in specific flavor, is more prevalent among youth tobacco users. Additional longitudinal research can further examine the role flavors play in appeal, product trial, and switching.

1. Introduction

For decades, manufacturers of tobacco products have added flavorings to increase appeal, improve palatability, and mask the harsh effects of tobacco. (Kostygina and Ling, 2016; Kostygina et al., 2016; Kreslake and Yerger, 2010; Sokol et al., 2014) The tobacco industry also has a history of using flavor as a marketing tool. (Carpenter et al., 2005; Cummings et al., 2002) Section 907 of the Family Smoking Prevention and Tobacco Control Act of 2009 banned flavors (except menthol) in cigarettes, but did not extend the ban to other tobacco products, including smokeless tobacco. When the Food and Drug Administration (FDA) gained authority over all tobacco products in 2016, (Deeming Tobacco Products, 2016) that flavor ban was not extended to the newly deemed products, including electronic nicotine delivery systems (ENDS), cigar products, or hookah. In February 2020, FDA implemented a national regulation restricting the sale of flavored, cartridge-based ENDS in the U.S. (U.S., 2020) In addition, several states including New York, New Jersey, and Rhode Island have restricted the sale of flavored ENDS, while Massachusetts banned the sale of all flavored tobacco products and California banned the sale of flavored ENDS and menthol cigarettes. Several localities have also restricted the sale of flavored tobacco products to some degree, with variations in the specific products included in the restrictions. (Campaign for Tobacco-Free Kids, 2021) While cigarettes remain available in only tobacco or menthol flavors, non-cigarette tobacco products are currently available in a multitude of flavors, including

menthol or mint, fruit, candy, and other sweet flavors such as Cotton Candy, Pink Chewing Gum, and Cinnamon Danish. On April 29, 2021, FDA announced its intention to issue a proposed rule to prohibit menthol as a characterizing flavor in cigarettes, as well as prohibit characterizing flavors in cigars. (U.S. Food, 2021) If implemented, these restrictions on all flavors in cigarettes and cigars would effectively eliminate flavored combustible tobacco products in the US (Figs. 1–3).

Flavored tobacco product use is widespread, especially in young tobacco users; however, little is known about changes in preferences of types of flavors used over time. (Delnevo et al., 2015) Understanding this would provide greater insight into the impact of allowing or restricting specific flavors (i.e., fruit flavors, sweet flavors, spice flavors) for tobacco products, particularly as FDA considers premarket tobacco product applications for ENDS that are applying for authorization in specific flavors. (U.S., 2020) At Wave 1 (2013–2014) of the Population Assessment of Tobacco and Health (PATH) Study, 80% of current youth tobacco users (ages 12–17), 73% of current young adult users (ages 18–24), and 45% of adult users (ages 25 +) used a flavored product, respectively. (Villanti et al., 2017) In the same study, 81% of youth, 86% of young adults, and 54% of adults who ever used tobacco did so using a flavored product at their first use (including cigarettes); first use of a flavored tobacco product was associated with higher prevalence of current tobacco use. (Villanti et al., 2017) Additional work by Rose et al. (Rose et al., 2020) examined flavored tobacco product use from Wave 2 of the PATH Study (2014–2015) and found that prevalence of past 30 day flavored tobacco product use remained greatest among youth (72%), followed by young adults (68%) and then adults (45%). Rose et al., (Rose et al., 2020) as well as subsequent analyses by Villanti et al., (Villanti et al., 2019) found that among new users of a tobacco product between Waves 1 and 2 of the PATH Study, over 70% of youth, 55% of young adults, and 45% of adults used at least one flavored tobacco product at first use. Rostron et al. found that in Wave 4 of the PATH Study, flavor use among current ENDS users was particularly high with over 80% of adults and over 95% of youth and young adults reporting past 30-day use of flavored ENDS. (Rostron et al., 2020) Cigarillos were the most commonly used cigar product among this sample and approximately half of the cigarillo users in all three age groups reported current use of a flavored product. More recent data from the 2020 National Youth Tobacco Survey found that among high school students, current ENDS use increased from 2% in 2011 to 19.6% in 2020, with 84.7% of current ENDS users in this group using flavored ENDS. (Wang et al., 2020; Cullen et al., 2018) There is increasing evidence to suggest that youth find the widely marketed varieties of new and existing flavored tobacco products appealing (Delnevo et al., 2015; Gentzke et al., 2020) and that this likely plays a significant role in recent increases in the use of novel tobacco products, including ENDS and hookah, among youth and young adults. (Harrell et al., 2017; Cullen et al., 2019)

In general, flavors in tobacco products may play several roles in increasing appeal among youth, young adults, and adults, including potentially decreasing perceptions of harm from flavored tobacco products and influencing the rate of nicotine absorption through an effect on pH (St.Helen et al., 2017; Zare et al., 2018; Dai and Hao, 2016; Pepper et al., 2016). A recent systematic review by Zare et al. (Zare et al., 2018) examined the literature describing ENDS consumer preference for the specific attributes of flavor, nicotine strength, and type.

This review found that ENDS users, also known as vapers, ranked the selection of flavors and unique flavors as two of the most important factors when choosing between vape shops. (Sussman et al., 2014) Less is known about who uses flavored ENDS, how vapers use flavors, and how often they switch between flavored ENDS, particularly over time.

Previous research evaluating flavored tobacco product use has largely described cross-sectional data with limited evaluation of specific flavor preferences by users of non-cigarette tobacco products. The current study analyzes PATH Study data from completed Wave 2 (2014–2015) and Wave 3 (2015–2016) youth (12–17 years), young adult (18–24 years), and adult (25 + years) interviews. This study provides a more comprehensive report of flavored tobacco and ENDS use among youth, young adults, and adults, as well as extends this cross-sectional work by examining flavor switching over time. This work is designed to add to existing evidence about use patterns of flavored tobacco and ENDS to help inform product regulation. Four aims are evaluated in these analyses: 1) Estimate the prevalence of flavored non-cigarette tobacco product use among past 30-day users of each tobacco product type at Wave 2 and Wave 3; 2) Estimate the prevalence of flavored non-cigarette tobacco product use among new users of each tobacco product type at Wave 2 and Wave 3; 3) Estimate the prevalence of change between flavors, within specific non-cigarette tobacco product types, between Waves 2 and 3; and 4) Examine characteristics of those who changed flavor between Waves 2 and 3 for each non-cigarette tobacco product type. Findings for Wave 1 of the PATH Study are presented elsewhere. (Villanti et al., 2017)

2. Methods

The PATH Study is an ongoing, nationally representative, longitudinal cohort study of 32,320 adults and 13,651 youth in the United States (US). The National Institutes of Health (NIH), through the National Institute on Drug Abuse (NIDA), is partnering with the Food and Drug Administration's (FDA) Center for Tobacco Products to conduct the PATH Study under a contract with Westat. Wave 1 data collection was from September 12, 2013 to December 14, 2014; Wave 2 was from October 23, 2014 to October 30, 2015; Wave 3 took place from October 19, 2015 through October 23, 2016.

The current study analyzes data from the PATH Study Public-Use Files. Full-sample and replicate weights adjusted for the complex study design characteristics and nonresponse at each wave; combined with the probability sample, the weights allow computation of estimates that are robust and representative of the non-institutionalized, civilian US population ages 12 and older.

We present cross-sectional analyses for flavored tobacco product use at Wave 2 and Wave 3. For this manuscript, Wave 2 is comprised of 20,183 adults, 8,174 young adults, and 12,172 youth completed interviews, and Wave 3 includes 19,691 adults, 8,453 young adults and 11,814 youth completed interviews. We also present longitudinal data, from adults (18,127), young adults (7,252), and youth (11,279), who completed both Wave 2 and Wave 3 interviews. At Wave 3, 1,737 of the young adult interviews were completed by "aged-up" adults who had completed a youth interview at Wave 2 and are therefore included in the youth tables. Further details regarding the PATH Study design and methods are published

elsewhere. (Hyland et al., 2017) Details on interview procedures, questionnaires, sampling, response rates, weighting, and accessing the data are available at https://doi.org/10.3886/Series606. The study was conducted by Westat and approved by the Westat Institutional Review Board. All respondents age 18 + provided informed consent. Youth respondents (12–17) provided assent; their parent/legal guardian provided consent.

2.1. Measures

The PATH Study assessed past 30-day non-cigarette tobacco use among youth and adults. This analysis is not restricted to exclusive use of any tobacco product and as such, respondents included in any of the tobacco product use categories may be users of more than one tobacco product, including cigarettes. This analysis focuses on past 30-day use of ENDS, traditional (large) cigars, cigarillos, filtered (little) cigars, hookah tobacco, smokeless tobacco (snuff, dip, chew, loose snus), snus pouches, pipe, and dissolvable tobacco (adults only as youth were not asked about flavored pipe or dissolvable use). New users of a product at Wave 2 reported never use of a product at Wave 1 and past 30-day use of that product at Wave 2. Similarly, new users of a product at Wave 3 reported never use of a product at Wave 2 and past 30-day use of that product at Wave 3. Between Waves 2 and 3, measures evaluating use of flavored ENDS were slightly modified: for Wave 2, among those who reported use of ENDS, respondents were asked if they used flavored ENDS; those who said 'yes' were subsequently asked about their specific flavor preferences. At Wave 3, all respondents who reported use of ENDS were asked about their specific ENDS flavor preferences.

Aim 1 evaluated what proportion of youth, young adult, and adult past 30-day tobacco users at Waves 2 and 3 used products in the past 30 days that were flavored. Users of tobacco products were asked, "Which flavors have you [smoked/used] in the past 30 days?" (response options include (select all that apply): mint/menthol, clove or spice, fruit, chocolate, an alcoholic drink [such as wine, cognac, margarita or other cocktails], candy, desserts (ENDS users only) or other sweets, or some other flavor). At Wave 3, flavor response options for snus and smokeless tobacco included "wintergreen, spearmint, or frost", while flavor response options for ENDS included: "tobacco flavored", and "a non-alcoholic drink [such as coffee, soda, energy drinks, or other beverages]". In an effort to standardize the response options between data collection waves, the "tobacco-flavored" response option was recoded as "no flavor" for this analysis, which is consistent with concurrent work by Villanti et al. on menthol cigarette use. (Villanti et al., 20212021). This applied to first use of a flavored tobacco product as well.

Aim 2 evaluated first use of a flavored tobacco product at Wave 3. Respondents using a new tobacco product at Wave 2 or Wave 3 reported whether the first use of that product was "flavored to taste like menthol, mint, clove, spice, fruit, chocolate, alcoholic drinks, candy or other sweets?" (yes/no/don't know). Respondents who said yes then answered, "Which flavor did you first start using/smoking?" (mint/menthol, clove or spice, fruit, chocolate, an alcoholic drink, candy or other sweets, or some other flavor). At Wave 3, flavor response options for snus and smokeless tobacco included "wintergreen, spearmint, or frost", while flavor response options for ENDS included: "tobacco flavored", and "a non-alcoholic drink

[such as coffee, soda, energy drinks, or other beverages]". Respondents could select more than one flavor.

Aim 3 evaluated the change in the number of flavors used within each tobacco product type among past 30-day users of each product by first creating a count of the number of flavors chosen for each product at Wave 2 and Wave 3. We then created a change measure to categorize whether a respondent changed from using a single flavor to multiple flavors of the same product, changed from using multiple flavors to a single flavor of the same product, or did not change the number of flavors of a product that they used (i.e., consistent use of a single flavor or consistent use of multiple flavors). Finally, using a dummy variable, we created an algorithm to assess if respondents reported a change in specific flavors for each tobacco product used between Wave 2 and Wave 3 (yes/no). Aim 4 of this study evaluated correlates of change in specific flavor within each tobacco product used between Waves 2 and 3.

Sociodemographic variables used in these analyses included self-reported age (categorized as 12–14, 15–17, 18–24, 25–44, 45–64, and 65 +), gender (male/female), race/ethnicity (non-Hispanic White, non-Hispanic Black, other), educational attainment among adults (less than high school, high school diploma or GED, some college, bachelor's degree or more), annual household income among adults (<$10,000, $10,000-$24,999, $25,000-$49,999, $50,000-$99,999, $100,000 or more), and frequent use of products (use on 20 or more days out of the past 30 days). Missing data on age, gender, race, Hispanic ethnicity, and adult education were imputed as described in the PATH Study Public Use Files User Guide. For each product, respondents reported whether one of their reasons for use of that product was because it "comes in flavors I like" (yes/no); use of the product because it comes in flavors that the respondent liked was included as a covariate in the analyses.

2.2. Statistical analyses

We conducted analyses in Stata/SE version 14.1 using survey procedures to account for weighting. We present weighted population-based prevalence estimates for flavor use using the balanced repeated replication (BRR) method with Fay's adjustment set to 0.3, using wave-specific cross-sectional weights. We excluded missing values for use of a flavored product from the analytic sample, presenting only responses of 'Yes', 'No', and 'Don't know'. Logistic regression models were then constructed using Wave 3 longitudinal, all-waves weights to evaluate factors and characteristics of those who changed (yes/no) the number of flavors between Waves 2 and 3 within tobacco products. Respondents with missing data on income, frequency of product use, or reason for product use were excluded from the respective model's analytic sample. For all analyses, estimates were flagged for unreliability if they were based on denominator sample sizes of less than 50, or when the coefficient of variation of the estimate or its complement is larger than 30 percent. (Klein et al., 2010)

3. Results

3.1. Product-specific past 30-day flavor

- *Menthol/mint:* Across all three age groups, menthol/mint was the predominant flavor for past 30-day snus pouch and smokeless users at Wave 2, whereas it was spearmint or wintergreen at Wave 3, when this specific flavor choice was included as an additional response option for snus pouches and smokeless tobacco.

- *Fruit:* Across age groups, and at both waves, fruit was the most prevalent flavor among past 30-day users of ENDS, cigars, cigarillos, and hookah.

- *Candy/sweets:* Candy/sweets flavor was not the most prevalent flavor for any product, but at both waves, it was more commonly used by users of ENDS compared to other products, across all 3 age groups. In the past 30 days, youth and young adults used candy/sweets-flavored ENDS at higher rates than adults. (Figs. 1, 2, and 3)

3.2. Product-specific first product flavor

- *Menthol/mint:* Across age groups, menthol/mint was the predominant flavor for new use of snus pouches and smokeless tobacco users at Wave 2, whereas users were more likely to choose spearmint or wintergreen at Wave 3, when this choice was first offered.

- *Fruit:* Across age groups, and at both waves, fruit was the most prevalent flavor among new users of ENDS, cigars, cigarillos, and hookah.

- *Candy/sweets:* Candy/sweets flavor was not the most prevalent flavor for any product, but at Wave 3, its use was higher for ENDS than for other products and use increased between waves, across age groups. Youth used candy/sweets-flavored ENDS at their first product use at higher rates than adults.

3.3. Change in number of flavors between waves 2 and 3

A greater proportion of adults compared to youth had no change in the total number of flavors used for each tobacco product type (Table 1). More explicitly, a majority of adults who used a single flavor (or multiple flavors) for a specific tobacco product in Wave 2 also used a single flavor (or multiple flavors), respectively, for that specific tobacco product in Wave 3. Among adults who changed the total number of flavors between waves, a greater percentage were likely to go from multiple flavors at Wave 2 to a single flavor for each specific tobacco product at Wave 3. This pattern was also true for young adults; most had no change, but among those for whom there was a change in total number of flavors, more young adults changed from multiple flavors to a single flavor. Among youth, although sample sizes were low, most respondents did not change between waves in the total number of flavors used for each tobacco product.

3.4. Change in specific flavors for each tobacco product used between waves 2 and 3

Among adult past 30-day tobacco users, change in flavor between Wave 2 and Wave 3 was seen most commonly among users of ENDS (64%, standard error [se] = 2.5), cigarillos (55%, se = 5.4) and hookah (73%, se = 5.4) (Table 2, e.g. menthol/mint at Wave 2 and candy at Wave 3). Similarly, among young adults, change in flavor between Wave 2 and Wave 3 was seen most commonly among users of ENDS (80%, se = 2.3), cigarillos (55%, se = 6.8, and hookah (72%, se = 3.6). Table 2 shows that, among youth, a fairly high percentage of ENDS users changed flavors between waves (81%, se = 3.1).

3.5. Predictors of change in specific flavor within tobacco products used

Changes in specific flavor were only explored among adult ENDS users, due to small sample sizes of users of other products. This study found that, among adult ENDS users, the likelihood of changing flavor decreased with age (Table 3). Compared to young adults (age 18 to 24), the likelihood of changing flavors was lower among those age 25 to 44 (OR = 0.91, p = 0.04), those age 45 to 64 (OR = 0.0.88, p = 0.02), and those age 65 and over (OR = 0.70, p = 0.01).

4. Discussion

This study found that in Waves 2 and 3 of the PATH Study, flavored tobacco product use was prevalent across all non-cigarette tobacco products, with fruit being the most popular flavor among youth, young adults, and adults. New users of a tobacco product at Wave 3 more frequently used menthol/mint, fruit, or no flavor/tobacco flavor. This is consistent with other research that suggests these three flavors are the most popular among consumers. (Zare et al., 2018; Soneji et al., 2019; Yingst et al., 2017; Ali et al., 2020; Leventhal et al., 2019)

Results from this study also suggest, between the two time points, that there was stability in the number of flavors and specific flavor used among adult tobacco users, while young adults and youth tobacco users more commonly used products of multiple flavors and changed specific flavors used over time. Further exploration of these findings can inform our understanding of the role flavors play in appeal, product trial, and switching. While adults may be selecting a specific flavor and sticking to it, Table 1 suggests that youth and young adults more frequently changed flavors over time, going from multiple flavors in Wave 2 to a single flavor in Wave 3, or vice versa. This behavior and the underlying motivations are important to understand because they may have implications for greater experimentation among nonusers by increasing appeal to use. In particular, among young adults, a greater percentage used multiple flavors for each product at Wave 2 and used a single flavor at Wave 3. It is possible that youth and young adults are "sampling" multiple flavors for a finite period of time before settling on one preferred flavor. These findings identify switching patterns and specific flavor preferences across different age groups. Additional longitudinal research can further examine more in-depth analyses of frequency of flavor changes within each tobacco product used, as well as how flavor exploration is ultimately associated with tobacco use patterns and progression of use among youth and young adults.

There are some limitations to the presented analyses. These findings are based on participants' self-reported perception of flavor. Potential additional analyses might link a quantitative measure, such as UPC code or chemical analysis of flavor, to determine the flavor of each product more objectively. Also, these analyses are based on data collected from an annual survey, assessing past 30-day tobacco product use. Therefore, interpretation is limited given that flavor switching between surveys that are conducted approximately 12 months apart is unknown. Finally, these analyses are based on PATH Study data collected in 2016, and the flavored tobacco product market has subsequently changed. While the results suggest stability in the number of flavors used among adults, to fully understand this behavior, supplementing this data with more frequent assessment would help provide a more complete picture of the behaviors of flavored tobacco product users.

The high prevalence of flavored non-cigarette tobacco product use found in this study supports the need to decrease youth access to, and appeal of, flavored tobacco products, including ENDS and cigar products. In March 2019, FDA published a draft guidance for the tobacco industry (U.S. Food & Drug Administration Center for Tobacco Products) that discusses prioritizing enforcement resources for flavored ENDS and cigars that do not have proper marketing authorizations from FDA and are sold in ways that increase risk for youth access. In April 2020; FDA finalized the enforcement policy (U.S., 2020) on unauthorized flavored cartridge-based e-cigarettes in the US; including fruit and mint, which were removed from the market by February 2020. However, the removal of these specific flavored products may potentially have allowed for increased use of other types of flavored ENDS, including disposable and tank systems. Given the predominant use of flavored products among tobacco users, additional analyses can monitor the impact of these types of regulations on product initiation and flavor switching among all users. In addition, analyzing the specific preferences and patterns of flavored non-cigarette tobacco products used by cigarette smokers would be informative, as smokers of cigarettes might have different preferences for certain flavors compared to cigarette non-smokers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

Ali FRM, Diaz MC, Vallone D, Tynan MA, Cordova J, Seaman EL, et al. (2020). E-cigarette Unit Sales, by Product and Flavor Type - United States, 2014–2020. MMWR. Morbidity and Mortality Weekly Report, 69(37), 1313–1318. [PubMed: 32941416]

Campaign for Tobacco-Free Kids. States and Localities with Flavored Tobacco Restrictions. 2021; https://www.tobaccofreekids.org/assets/factsheets/0398.pdf.

Carpenter CM, Wayne GF, Pauly JL, Koh HK, &Connolly GN (2005). New cigarette brands with flavors that appeal to youth: Tobacco marketing strategies. Health Affairs (Project Hope)., 24(6), 1601–1610. [PubMed: 16284034]

Cullen KA, Ambrose BK, Gentzke AS, Apelberg BJ, Jamal A, & King BA (2018). Notes from the Field: Use of Electronic Cigarettes and Any Tobacco Product Among Middle and High School Students - United States, 2011–2018. MMWR. Morbidity and Mortality Weekly Report, 67(45), 1276–1277. [PubMed: 30439875]

Cullen KA, Liu ST, Bernat JK, Slavit WI, Tynan MA, King BA, et al. (2019). Flavored Tobacco Product Use Among Middle and High School Students - United States, 2014–2018. MMWR. Morbidity and Mortality Weekly Report, 68(39), 839–844 [PubMed: 31581163]

Cummings KM, Morley CP, Horan JK, Steger C, & Leavell N-R (2002). Marketing to America's youth: Evidence from corporate documents. Tobacco Control, 11 (Supplement 1), i5–i17. [PubMed: 11893810]

Dai H, & Hao J (2016). Flavored Electronic Cigarette Use and Smoking Among Youth. Pediatrics, 138(6).

Deeming Tobacco Products To Be Subject to the Federal Food, 2016. Drug, and Cosmetic Act, as Amended by the Family Smoking Prevention and Tobacco Control Act; Restrictions on the Sale and Distribution of Tobacco Products and Required Warning Statements for Tobacco Products; Final Rule; https://www.govinfo.gov/content/pkg/FR-2016-05-10/pdf/2016-10685.pdf.

Delnevo CD, Giovenco DP, Ambrose BK, Corey CG, & Conway KP (2015). Preference for flavoured cigar brands among youth, young adults and adults in the USA. Tobacco Control, 24(4), 389–394. [PubMed: 24721967]

Gentzke AS, Wang TW, Jamal A, Park-Lee E, Ren C, Cullen KA, et al. (2020). Tobacco Product Use Among Middle and High School Students - United States, 2020. MMWR. Morbidity and Mortality Weekly Report, 69(50), 1881–1888. [PubMed: 33332300]

Harrell M, Loukas A, Jackson C, Marti CN, & Perry C (2017). Flavored Tobacco Product Use among Youth and Young Adults: What if Flavors Didn't Exist? Tobacco Regulatory Science., 3(2), 168–173. [PubMed: 28775996]

Hyland A, Ambrose BK, Conway KP, Borek N, Lambert E, Carusi C, et al. (2017). Design and methods of the Population Assessment of Tobacco and Health (PATH) Study. Tobacco Control, 26(4), 371–378. [PubMed: 27507901]

Klein RJ, Proctor SE, Boudreault MA, Turczyn KM. Healthy People 2010 criteria for data suppression. Healthy People 2010 statistical notes: from the Centers for Disease Control and Prevention/National Center for Health Statistics. 2002(24):1–12.

Kostygina G, Ling PM. (2016). Tobacco industry use of flavourings to promote smokeless tobacco products. Tobacco Control 25(Suppl 2):ii40–ii49. [PubMed: 27856998]

Kostygina G, Glantz SA, & Ling PM (2016). Tobacco industry use of flavours to recruit new users of little cigars and cigarillos. Tobacco Control, 25(1), 66–74 [PubMed: 25354674]

Kreslake JM, & Yerger VB (2010). Tobacco industry knowledge of the role of menthol in chemosensory perception of tobacco smoke. Nicotine & Tobacco Research, 12(Supplement 2), S98–S101. [PubMed: 21177374]

Leventhal AM, Miech R, Barrington-Trimis J, Johnston LD, O'Malley PM, & Patrick ME (2019). Flavors of e-Cigarettes Used by Youths in the United States. JAMA, 322(21), 2132–2134. [PubMed: 31688891]

Pepper JK, Ribisl KM, Brewer NT. Adolescents' interest in trying flavoured e-cigarettes. Tobacco control. 2016;25(Suppl 2):ii62–ii66. [PubMed: 27633762]

Rose SW, Johnson AL, Glasser AM, et al. (2020). Flavour types used by youth and adult tobacco users in wave 2 of the Population Assessment of Tobacco and Health (PATH) Study 2014–2015. Tobacco Control, 29(4), 432–446. [PubMed: 31542778]

Rostron BL, Cheng YC, Gardner LD, & Ambrose BK (2020). Prevalence and Reasons for Use of Flavored Cigars and ENDS among US Youth and Adults: Estimates from Wave 4 of the PATH Study, 2016–2017. American Journal of Health Behavior, 44 (1), 76–81. [PubMed: 31783934]

Sokol NA, Kennedy RD, & Connolly GN (2014). The role of cocoa as a cigarette additive: Opportunities for product regulation. Nicotine & Tobacco Research, 16(7), 984–991. [PubMed: 24610479]

Soneji SS, Knutzen KE, Villanti AC. Use of Flavored E-Cigarettes Among Adolescents, Young Adults, and Older Adults: Findings From the Population Assessment for Tobacco and Health Study. Public health reports (Washington, DC : 1974). 2019;134 (3):282–292.

St.Helen G, Dempsey DA, Havel CM, Jacob P, & Benowitz NL (2017). Impact of e-liquid flavors on nicotine intake and pharmacology of e-cigarettes. Drug and Alcohol Dependence, 178, 391–398. [PubMed: 28704768]

Sussman S, Garcia R, Cruz TB, Baezconde-Garbanati L, Pentz MA, & Unger JB (2014). Consumers' perceptions of vape shops in Southern California: An analysis of online Yelp reviews. Tobacco Induced Diseases, 12(1), 1–9. [PubMed: 24444137]

U.S. Food & Drug Administration Center for Tobacco Products. FDA Deems Certain Tobacco Products Subject to FDA Authority, Sales and Distribution Restrictions, and Health Warning Requirements for Packages and Advertisements, https://www.fda.gov/regulatory-information/search-fda-guidance-documents/fda-deems-certain-tobacco-products-subject-fda-authority-sales-and-distribution-restrictions-and.

U.S. Food & Drug Administration. FDA News Release. FDA Commits to Evidence-Based Actions Aimed at Saving Lives and Preventing Future Generations of Smokers. 2021; https://www.fda.gov/news-events/press-announcements/fda-commits-evidence-based-actions-aimed-saving-lives-and-preventing-future-generations-smokers.

U.S. Food and Drug Administration Center for Tobacco Products. 2020, Enforcement Priorities for Electronic Nicotine Delivery Systems (ENDS) and Other Deemed Products on the Market Without Premarket Authorization (Revised). https://www.fda.gov/media/133880/download.

U.S. Food & Drug Administration. Premarket Tobacco Product Applications. 2020; https://www.fda.gov/tobacco-products/market-and-distribute-tobacco-product/premarket-tobacco-product-applications.

United States Department of Health and Human Services. National Institutes of Health. National Institute on Drug Abuse, and United States Department of Health and Human Services Food and Drug Administration. Center for Tobacco Products. Population Assessment of Tobacco and Health (PATH) Study [United States] Public Use Files 2018–09-28. Inter-university Consortium for Political and Social Research [distributor] Ann Arbor, MI 10.3886/ICPSR36498.v8.

Villanti AC, Johnson AL, Halenar MJ, et al. Menthol and Mint Cigarettes and Cigars: Initiation and Progression in Youth, Young Adults and Adults in Waves 1–4 of the PATH Study, 2013–2017. Nicotine & Tobacco Research. 2020.

Villanti AC, Johnson AL, Ambrose BK, Cummings KM, Stanton CA, Rose SW, et al. (2017). Flavored Tobacco Product Use in Youth and Adults: Findings From the First Wave of the PATH Study (2013–2014). American Journal of Preventive Medicine, 53(2), 139–151. [PubMed: 28318902]

Villanti AC, Johnson AL, Glasser AM, Rose SW, Ambrose BK, Conway KP, et al. (2019). Association of Flavored Tobacco Use With Tobacco Initiation and Subsequent Use Among US Youth and Adults, 2013–2015. JAMA Netw Open., 2(10), e1913804. 10.1001/jamanetworkopen.2019.13804 [PubMed: 31642927]

Wang TW, Neff LJ, Park-Lee E, Ren C, Cullen KA, & King BA (2020). E-cigarette Use Among Middle and High School Students - United States, 2020. MMWR. Morbidity and Mortality Weekly Report, 69(37), 1310–1312. [PubMed: 32941408]

Yingst JM, Veldheer S, Hammett E, Hrabovsky S, & Foulds J (2017). A Method for Classifying User-Reported Electronic Cigarette Liquid Flavors. Nicotine & Tobacco Research, 19(11), 1381–1385. [PubMed: 28064201]

Zare S, Nemati M, Zheng Y, & Cormet-Boyaka E (2018). A systematic review of consumer preference for e-cigarette attributes: Flavor, nicotine strength, and type. PLoS ONE, 13(3), e0194145. [PubMed: 29543907]
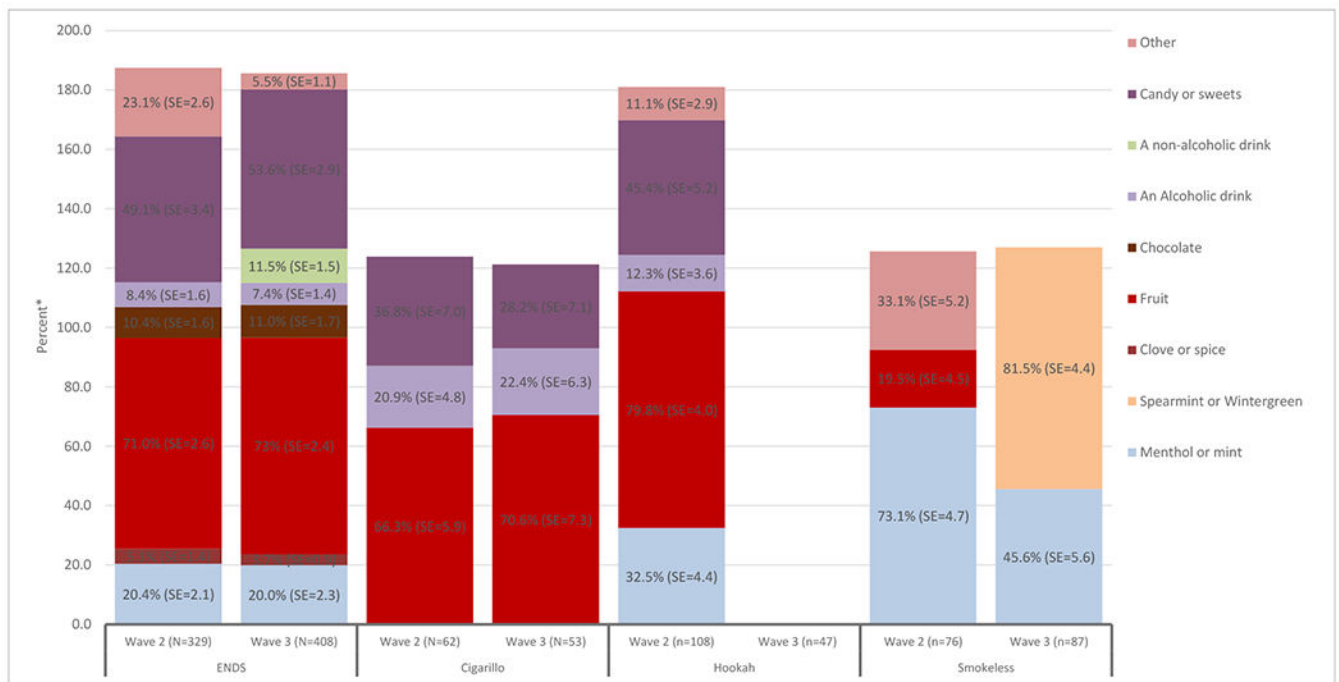
Fig. 1.
Past 30-day use of flavored tobacco products among youth (12–17) at Wave 2 and Wave 3 Notes: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 2 and Wave 3 cross-sectional weights. Smokeless includes snuff, dip, chew, and loose snus. Percentages add up to more than 100% because respondents were allowed to select more than one flavor used in the past 30 days. Results for traditional cigars, filtered cigars, hookah (Wave 3), and snus pouches are not presented because the result is statistically unreliable. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30 percent.
Notes: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 2 and Wave 3 cross-sectional weights. Smokeless includes snuff, dip, chew, and loose snus. Percentages add up to more than 100% because respondents were allowed to select more than one flavor used in the past 30 days.
Results for traditional cigars, filtered cigars, hookah (Wave 3), and snus pouches are not presented because the result is statistically unreliable. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30 percent.

Fig. 2.

Past 30-day use of flavored tobacco products among young adults (18–24) at Wave 2 and Wave 3 Notes: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 2 and Wave 3 cross-sectional weights. Smokeless includes snuff, dip, chew, and loose snus. Percentages add up to more than 100% because respondents were allowed to select more than one flavor used in the past 30 days. Results pipes are not presented because the result is statistically unreliable. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30 percent.

Note: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 2 and Wave 3 cross-sectional weights. Smokeless includes snuff, dip, chew, and loose snus. Percentages add up to more than 100% because respondents were allowed to select more than one flavor used in the past 30 days.

Results pipes are not presented because the result is statistically unreliable. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30 percent.
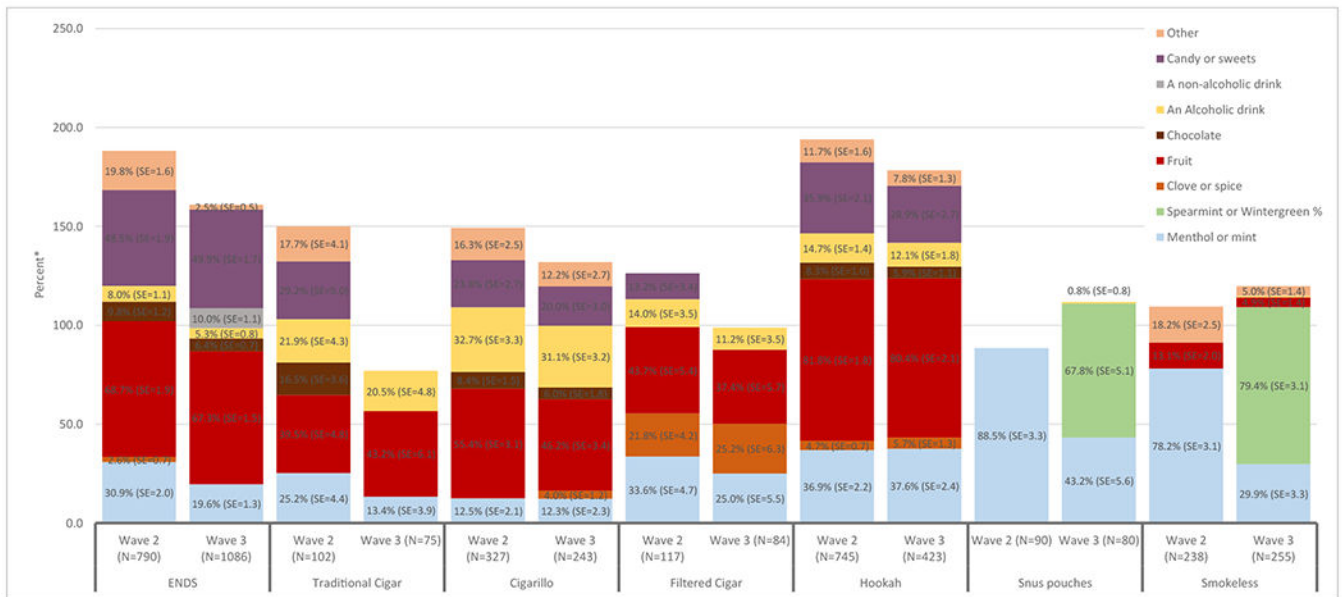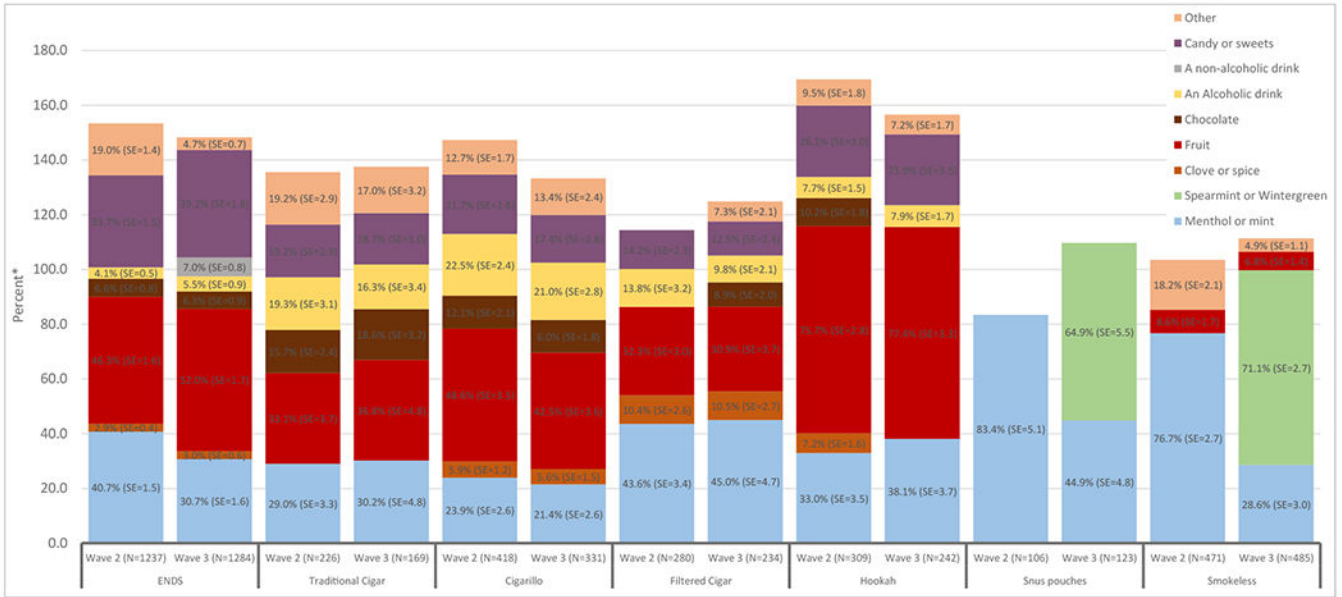
Fig. 3.

Past 30-day use of flavored tobacco products among adults (25 +) at Wave 2 and Wave 3 Notes: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 2 and Wave 3 cross-sectional weights. Smokeless includes snuff, dip, chew, and loose snus. Percentages add up to more than 100% because respondents were allowed to select more than one flavor used in the past 30 days. Results pipes are not presented because the result is statistically unreliable. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30 percent.

Notes: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 2 and Wave 3 cross-sectional weights. Smokeless includes snuff, dip, chew, and loose snus. Percentages add up to more than 100% because respondents were allowed to select more than one flavor used in the past 30 days.

Results pipes are not presented because the result is statistically unreliable. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30 percent.

Table 1

Changes in number of flavor categories used by PATH Study adults, young adults, and youth, between Waves 2 and 3.

Number of flavors used at Wave 2 and Wave 3 among youth respondents to both waves (n = 11,279)

| | | Change in Number of Flavor Categories Used | | | | | | | | | | | |
| | | No Change (single to single) | | | No Change (multiple to multiple) | | | Multiple to Single | | | Single to Multiple | | |
Flavored tobacco product	N (past 30 day users of flavored products at both waves)	N	%	SE	N	%	SE	N	%	SE	N	%	SE
ENDS	130	42	31.7	4.2	38	28.5	4.3	30	21.9	3.6	20	17.9	3.2
Traditional Cigar	4	1	25.3^	22.7	0	0.0	0.0	1	14.7^	15.9	2	60.1^	26.6
Cigarillo	12	7	61.7^	16.4	2	12.9^	9.5	1	8.0^	8.1	2	17.4^	12.2
Filtered Cigar	5	2	51.4^	22.2	1	11.7^	16.3	1	17.0^	20.2	1	19.8^	15.1
Hookah	13	2	15.5^	10.7	6	35.8^	12.2	2	24.3^	16.2	3	24.5^	14.2
Snus pouches	6	2	42.4^	25.6	1	16.4^	17.4	2	31.3^	20.9	1	10.0^	9.5
Smokeless	37	20	50.6^	7.2	3	8.7^	5.0	9	25.9^	6.9	5	14.9^	6.3

Number of flavors used at Wave 2 and Wave 3 among young adult (age 18–24) respondents to both waves (n = 7,252)

| | | Change in Number of Flavor Categories Used | | | | | | | | | | | |
| | | No Change (single to single) | | | No Change (multiple to multiple) | | | Multiple to Single | | | Single to Multiple | | |
Flavored tobacco product	N (past 30 day users of flavored products at both waves)	N	%	SE	N	%	SE	N	%	SE	N	%	SE
ENDS	310	97	30.0	2.9	102	34.5	2.9	67	21.2	2.8	44	14.3	2.6
Traditional Cigar	11	5	49.5^	15.8	2	11.9^	9.0	3	30.9^	17.0	1	7.8^	7.8
Cigarillo	62	33	55.3	6.5	12	18.4	5.0	13	21.3	4.8	4	5.1^	2.6
Filtered Cigar	17	10	57.4^	11.2	1	6.3^	6.8	2	13.0^	8.4	4	23.3^	11.3
Pipe	5	4	90.9^	11.9	0	0.0	0.0	0	0.0	0.0	1	9.1^	11.9
Hookah	165	36	25.2	3.5	72	40.7	4.8	36	21.6	3.3	21	12.6	3.2
Snus pouches	23	20	83.9^	9.1	1	4.2^	4.3	2	11.9^	8.4	0	0.0	0.0
Smokeless	121	91	77.7	3.6	3	2.3^	1.4	19	14.0	3.2	8	5.9^	2.0

Number of flavors used at Wave 2 and Wave 3 among adult (age 25 +) respondents to both waves (n = 18,127)

| | | Change in Number of Flavor Categories Used | | | |
		No Change (single to single)	No Change (multiple to multiple)	Multiple to Single	Single to Multiple

Number of flavors used at Wave 2 and Wave 3 among youth respondents to both waves (n = 11,279)

		Change in Number of Flavor Categories Used											
		No Change (single to single)			No Change (multiple to multiple)			Multiple to Single			Single to Multiple		
Flavored tobacco product	N (past 30 day users of flavored products at both waves)	N	%	SE	N	%	SE	N	%	SE	N	%	SE
ENDS	528	250	47.5	2.7	125	23.4	1.9	92	18.1	2.0	61	11.0	1.5
Traditional Cigar	45	20	46.4^	8.5	6	12.0^	5.2	10	20.4^	6.1	9	21.3^	7.5
Cigarillo	108	67	65.5	4.9	14	12.3^	3.8	16	13.9	3.3	11	8.3	2.5
Filtered Cigar	96	75	76.9	5.8	3	5.2^	3.0	9	10.9^	3.7	9	7.1^	2.6
Pipe	6	4	77.5^	19.3	1	12.1^	14.7	0	0.0		1	10.5^	13.0
Hookah	79	23	28.5	6.4	26	32.5	7.2	13	16.9	4.7	17	22.1	5.3
Snus pouches	41	37	91.0	5.1	0	0.0	0.0	2	4.6^	3.6	2	4.4^	3.5
Smokeless	282	248	87.8	2.3	6	2.1^	1.0	16	5.0^	1.5	12	5.1^	1.7

Note: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 3 longitudinal weights. Smokeless includes snuff, dip, chew, and loose snus.

^
Estimate has been flagged because it is statistically unreliable. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30 percent.

Table 2

Changes in specific flavor categories used by PATH Study adults, young adults, and youth, between Waves 2 and 3.

Flavored tobacco product	N (past 30 day users of flavored products at both waves)	Change among youth		
		N	%	se
ENDS	130	105	80.9	3.1
Traditional Cigar	4	3	74.7^	22.7
Cigarillo	12	8	63.8^	14.2
Filtered Cigar	5	3	68.3^	18.1
Hookah	13	10	78.7^	11.5
Snus pouches	6	4	57.6^	25.6
Smokeless	37	23	66.4^	7.1

Table 3

Predictors of change in flavor category among PATH Study adults (age 18 +) who used flavored ENDS between Waves 2 and 3 (n = 587).

Wave 2 Demograhic and user characteristics		N	%	SE	OR	p-value
Sex	Male	330	58.3	2.6	1.00	Ref
	Female	257	41.7	2.6	0.93	0.12
Age	18–24	246	31.8	1.9	1.00	Ref
	25–44	247	46.8	2.2	0.91	0.04
	45–64	84	19.0	2.1	0.88	0.02
	65+	10	2.4	0.7	0.70	0.01
Race/Eth	Non-Hispanic White	468	83.5	2.1	1.00	Ref
	Non-Hispanic Black	37	5.6	1.1	0.83	0.05
	Other	70	11.0	1.6	1.02	0.78
Education	Less than High School	67	9.8	1.6	1.00	Ref
	High School Graduate	171	30.5	2.3	1.01	0.93
	Some College	277	47.4	2.6	1.08	0.26
	Bachelor's degree +	70	12.4	1.5	1.01	0.84
Income	Less than $10,000	96	17.0	1.8	1.00	Ref
	$10-$24,999	139	23.4	2.3	1.00	0.96
	$25–49,999	137	23.4	1.8	0.92	0.23
	$50–99,999	118	22.5	2.3	1.01	0.84
	$100,000 +	73	13.8	1.8	0.97	0.72
Frequent User	No	269	42.7	2.6	1.00	Ref
	Yes	318	57.3	2.6	0.96	0.39
Use product because it comes in flavors I like	Mentioned	500	90.2	1.9	1.00	Ref
	Not mentioned	41	9.8	1.9	0.95	0.48

Note: Data are from the PATH Study Public Use Files. N's are unweighted. Estimates are weighted using Wave 3 longitudinal weights. Table shows results of logistic regression models predicting change in flavor categories, controlling for each variable presented in the table.