



# HHS Public Access

Author manuscript

*Tob Regul Sci.* Author manuscript; available in PMC 2019 November 06.

Published in final edited form as:

*Tob Regul Sci.* 2019 November ; 5(6): 518–531. doi:10.18001/TRS.5.6.4.

## Flavored ENDS Use among Adults Who Have Used Cigarettes and ENDS, 2016–2017

**Dina M. Jones, PhD, MPH [Postdoctoral Research Fellow]**

University of Arkansas for Medical Sciences, College of Public Health, Little Rock, AR.

**David L. Ashley, PhD [Professor], Scott R. Weaver, PhD [Associate Professor]**

Georgia State University, School of Public Health, Department of Population Health Sciences, Atlanta, GA.

**Michael P. Eriksen, ScD [Interim Vice President for Research and Economic Development, Regents' Professor, Founding Dean]**

Georgia State University, School of Public Health, Department of Health Policy and Behavioral Sciences, Atlanta, GA.

### Abstract

**Objective:** In this study, we assessed differences in type, number, and perceptions of ENDS flavors used at initiation and currently among 4 smoking and ENDS use profiles of US adults with a history of smoking and ENDS use.

**Methods:** Our nationally representative survey sample included 1814 participants. We estimated Rao-Scott  $\chi^2$  and adjusted odds ratios. Use profiles included: (1) Dual Users (current smokers/current ENDS users), (2) ENDS Rejecters (current smokers/former ENDS users), (3) Switchers (former smokers/current ENDS users), and (4) Quitters (former smokers/former ENDS users).

**Results:** Multiple flavor use at initiation was associated with higher odds of being a Dual User or Switcher. Those who used mint/wintergreen/menthol flavored ENDS at initiation had lower odds of being an ENDS Rejecter (vs Dual User). Current use of tobacco/unflavored or menthol/mint/wintergreen flavor was associated with higher odds of being a Dual User (vs Switcher). Switchers were more likely to perceive flavors as safe in ENDS and rate flavors as important to their ENDS use.

**Conclusions:** Multiple flavor use at initiation, perceiving flavors as safe, and use of specific flavors (mint/wintergreen/menthol) at initiation may discourage rejecting ENDS. However, current use of traditional cigarette flavors (ie, tobacco, menthol) may promote sustained smoking.

---

Correspondence Dr Jones; dmjones2@uams.edu.

Human Subjects Statement

This study was approved by the Georgia State University Institutional Review Board (approval #H14028, 05/15/14) who granted a waiver of informed consent.

Conflict of Interest Disclosure Statement

MPE receives unrestricted research funding support from Pfizer, Inc ('Diffusion of Tobacco Control Fundamentals to Other Large Chinese Cities' MPE, Principal Investigator). DLA has received funds for work done for the World Health Organization Tobacco Free Initiative and as a Special Government Employee of the US Food and Drug Administration.

## Keywords

flavors; e-cigarettes; dual use; risk perceptions; smoking; cessation; harm reduction

There is a debate concerning the utility of electronic nicotine delivery systems (ENDS; such as e-cigarettes) as a harm reduction tool.<sup>1</sup> Some research suggests that ENDS could provide a net population health benefit by reducing cigarette smoking prevalence as smokers switch to exclusive ENDS use or quit both smoking and using ENDS.<sup>1</sup> Conversely, other research suggests that ENDS may have a negative net harm, resulting in cigarette use among youth and young adults, sustained smoking and nicotine dependence among cigarette smokers who are struggling to quit, and dual use of cigarettes and ENDS.<sup>2</sup> Consequently, there is a growing literature aimed at elucidating influences of ENDS use, and flavors have emerged as a potentially important factor.<sup>3–10</sup>

Although characterizing flavors, except tobacco and menthol, were banned in cigarettes in 2009 under the Family Smoking Prevention and Tobacco Control Act (Tobacco Control Act), the sale of other flavored tobacco products, such as ENDS, is still allowed in the United States (US). Use of flavored tobacco products is associated with poly-tobacco use and those whose first tobacco product was flavored are more likely to be current tobacco users.<sup>6,11</sup> Similarly, nationally representative surveys demonstrate that flavored ENDS are among the most frequently used flavored tobacco products and that most youth, young adults, and adults alike initiate ENDS use with a flavor other than tobacco.<sup>6,7,9,11,12</sup> Moreover, ENDS users have cited characterizing flavors as important to their initiation and use of ENDS<sup>6,8,9,12–16</sup> and their ability to quit smoking cigarettes.<sup>4,5,17</sup> However, since 2011, particularly within the past year, there has been a considerable increase in youth ENDS use; this increase is partially attributed to flavors in ENDS.<sup>18,19</sup> Thus, in November 2018 the US Food and Drug Administration (FDA) expressed intent to restrict the sale of flavored ENDS with the exception of unflavored, tobacco, mint, and menthol to retail locations that do not allow minors where these products are sold, and to require enhanced age verification for the sale of ENDS by online retailers. In addition, the FDA announced that it is considering a proposed rulemaking to ban menthol in combustible tobacco products to accompany steps to protect youth by preventing access to flavored tobacco products.<sup>20</sup>

As the FDA prepares to regulate non-traditional flavors (ie, fruit, candy, coffee) in ENDS, it is important to clarify the role flavors play in helping or hindering current cigarette smokers' switch to non-combustible tobacco products, such as ENDS, or ideally, quitting smoking entirely. However, there is little research on this topic, and one systematic review found inconclusive evidence about the role of flavored ENDS in smoking cessation.<sup>12</sup> Moreover, there is scant research about the impact on use behavior or perceived safety of flavors in ENDS among those with a history of both cigarette and ENDS use.<sup>12</sup> Such research is needed to understand how perceptions of flavors in ENDS contribute to their harm reduction potential, specifically non-traditionally flavored ENDS, as well as gain general insight into public perceptions regarding the importance and safety of ENDS flavors. For example, it is conceivable that adult smokers with negative perceptions towards flavors in ENDS may be less likely to use flavored ENDS, and in turn, potentially less likely to be successful at

quitting smoking. Similarly, adult smokers' and ENDS users' perception (or lack thereof) of ENDS flavors as an important contributor to their adoption/continued use of ENDS has direct implications for FDA regulation.

Using 2 years of cross-sectional data from a national sample, we examined the association between perceptions and use of flavored ENDS during ENDS initiation and current use among 4 cigarette smoking and ENDS use profiles: Dual Users of cigarettes and ENDS, ENDS Rejecters (current cigarette smokers, former ENDS users), Switchers (former cigarette smokers, current ENDS users), and Quitters (former cigarette smokers, former ENDS users). We hypothesized that use of non-traditional flavors and multiple flavors, in particular fruit, would be associated with being a Switcher (and being a Dual User for multiple flavor use) while use of traditional flavors (ie, tobacco, menthol) would be associated with being a Dual User, Switcher, and/or Quitter of both products. Lastly, we hypothesized that perceiving ENDS flavors as safe would be associated with being a Switcher or Dual User versus being an ENDS Rejecter or Quitter.

## METHODS

### Procedure and Sample

Our data came from the 2016 and 2017 cross-sectional Tobacco Products and Risk Perceptions Surveys conducted by the Georgia State University (GSU) Tobacco Center of Regulatory Science (TCORS). Participants were recruited through GfK's KnowledgePanel, a probability-based Web panel designed to be representative of non-institutionalized US adults, with a representative oversample of cigarette smokers. Participants were provided with small, cash-equivalent compensation.

Data from both surveys were pooled to improve estimate precision. Data collection occurred in September/October 2016 and August/September 2017; the 2017 sample excluded anyone who completed the 2016 survey. In 2016, a total of 8125 KnowledgePanel members were invited to participate. Of the 6061 qualified completers, 47 cases were excluded due to refusing to answer more than half of the survey questions, yielding an analytic sample of 6014. In 2017, a total of 8229 KnowledgePanel members were invited to participate. Of the 6033 qualified completers, 22 cases were excluded due to refusing to answer more than half the survey questions and 19 were removed due to low duration (<3 minutes) or being flagged twice for highly improbable or incompatible responses, yielding an analytic sample of 5992. Final stage completion rates of 74.0% and 74.3% were obtained for the 2016 and 2017 samples, respectively. A study-specific post-stratification weight was computed using an iterative proportional fitting (raking) procedure to adjust for survey non-response and oversampling of smokers. Demographic and geographic distributions from the 2017 Current Population Survey (CPS) were utilized as benchmarks for adjustment, and included sex, age, race/ethnicity, census region, education, household income, and metropolitan area. Participants in the present study were restricted to those with a history of both cigarette smoking and ENDS, forming a final analytic sample of 1814.

## Measures

**Smoking status.**—Participants who indicated that they had smoked at least 100 cigarettes in their lifetime were asked: “Do you currently smoke cigarettes every day, some days, or not at all?” Those who responded “every day” or “some days” were considered current smokers, and those who responded “not at all” were considered former smokers.

**ENDS use.**—Participants were provided with a description of ENDS, including mention of different terminology and ENDS types (eg, e-cigarettes, e-cigars, e-hookahs, e-pipes, vape pens, hookah pens, or personal vaporizers/mods) and shown pictures of example ENDS. Those respondents reporting awareness of ENDS were asked whether they had ever used ENDS. Those who ever used ENDS were asked: “Do you now use electronic vapor products every day, some days, rarely, or not at all?” Those who reported using ENDS “every day,” “some days,” or “rarely” were considered current ENDS users; persons responding “not at all” were considered former ENDS users. Those who reported ever using ENDS were also asked: “Have you ever used electronic vapor products fairly regularly?” Use of ENDS containing nicotine (“Does/did the electronic vapor product you usually use/used contain nicotine?”) was assessed among current ENDS users or those who reported ever using ENDS fairly regularly.

**Cessation attempts.**—Current cigarette smokers who indicated that they had ever made a serious attempt to quit smoking (ie, stopped smoking for at least one day or longer because they were trying to quit) reported the number of past year cigarette quit attempts. Current ENDS users also reported the number of past year ENDS quit attempts.

**Cigarette smoking/ENDS use profiles.**—Participants were classified into 4 use profiles that comprised the analytic sample for this study: Dual Users (N = 598), ENDS Rejecters (N = 891), Switchers (N = 112), and Quitters (N = 213). Dual Users were defined as current cigarette smokers who were also classified as current ENDS users; ENDS Rejecters as current cigarette smokers who were former ENDS users; Switchers as former cigarette smokers who were current ENDS users; and Quitters as former cigarette smokers who were former ENDS users. Data were collected to ascertain whether participants also currently used traditional cigars or little cigars, cigarillos, or filtered cigars (LCCs). Respondents who were ‘every day’ or ‘some day’ traditional cigar and/or LCC users (Switcher: N = 10; Quitter: N = 12) were excluded from analyses to restrict the analytic sample to former smokers who were not regular non-cigarette combustible tobacco users.

Moreover, using self-reported current age, age at ENDS initiation, and year/age of cigarette smoking cessation, we determined whether participants began using ENDS prior to, at the same time (within the same year), or after their cigarette quit date. Those who began using ENDS one year or later following their cigarette quit date (Switcher: N = 64; Quitter: N = 170) were excluded to restrict the analytic sample to those who could have potentially used ENDS as a smoking cessation aid. Exploratory analyses indicated that many of those who were excluded initiated ENDS use following an established period of smoking abstinence.

**Flavored ENDS use.**—Flavored ENDS use at ENDS initiation was assessed by asking ever ENDS users: “When you first started using electronic vapor products, which flavor(s) did you use?” Flavored ENDS use now was assessed by asking current ENDS users: “Which flavors of electronic vapor products do you use most often?” Flavor categories for both items included mint or wintergreen, menthol, fruit, coffee, candy or dessert flavors, spice, alcohol or cocktail, non-alcoholic or non-coffee drink, tobacco flavor, unflavored, and an ‘other’/ write-in option. Responses from the other/write-in option were excluded as most referred to marijuana use or the flavor category was unclear. All characterizing flavor response options included examples and participants had the response options of ‘yes’ and ‘no’. Participants could respond yes to more than one flavor category.

**Perceptions of flavors in ENDS.**—Current ENDS users rated the importance of several reasons for ENDS use, including “They come in flavors I like,” with a 7-point scale ranging from “0 = Not at all important” to “6 = Very Important.” Participants also rated their agreement with the following statement: “Flavor additives are safe to use in electronic vapor products” using a 5-point scale ranging from “Strongly Disagree” to “Strongly Agree” and a “Don’t Know” option. Response categories were collapsed to a 3-point scale including, “Disagree” or “Neither Disagree nor Agree” and “Agree” with a “Don’t Know” option in analyses.

**Demographic characteristics.**—Sex, age, race/ethnicity, education, region, and annual household income were obtained from GfK profile surveys.

## Data Analysis

Weighted point estimates and 95% confidence intervals were obtained using SAS 9.4. Rao-Scott  $\chi^2$  tests were conducted to examine associations between flavored ENDS use during ENDS initiation and now, perceived safety of flavors in ENDS, and the 4 use profiles (dependent variable); weighted t-tests were used to examine use profile differences in rated importance of flavors as a reason for ENDS use. Multivariable binomial and multinomial logistic regression analyses also were conducted, controlling for sex, age, race/ethnicity, education, and income. Moreover, Dual Users, who use both ENDS and cigarettes, served as the reference group in regression analyses for comparisons with other use profiles, especially Switchers, who represent harm reduction provided that smokers utilized ENDS to aid their smoking cessation. Because data were pooled to increase estimate precision, separate models with each 2-way interaction term between flavor variables and survey year, all flavor category variables, and demographic characteristics were included to assess whether associations differed by survey year. Interaction terms were not statistically significant at the  $\alpha = .05$  level; therefore, final models did not include interaction terms.

## RESULTS

### Demographic Characteristics, ENDS Use Characteristics, and Cessation Attempts

Dual Users and ENDS Rejecters, both comprised of current cigarette smokers, were similar in terms of income and education (Table 1) and comprised 72.9% of our analytic sample. More than one-fifth of Dual Users and ENDS Rejecters had less than a high school

education and about one-third had an annual income of less than \$25,000. Following adjustment for demographic characteristics, being aged 25 or older (vs 18–24) (adjusted odds ratio (AOR)s 0.19 to 0.50) and having high school or some college (vs college degree +) (both AORs: 0.62) was associated with lower odds of being a Dual User as compared to an ENDS Rejecter (data not shown). Conversely, Switchers and Quitters, both comprised of former cigarette smokers, were also similar in terms of income and race/ethnicity; over one-fourth had an annual income of \$100,000 or greater and three-fourths were non-Hispanic white. No associations were observed by demographic characteristics among Switchers and Quitters (data not shown).

The use profiles also differed by ENDS use characteristics and cessation attempts of both cigarettes and ENDS (bottom of Table 1). Whereas 67.1% of Switchers reported currently using ENDS daily, only 15.3% of Dual Users reported current daily ENDS use. Additionally, 85.0% of Switchers reported having ever used ENDS fairly regularly compared to only 55.4% of Dual Users, 22.9% of ENDS Rejecters, and 30.1% of Quitters. Among current ENDS users and those who ever used ENDS fairly regularly, 92.8% of Quitters reported using ENDS with nicotine as compared to 74.0% of Switchers and around 85% of Dual Users and ENDS Rejecters. Among those who reported having ever made a serious cigarette quit attempt, nearly three-fourths of Dual Users (71.6% [95% CI: 66.5, 76.8]) had made at least one cigarette quit attempt in the past year. Conversely, only 50.9% (95% CI: 46.0, 55.7) of ENDS Rejecters had made at least one cigarette quit attempt in the past year. We also examined past year ENDS quit attempts and found that 28.4% (95% CI: 23.3, 33.5) of all Dual Users had made at least one ENDS quit attempt in the past year as compared to only 9.3% (95% CI: 3.5, 15.1) of Switchers.

### ENDS Flavor Perceptions

Table 2 shows the agreement with the statement: “Flavor additives are safe to use in electronic vapor products” by use profile. About one-fourth (22.2%) of Dual Users agreed with this statement compared to one-third (33.2%) of Switchers and less than 15% of ENDS Rejecters and Quitters. Conversely, approximately 7% of Switchers disagreed with this statement compared to 20%–30% of the other use profiles; 33%–42% of each use profile neither disagreed nor agreed with this statement, and 15%–25% reported they did not know. In adjusted analyses, those who expressed agreement (vs neutrality or disagreement) had lower odds of being an ENDS Rejecter (AOR: 0.54 [95% CI: 0.36, 0.81]) or Quitter (AOR: 0.54 [95% CI: 0.31, 0.95]) but higher odds of being a Switcher (AOR: 1.76 [95% CI: 1.03, 2.99]) versus being a Dual User. Current ENDS users also rated the importance of flavors in their use of ENDS. On average, Switchers rated ENDS flavors as being more important as a reason to use ENDS (Mean: 4.08 [95% CI: 3.64, 4.53]) as compared to Dual Users (Mean: 3.43 [95% CI: 3.21, 3.65]). Following adjustment for demographic characteristics, there was a 16% lower odds of being a Dual User for every 1-point increase in the rated of importance of flavors (AOR: 0.84, [95% CI: 0.73, 0.97],  $p = .019$ ).

### Flavored ENDS Use at ENDS Initiation

The use profiles differed in the prevalence of flavored ENDS use at initiation (Table 3). About half of persons in each use profile reported use of tobacco or unflavored ENDS and at



least one-third of persons in each use profile reported use of mint, wintergreen, or menthol flavored ENDS at initiation. Dual Users and Switchers were more likely than ENDS Rejecters and Quitters to report using fruit flavor (> 50% vs < 40%), candy/dessert (>30% vs 20.5%), coffee/alcohol (~20% vs 10%), or spice and other (non-coffee, non-alcohol) beverage flavors (~20% vs < 10%) at initiation. However, following adjustment for demographic characteristics and use of all other flavor categories, there were few statistically significant differences. Those who reported using mint, wintergreen, or menthol flavored ENDS when they initiated use had lower odds of being an ENDS Rejecter (AOR: 0.69 [95% CI: 0.50, 0.96]) compared to being a Dual User (Table 3). Meanwhile, use of spice or other (non-alcoholic, non-coffee) beverage flavored ENDS at initiation was associated with lower odds of being a Quitter (AOR: 0.42 [95% CI: 0.20, 0.88]) as compared to being a Dual User, following covariate adjustment. ENDS flavor categories used at initiation did not predict differences in the odds of being a Switcher as compared to being a Dual User.

In a different comparison (Switchers as reference group), use of fruit flavored (AOR: 0.50 [95% CI: 0.27, 0.94]) and candy or dessert flavored ENDS (AOR: 0.50 [95% CI: 0.25, 0.99]) at initiation was associated with lower odds of being an ENDS Rejecter following covariate adjustment (data not shown). Moreover, use of spice or other (non-alcoholic, non-coffee) beverage flavored ENDS at initiation was associated with lower odds of being a Quitter (AOR: 0.35 [95% CI: 0.13, 0.89]) (data not shown).

Compared to using only one ENDS flavor category at initiation, use of 2 flavor categories and 3 or more ENDS flavor categories was associated with lower odds of being an ENDS Rejecter (AOR: 0.58 [95% CI: 0.40, 0.85]; AOR: 0.35 [95% CI: 0.24, 0.52], respectively) and Quitter (AOR: 0.60 [95% CI: 0.37, 0.97]; AOR: 0.37 [95% CI: 0.22, 0.64], respectively) as compared to being a Dual User (Table 3). Additionally, use of 2 flavor categories and 3 or more ENDS flavor categories at initiation was associated with lower odds of being an ENDS Rejecter (AOR: 0.52 [95% CI: 0.28, 0.96]; AOR: 0.31 [95% CI: 0.17, 0.59], respectively) and use of 3 or more ENDS flavor categories at initiation was associated with lower odds of being a Quitter (AOR: 0.33 [95% CI: 0.16, 0.68]) as compared to being a Switcher (data not shown).

### Flavor Use Most Often Now

Current ENDS users (Dual Users and Switchers) also reported the ENDS flavors that they currently use most often now (Table 4). Although Dual Users and Switchers reported current use of candy/dessert, coffee/alcohol, and spice/other beverage flavored ENDS at similar rates, Dual Users had a higher prevalence of current use of tobacco or unflavored (38.9% vs 24.3%) and mint, wintergreen, or menthol (38.8% vs 23.8%) flavored ENDS. Conversely, Switchers had a higher prevalence of current use of fruit flavored ENDS (52.4% vs 44.4%). Following adjustment for all other flavor categories and demographic characteristics, use of tobacco or unflavored ENDS (AOR: 0.28 [95% CI: 0.13, 0.58]) and mint, wintergreen, or menthol flavor (AOR: 0.41 [95% CI: 0.20, 0.87]) was associated with lower odds of being a Switcher as compared to being a Dual User. No statistically significant association was found with use of the remaining ENDS flavor categories (Table 4).

### Changes in Flavor Categories Used between Initiation and Now

Currently used ENDS flavor categories by flavor categories used at initiation are shown in Table 5. Generally, most Dual Users and Switchers who initiated with a given flavor category reported current use of that flavor category. Similarly, less than 10% of those who did not initiate with a given flavor category reported currently using it. Among both use profiles, tobacco/unflavored, mint/wintergreen/menthol, and fruit flavor were most commonly used at initiation, with fewer participants initiating with other flavor categories. However, a significantly higher proportion of Dual Users initiated with and continued to use tobacco/unflavored and mint/wintergreen/menthol flavored ENDS while a higher, although not significantly different, proportion of Switchers initiated with and continued to use fruit flavored ENDS.

## DISCUSSION

Our findings indicate several differences among Dual Users, ENDS Rejecters, Switchers, and Quitters related to risk perceptions of flavors in ENDS and flavored ENDS use, particularly in regard to current use of traditional tobacco flavors. Across all 4 use profiles, many reported using either traditional tobacco-related flavors (tobacco/unflavored, mint/wintergreen/menthol) or fruit at initiation, but the use prevalence of the remaining flavor categories (candy/dessert, coffee/alcohol/ and spice/other beverage) among Dual Users and Switchers was notably higher than ENDS Rejecters and Quitters. Moreover, use of 2 or more ENDS flavors at initiation was associated with higher odds of being a Dual User or Switcher as compared to ENDS Rejection and Quitting. Additionally, current use of traditional cigarette flavors (ie, tobacco/unflavored and mint/wintergreen/menthol) in ENDS was associated with lower odds of being a Switcher compared to being a Dual User. Although, Dual Users and Switchers reported higher prevalence of non-traditional tobacco flavors such as candy, fruit, and spice flavors, significant differences in specific initiating flavors and current use profile status did not emerge as indicated by the adjusted analyses. Instead, the data suggest that use of multiple flavor categories at initiation may have been associated with sustained use of ENDS in Dual Users and Switchers compared to those who rejected ENDS. About 60% of ENDS Rejecters and Quitters reported using only one ENDS flavor category at initiation compared to around 40% of Dual Users and Switchers. This finding persisted in adjusted analyses and suggests that use of multiple ENDS flavors at initiation may aid in continuing to use ENDS. However, no associations were found between the number of ENDS flavor categories currently used and the use profiles.

Previous research has found that the variability of flavors was rated as moderately to very important among ENDS users<sup>4,21</sup> and that not liking flavor options was a reason for not using ENDS, particularly among current smokers.<sup>8</sup> Meanwhile, Morean et al<sup>22</sup> found that among adults there was no association between the frequency of ENDS use in the past 30 days, flavor preference, and the total number of flavors preferred. Therefore, having multiple flavor options and using multiple flavors at initiation may be helpful to adults in establishing more sustained ENDS use. However, additional research is needed to improve understanding of the use of multiple ENDS flavors in the continuation of use among established, regular ENDS users.



A careful analysis is needed to evaluate the impact of banning certain ENDS flavors and whether this would be appropriate for the protection of public health. Although the goal of this study was to investigate the role of ENDS flavors in adult smoker's cessation or dual use/sustained nicotine addiction, ENDS flavors may contribute to youth ENDS initiation which must also be considered in policy development and impact assessments. Additionally, those who continued to use ENDS (ie, Switchers) were more likely to endorse the belief that flavor additives are safe to use in ENDS compared to those who had stopped using ENDS (ie, ENDS Rejecters and Quitters), who were much less likely to have ever used ENDS fairly regularly. Thus, it is possible that ENDS Rejecters and Quitters were less trusting of the safety of flavors in ENDS, and as such, did not establish a pattern of regular ENDS use. Additional research is needed to assess the role of flavor risk perceptions in adult ENDS use.

Conversely, the data suggest that current use of flavors related to traditional tobacco use (ie, tobacco/unflavored, mint/wintergreen/menthol) is associated with dual use as compared to switching to exclusive ENDS use. Previous studies have noted that current smokers are more likely to report use of traditional cigarette flavors while former smokers are more likely to report using non-traditional and sweet characterizing flavors.<sup>4,7</sup> For example, a longitudinal study found that young adults who had ever smoked cigarettes but not in the past month (vs past month cigarette smokers) at Wave 1 were less likely to use tobacco or menthol flavored ENDS at Wave 2 than to use non-tobacco or menthol flavors.<sup>23</sup>

Moreover, our findings related to multiple flavors and current use of non-traditional tobacco flavors is consistent with a longitudinal study of young adults which found that use of one and multiple non-traditional ENDS flavors was associated with reduced smoking or smoking cessation at one-year follow-up.<sup>24</sup> Previous research demonstrates that tobacco users perceive flavored tobacco products as more appealing and better tasting<sup>25</sup> and that menthol flavor can mask the bitterness, harshness, and irritation associated with tobacco and nicotine.<sup>26,27</sup> Similarly, ENDS flavors perceived as sweet or cool (eg, menthol) were associated with liking a flavor, and flavors perceived as bitter or harsh (eg, tobacco flavor) were associated with disliking an ENDS flavor and the impact of sweetness on liking an ENDS flavor was greater than the impact of coolness.<sup>15</sup> Thus, Dual Users' and Switchers' higher use rates of non-menthol and non-tobacco characterizing flavors at initiation may have provided a more satisfying ENDS use experience, making it easier to adopt and continue using ENDS. Similarly, it is possible that Switchers' higher use rate of fruit flavored ENDS, currently, may have contributed to their successful smoking cessation in addition to their higher rates of daily ENDS use. Biener and Hargraves<sup>28</sup> found that adult smokers who used ENDS daily for at least one month had 6 times the odds of smoking cessation at follow-up, whereas no difference in cessation was found between less frequent ENDS users and non-ENDS users. Although many Dual Users in the present study reported past year cigarette and ENDS quit attempts, they were less likely to report current daily ENDS use or ever using ENDS fairly regularly. As such, it is possible that Switchers' more regular use of ENDS may have supported their transition away from combustible cigarettes better, and Dual Users' less regular use may have been more reflective of supplemental ENDS use. Moreover, it is possible that Dual Users' higher rates of current use of traditional tobacco flavors in ENDS may have been associated with their current cigarette smoking and the flavor similarities.

As Abrams et al<sup>29</sup> posit, the ability of ENDS to maximize their harm reduction potential rests on their harmfulness, appeal (including flavors), and satisfaction. Specifically, ENDS must be sufficiently appealing to adult cigarette smokers to encourage ENDS adoption, sustained use, and (ideally) switching to exclusive ENDS use and flavors, particularly non-traditional flavors, may serve as such a factor. The proposed FDA regulatory restrictions on non-traditional characterizing flavors are directed toward addressing the potential risk to youth while keeping traditional characterizing flavors available to adults in age-restricted and non-age restricted locations and online. In considering ENDS flavor regulation for harm reduction, our results suggest that use of traditional cigarette flavors is associated with sustained smoking and specifically dual use of ENDS and cigarettes. The FDA should consider these issues when evaluating which flavors are appropriate for the protection of public health.

### Strengths and Limitations

This study has several strengths including a national probability sample, use of recent (2016–2017) data, and comparisons of flavored ENDS use and perceptions among adults with a history of cigarette and ENDS use. Nevertheless, this study is subject to several limitations. We utilized cross-sectional data and are unable to make causal inferences or assess temporality. Similarly, the data are based on self-report and there may be potential recall bias, particularly with respect to reporting of initial flavor use. Additionally, less than one-third of ENDS Rejecters and Quitters and about one-half of Dual Users reported ever using ENDS fairly regularly. Thus, it is possible that these participants may have only engaged in experimental levels of ENDS use and been less likely to use ENDS for cessation purposes. Moreover, participants may have varied in their understanding and response to the phrase “fairly regularly.” Similarly, participants who initiated using ENDS one year or later after they quit using cigarettes were excluded from analyses and use of ENDS for smoking cessation was not directly assessed. Future studies may benefit from such assessment. We did not consider potential differences in the types of ENDS devices used among the use profiles, which may have also contributed to participant’s transition to their respective use profile. Although we did not consider ENDS flavor perceptions in the use analyses, we acknowledge that the relationship is likely reciprocal such that those who view flavors as safe may be more likely to use flavors, and that those who use flavors may be more likely to consider them to be safe. Future studies should consider examining this relationship. Additionally, flavor use measures utilized an unflavored response option and we referenced it throughout this study. However, it is possible that reported unflavored ENDS use may have been misclassified by participants or through manufacturer use of flavorings in products marketed or perceived as unflavored. Lastly, we were unable to assess participants’ motivations to try flavored ENDS, perceptions about the variability of flavors used, and assessment of harm perceptions of specific flavors. We recommend that future studies consider such measures and ENDS device type for added insight.

### Conclusions

Our data suggest that current use of traditional tobacco flavors may be associated with sustained smoking and discourage smokers from switching to exclusive ENDS use, although use of mint, wintergreen, or menthol at initiation may discourage rejection of ENDS.

Additionally, multiple ENDS flavors at initiation and belief that flavors are safe in ENDS may be associated with continued ENDS use at initiation. Development of a potential flavor ban should consider all of the factors that can maximize cessation related benefits by encouraging adults to switch completely from cigarettes to ENDS as well as minimize harms to youth and young adults.

## IMPLICATIONS FOR TOBACCO REGULATION

Current use of traditional (ie, menthol and tobacco) cigarette flavors in ENDS is associated with higher odds of being a Dual User as compared to a Switcher in a national probability sample of US adults. In developing ENDS flavor regulations, the FDA should consider harm reduction for youth and adult smokers when determining which flavors should be subject to regulation. Future research also should investigate the potential role of risk perceptions related to ENDS flavors.

## Acknowledgements

This research was supported by grant number P50DA036128 from the NIH/NIDA and FDA Center for Tobacco Products (CTP). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH or the FDA.

## References

1. Warner KE, Mendez D. E-cigarettes: comparing the possible risks of increasing smoking initiation with the potential benefits of increasing smoking cessation. *Nicotine Tob Res.* 2018;21(1):41–47.
2. Soneji SS, Sung H-Y, Primack BA, et al. Quantifying population-level health benefits and harms of e-cigarette use in the United States. *PLoS One.* 2018;13(3):e0193328. [PubMed: 29538396]
3. Ayers JW, Leas EC, Allem J-P, et al. Why do people use electronic nicotine delivery systems (electronic cigarettes)? A content analysis of Twitter, 2012–2015. *PLoS One.* 2017;12(3):e0170702. [PubMed: 28248987]
4. Farsalinos KE, Romagna G, Tsiapras D, et al. Impact of flavour variability on electronic cigarette use experience: an internet survey. *Int J Environ Res Public Health.* 2013;10(12):7272–7282. [PubMed: 24351746]
5. Barbeau AM, Burda J, Siegel M. Perceived efficacy of e-cigarettes versus nicotine replacement therapy among successful e-cigarette users: a qualitative approach. *Addict Sci Clin Pract.* 2013;8(1):5. [PubMed: 23497603]
6. Villanti AC, Johnson AL, Ambrose BK, et al. Flavored tobacco product use in youth and adults: findings from the first wave of the path study (2013–2014). *Am J Prev Med.* 2017;53(2):139–151. [PubMed: 28318902]
7. Harrell MB, Weaver SR, Loukas A, et al. Flavored e-cigarette use: characterizing youth, young adult, and adult users. *Prev Med Rep.* 2017;5(1):33–40. [PubMed: 27896041]
8. Berg CJ. Preferred flavors and reasons for e-cigarette use and discontinued use among never, current, and former smokers. *Int J Public Health.* 2016;61(2):225–236. [PubMed: 26582009]
9. Villanti AC, Richardson A, Vallone DM, Rath JM. Flavored tobacco product use among U.S. young adults. *Am J Prev Med.* 2013;44(4):388–391. [PubMed: 23498105]
10. Rodu B, Plurphanswat N. E-cigarette use among US adults: population assessment of tobacco and health (PATH) study. *Nicotine Tob Res.* 2018;20(8):940–948. [PubMed: 29986104]
11. Smith DM, Bansal-Travers M, Huang J, et al. Association between use of flavoured tobacco products and quit behaviours: findings from a cross-sectional survey of US adult tobacco users. *Tob Control.* 2016;25(Suppl 2):ii73–ii80. [PubMed: 27708123]
12. Zare S, Nemati M, Zheng Y. A systematic review of consumer preference for e-cigarette attributes: flavor, nicotine strength, and type. *PLoS One.* 2018;13(3):e0194145. [PubMed: 29543907]

13. Harrell MB, Loukas A, Jackson CD, et al. Flavored tobacco product use among youth and young adults: what if flavors didn't exist? *Tob Regul Sci.* 2017;3(2):168–173. [PubMed: 28775996]
14. Kowitz SD, Meernik C, Baker HM, et al. Perceptions and experiences with flavored non-menthol tobacco products: a systematic review of qualitative studies. *Int J Environ Res Public Health.* 2017;14(4):338.
15. Kim H, Lim J, Buehler SS, et al. Role of sweet and other flavours in liking and disliking of electronic cigarettes. *Tob Control.* 2016;25(Suppl 2):ii55–ii61. [PubMed: 27708124]
16. Kong G, Morean ME, Cavallo DA, et al. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine Tob Res.* 2015;17(7):847–854. [PubMed: 25481917]
17. Litt MD, Duffy V, Oncken C. Cigarette smoking and electronic cigarette vaping patterns as a function of e-cigarette flavourings. *Tob Control.* 2016;25(Suppl 2):ii67–ii72. [PubMed: 27633766]
18. Wang TW, Gentzke A, Sharapova S, et al. Tobacco product use among middle and high school students – United States, 2011–2017. *MMWR Morb Mortal Wkly Rep.* 2018;67(22):629–633. [PubMed: 29879097]
19. Cullen KA, Ambrose BK, Gentzke AS, et al. Notes from the field: use of electronic cigarettes and any tobacco product among middle and high school students – United States, 2011–2018. *MMWR Morb Mortal Wkly Rep.* 2018;67(45):1276–1277. [PubMed: 30439875]
20. US Food and Drug Administration. Statement from FDA Commissioner Scott Gottlieb, M.D., on proposed new steps to protect youth by preventing access to flavored tobacco products and banning menthol in cigarettes. Available at: <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm625884.htm>. Accessed November 19, 2018.
21. Farsalinos KE, Romagna G, Tsiapras D, et al. Characteristics, perceived side effects and benefits of electronic cigarette use: a worldwide survey of more than 19,000 consumers. *Int J Environ Res Public Health.* 2014;11(4):4356–4373. [PubMed: 24758891]
22. Morean ME, Butler ER, Bold KW, et al. Preferring more e-cigarette flavors is associated with e-cigarette use frequency among adolescents but not adults. *PLoS One.* 2018;13(1):e0189015. [PubMed: 29300749]
23. Chen JC, Green KM, Arria AM, Borzekowski DLG. Prospective predictors of flavored e-cigarette use: a one-year longitudinal study of young adults in the U.S. *Drug Alcohol Depend.* 2018;191(1):279–285. [PubMed: 30165328]
24. Chen JC. Flavored e-cigarette use and cigarette smoking reduction and cessation – a large national study among young adult smokers. *Subst Use Misuse.* 2018;53(12):2017–2031. [PubMed: 29624135]
25. Huang L-L, Baker HM, Meernik C, et al. Impact of non-menthol flavours in tobacco products on perceptions and use among youth, young adults and adults: a systematic review. *Tob Control.* 2017;26(6):709–719. [PubMed: 27872344]
26. Rosbrook K, Green BG. Sensory effects of menthol and nicotine in an e-cigarette. *Nicotine Tob Res.* 2016;18(7):1588–1595. [PubMed: 26783293]
27. Lee YO, Glantz SA. Menthol: putting the pieces together. *Tob Control.* 2011;20(Suppl 2):ii1–ii7. [PubMed: 21504926]
28. Biener L, Hargraves JL. A longitudinal study of electronic cigarette use among a population-based sample of adult smokers: association with smoking cessation and motivation to quit. *Nicotine Tob Res.* 2015;17(2):127–133. [PubMed: 25301815]
29. Abrams DB, Glasser AM, Pearson JL, et al. Harm minimization and tobacco control: reframing societal views of nicotine use to rapidly save lives. *Annu Rev Public Health.* 2018;39(1):193–213. [PubMed: 29323611]

**Table 1**  
Demographic Characteristics, ENDS Characteristics, and Cessation Attempts by Use Profile, 2016–2017

Characteristic	Dual Users N = 598 % (95% CI)	ENDS Rejecters N = 891 % (95% CI)	Switchers N = 112 % (95% CI)	Quitters N = 213 % (95% CI)
<b>Sex</b>				
Male	50.7 (45.4, 56.1)	44.6 (40.3, 48.9)	50.0 (39.4, 60.6)	44.6 (36.8, 52.3)
Female	49.3 (43.9, 54.6)	55.4 (51.1, 59.7)	50.0 (39.4, 60.6)	55.4 (47.7, 63.2)
<b>Age**</b>				
18–24	12.4 (8.4, 16.3)	5.1 (2.7, 7.5)	7.1 (2.6, 11.6)	7.7 (2.7, 12.7)
25–34	36.7 (31.3, 42.1)	27.6 (23.5, 31.8)	30.8 (20.6, 41.0)	34.0 (26.5, 41.5)
35–44	19.7 (15.5, 24.0)	20.1 (16.6, 23.7)	21.2 (12.1, 30.3)	20.8 (14.1, 27.6)
45–54	14.7 (11.5, 17.9)	19.4 (16.2, 22.6)	14.3 (7.1, 21.5)	13.3 (8.6, 18.1)
55–64	12.4 (9.2, 15.6)	19.0 (16.1, 21.9)	14.4 (7.4, 21.4)	16.0 (10.8, 21.2)
65+	4.1 (2.6, 5.6)	8.7 (6.7, 10.7)	12.2 (5.7, 18.6)	8.1 (4.4, 11.9)
<b>Race/Ethnicity**</b>				
White, NH	58.5 (53.0, 64.0)	67.2 (62.8, 71.5)	75.7 (65.9, 85.5)	73.5 (66.2, 80.9)
Black, NH	11.7 (8.2, 15.2)	14.3 (10.9, 17.7)	5.3 (0.2, 10.3)	8.3 (4.0, 12.6)
Other, NH	10.9 (6.9, 14.9)	5.7 (3.4, 8.0)	4.8 (0.5, 9.0)	7.2 (2.5, 11.9)
Hispanic	18.9 (14.3, 23.4)	12.8 (9.6, 16.0)	14.3 (5.7, 22.8)	11.0 (5.5, 16.4)
<b>Education***</b>				
<High School	22.1 (16.8, 27.4)	21.6 (17.4, 25.8)	8.5 (1.1, 15.9)	5.7 (1.0, 10.4)
High School	32.5 (27.6, 37.5)	38.7 (34.5, 42.9)	38.7 (28.1, 49.3)	37.5 (29.7, 45.3)
Some College	28.5 (24.1, 32.9)	29.5 (25.9, 33.0)	35.7 (26.1, 45.3)	33.1 (26.1, 40.1)
College Degree+	16.9 (13.0, 20.8)	10.3 (8.3, 12.3)	17.1 (9.5, 24.7)	23.7 (17.3, 30.2)
<b>Income***</b>				
<\$25K	29.5 (24.7, 34.2)	30.5 (26.6, 34.4)	5.7 (1.8, 9.7)	14.7 (10.0, 19.3)
\$25K–\$49,99K	25.0 (20.4, 29.6)	24.6 (21.0, 28.2)	30.5 (20.8, 40.2)	25.0 (18.1, 31.8)
\$50K–\$74,99K	19.8 (15.3, 24.2)	19.2 (16.0, 22.5)	23.3 (14.1, 32.5)	16.8 (11.4, 22.1)
\$75K–\$99,99K	7.4 (4.8, 10.0)	7.9 (5.8, 10.0)	13.6 (6.6, 20.6)	14.0 (8.6, 19.5)
\$100K+	18.3 (13.8, 22.8)	17.8 (14.1, 21.4)	26.8 (17.1, 36.5)	29.6 (21.9, 37.3)

Characteristic	Dual Users N = 598 % (95% CI)	ENDS Rejecters N = 891 % (95% CI)	Switchers N = 112 % (95% CI)	Quitters N = 213 % (95% CI)
<b>Currently Use ENDS Daily</b> <sup>***</sup>				
Yes	15.3 (11.5, 19.0)		67.1 (57.2, 77.0)	
No	84.7 (81.0, 88.5)		32.9 (23.0, 42.8)	
<b>Ever Used ENDS Fairly Regularly</b> <sup>***</sup>				
Yes	55.4 (50.0, 60.7)	22.9 (19.2, 26.5)	85.0 (78.2, 91.8)	30.1 (23.0, 37.1)
No	44.6 (39.3, 50.0)	77.1 (73.5, 80.8)	15.0 (8.2, 21.8)	69.9 (62.9, 77.0)
<b>Use(d) Nicotine</b> <sup>d**</sup>	N = 473	N = 192	N = 105	N = 67
Yes	84.8 (80.2, 89.3)	87.9 (81.5, 94.3)	74.0 (64.6, 83.5)	92.8 (85.1, 100.0)
No	15.2 (10.7, 19.8)	12.1 (5.7, 18.5)	26.0 (16.5, 35.4)	7.2 (0.0, 14.9)
<b>Past Year Cigarette Quit Attempt</b> <sup>***</sup>	N = 449	N = 674		
Yes	71.6 (66.5, 76.8)	50.9 (46.0, 55.7)		
No	28.4 (23.2, 33.5)	49.1 (44.3, 54.0)		
<b>Past Year ENDS Quit Attempt</b> <sup>***</sup>	N = 591		N = 112	
Yes	28.4 (23.3, 33.5)		9.3 (3.5, 15.1)	
No	71.6 (66.5, 76.7)		90.7 (84.9, 96.5)	

Note.

ENDS, electronic nicotine delivery systems; CI, confidence interval; NH, non-Hispanic; K, 1000.

<sup>d</sup>Use of e-liquid containing nicotine was only assessed among current ENDS users and those who indicated that they had ever used ENDS fairly regularly.

\* p < .05,

\*\* p < .01,

\*\*\* p < .001 according to Rao-Scott  $\chi^2$ . Boldface indicates statistical significance at the p < .05 level. Weighted row % are reported.



**Table 2**

ENDS Flavor Perceptions by Use Profile, 2016–2017

	Dual Users N = 593 % (95% CI)	Rejecters N = 889 % (95% CI)	Switchers N = 112 % (95% CI)	Quitters N = 211 % (95% CI)
<i>Flavor Additives Are Safe to Use in Electronic Vapor Products</i> ***				
Neutral or Disagree	62.4 (57.4, 67.5)	61.1 (56.9, 65.2)	46.8 (36.2, 57.4)	63.0 (55.3, 7.6)
Agree	22.2 (17.9, 26.5)	11.6 (8.7, 14.5)	33.2 (23.4, 42.9)	13.7 (8.2, 19.2)
Don't Know	15.3 (11.7, 18.9)	27.3 (23.7, 31.0)	20.1 (11.1, 29.0)	23.3 (16.5, 30.2)
Neutral or Disagree		AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Agree		ref	ref	ref
Don't Know		<b>0.54 (0.36, 0.81)</b>	<b>1.76 (1.03, 2.99)</b>	<b>0.54 (0.31, 0.95)</b>
		<b>1.58 (1.11, 2.26)</b>	1.47 (0.74, 2.93)	1.35 (0.81, 2.24)

Note.

ENDS, electronic nicotine delivery systems; CI, confidence interval; AOR, adjusted odds ratio. Weighted row % are reported and represent the proportion of each use profile that reported agreement/disagreement with the above statement.

\* p < .05,

\*\* p < .01,

\*\*\*

p < .001 according to Rao-Scott  $\chi^2$  based on bivariate analyses between the response to the above statement and use profile. Dual Users were the reference group for all multivariable logistic regression analyses. AORs controlled for sex, age, race/ethnicity, education, and income. Boldface indicates statistical significance at the p < .05 level.

**Table 3**

ENDS Flavors Used at Initiation by Use Profile, 2016–2017

Flavor Category	Dual Users N = 593 % (95% CI)	Rejecters N = 883 % (95% CI)	Switchers N = 112 % (95% CI)	Quitters N = 212 % (95% CI)
Tobacco/Unflavored	56.2 (50.8, 61.6)	58.8 (54.5, 63.1)	48.8 (38.2, 59.5)	52.4 (44.5, 60.3)
Mint/Wintergreen/Menthol*	45.4 (40.0, 50.8)	35.3 (31.1, 39.5)	34.9 (24.6, 45.2)	38.7 (30.9, 46.5)
Fruit***	53.1 (47.8, 58.5)	35.4 (31.1, 39.7)	58.0 (47.6, 68.3)	39.5 (31.6, 47.4)
Candy/Dessert***	32.0 (26.9, 37.1)	16.2 (12.8, 19.7)	35.0 (24.6, 45.4)	20.5 (13.7, 27.3)
Coffee/Alcohol***	22.2 (17.8, 26.6)	9.5 (6.6, 12.3)	18.4 (10.1, 26.7)	10.0 (4.7, 15.3)
Spice/Other Beverage***	18.6 (14.4, 22.8)	7.2 (4.7, 9.7)	17.5 (9.1, 25.9)	5.6 (2.2, 8.9)
		<b>AOR (95% CI)</b>	<b>AOR (95% CI)</b>	<b>AOR (95% CI)</b>
Tobacco/Unflavored		0.91 (0.66, 1.24)	0.64 (0.36, 1.13)	0.77 (0.49, 1.20)
Mint/Wintergreen/Menthol		<b>0.69 (0.50, 0.96)</b>	0.70 (0.41, 1.19)	0.81 (0.51, 1.26)
Fruit		0.75 (0.53, 1.06)	1.48 (0.79, 2.79)	0.76 (0.47, 1.22)
Candy/Dessert		0.64 (0.41, 1.00)	1.28 (0.66, 2.47)	0.94 (0.53, 1.68)
Coffee/Alcohol		0.64 (0.39, 1.04)	0.78 (0.34, 1.79)	0.62 (0.30, 1.29)
Spice/Other Beverage		0.60 (0.36, 1.02)	1.22 (0.56, 2.63)	<b>0.42 (0.20, 0.88)</b>
<b># of Flavor Categories Used***</b>				
1 Flavor Category Only	37.1 (31.8, 42.3)	60.3 (55.8, 64.7)	41.5 (31.2, 51.8)	59.3 (51.3, 67.3)
2 Flavor Categories	25.4 (20.7, 30.1)	20.8 (17.1, 24.5)	25.3 (15.8, 34.8)	21.6 (14.9, 28.2)
3+ Flavor Categories	37.5 (32.2, 42.8)	19.0 (15.2, 22.8)	33.2 (22.9, 43.5)	19.1 (12.3, 25.9)
		<b>AOR (95% CI)</b>	<b>AOR (95% CI)</b>	<b>AOR (95% CI)</b>
1 Flavor Category Only		ref	ref	ref
2 Flavor Categories		<b>0.58 (0.40, 0.85)</b>	1.13 (0.60, 2.14)	<b>0.60 (0.37, 0.97)</b>
3+ Flavor Categories		<b>0.35 (0.24, 0.52)</b>	1.13 (0.60, 2.11)	<b>0.37 (0.22, 0.64)</b>

Note.

ENDS, electronic nicotine delivery systems; CI, confidence interval; AOR, adjusted odds ratio. Participants could select more than one flavor category. Weighted row % are reported and represent the proportion of each use profile that reported use of a given flavor category at initiation.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

\* p < .05,  
\*\* p < .01,  
\*\*\*

\*\*\* p < .001 according to Rao-Scott  $\chi^2$  based on bivariate analyses between the flavor category used at initiation and use profile. Dual Users were the reference group for all multivariable multinomial logistic regression analyses. AORs controlled for all other flavor categories (flavor category analyses), sex, age, race/ethnicity, education, and income. Boldface indicates statistical significance at the p < .05 level.

**Table 4**

**ENDS Flavors Used Most Often Now by Use Profile, 2016–2017**

Flavor Category	Dual Users		Switchers		AOR (95% CI)
	N = 593	% (95% CI)	N = 112	% (95% CI)	
Tobacco/Unflavored**	38.9 (33.8, 44.0)	24.3 (15.4, 33.1)	<b>0.28 (0.13, 0.58)</b>		
Mint/Wintergreen/Menthol*	38.8 (33.3, 44.2)	23.8 (14.4, 33.3)	<b>0.41 (0.20, 0.87)</b>		
Fruit**	44.4 (39.0, 49.8)	52.4 (41.8, 63.0)	1.26 (0.67, 2.39)		
Candy/Dessert	26.9 (21.9, 31.9)	27.8 (17.6, 38.1)	0.99 (0.49, 2.02)		
Coffee/Alcohol	14.7 (10.9, 18.5)	10.9 (3.8, 18.0)	0.97 (0.36, 2.60)		
Spice/Other Beverage	11.1 (8.0, 14.3)	9.1 (1.9, 16.3)	0.90 (0.31, 2.62)		
<b># of Flavor Categories Used</b>					
1 Flavor Category Only	54.2 (48.7, 59.7)	61.4 (50.5, 72.3)	ref		
2 Flavor Categories	26.1 (21.2, 31.1)	30.3 (20.0, 40.6)	1.21 (0.68, 2.17)		
3+ Flavor Categories	19.7 (15.3, 24.1)	8.3 (1.2, 15.4)	0.56 (0.21, 1.49)		

Note.

ENDS, electronic nicotine delivery systems; CI, confidence interval; AOR, adjusted odds ratio. Weighted row % are reported and represent the proportion of each use profile that reported current use of a given flavor category.

\* p < .05,

\*\* p < .01,

\*\*\*

p < .001 according to Rao-Scott  $\chi^2$  based on bivariate analyses between the flavor category currently used and use profile. Participants could select more than one flavor category. Dual Users were the reference group for all multivariable regression analyses. AORs controlled for all other flavor categories (flavor category analyses), sex, age, race/ethnicity, education, and income. Boldface indicates statistical significance at the p < .05 level. Weighted % are reported.

**Table 5**  
Prevalence of Currently Used ENDS Flavor Categories by Flavor Category Used at Initiation among Dual Users and Switchers, 2016–2017

Dual Users		Switchers	
Flavor Category Used at Initiation	% (95% CI)	Flavor Category Used at Initiation	% (95% CI)
<b>Tobacco/Unflavored</b> <sup>***</sup>			
Yes at Initiation, N = 347	67.2 (60.4, 74.1) <sup>a</sup>	Yes at Initiation, N = 54	46.4 (31.1, 61.7) <sup>b</sup>
No at Initiation, N = 245	2.9 (0.5, 5.3)	No at Initiation, N = 58	-
<b>Mint/Wintergreen/Menthol</b> <sup>***</sup>			
Yes at Initiation, N = 244	81.2 (75.2, 87.2) <sup>a</sup>	Yes at Initiation, N = 37	64.8 (47.2, 82.3) <sup>b</sup>
No at Initiation, N = 349	3.7 (0.3, 7.2)	No at Initiation, N = 75	-
<b>Fruit</b> <sup>***</sup>			
Yes at Initiation, N = 290	75.3 (68.7, 81.9) <sup>a</sup>	Yes at Initiation, N = 61	83.7 (73.6, 93.9) <sup>a</sup>
No at Initiation, N = 302	8.7 (4.3, 13.0) <sup>a</sup>	No at Initiation, N = 51	9.3 (0.2, 18.4) <sup>a</sup>
<b>Candy/Dessert</b> <sup>***</sup>			
Yes at Initiation, N = 178	73.0 (65.0, 81.0) <sup>a</sup>	Yes at Initiation, N = 37	70.3 (54.6, 86.0) <sup>a</sup>
No at Initiation, N = 414	4.8 (1.8, 7.8) <sup>a</sup>	No at Initiation, N = 75	5.0 (0.0, 10.7) <sup>a</sup>
<b>Coffee/Alcohol</b> <sup>***</sup>			
Yes at Initiation, N = 127	57.7 (46.8, 68.7) <sup>a</sup>	Yes at Initiation, N = 20	39.1 (14.7, 63.6) <sup>a</sup>
No at Initiation, N = 463	2.4 (0.2, 4.5)	No at Initiation, N = 92	-
<b>Spice/Other Beverage</b> <sup>***</sup>			
Yes at Initiation, N = 97	51.3 (38.7, 64.0) <sup>a</sup>	Yes at Initiation, N = 19	52.1 (25.7, 78.4) <sup>a</sup>
No at Initiation, N = 495	1.7 (0.4, 2.9)	No at Initiation, N = 93	-

Note.

ENDS, electronic nicotine delivery systems; CI, confidence interval. Participants could select more than one flavor category. Weighted % are reported. Dashes represent cell sizes with  $n < 4$ .

\*  $p < .05$ ,

\*\*  $p < .01$ ,

\*\*\*  $p < .001$

according to Rao-Scott  $\chi^2$ . Different superscripts indicate a statistically significant difference in the prevalence of current use by use profile.