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## Perceived Flavored Smokeless Tobacco Ease-of-use and Youth Susceptibility

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### Abstract

**Objectives**—Beliefs that flavored smokeless tobacco (ST) is more pleasant, less potent, or otherwise easier to use could contribute to youth initiation. We evaluated associations between perceived ease-of-use of flavored ST (moist snuff and chewing tobacco) and ST initiation susceptibility in a representative sample of US youth.

**Methods**—Among 7,718 tobacco never-users in the Population Assessment of Tobacco and Health study (age: 12–17; collected: 2013–2014), we compared 4 ST susceptibility items (curiosity, expectation, willingness to try, and a composite) according to whether participants reported flavored ST to be “easier to use” than unflavored ST. We calculated marginal prevalences of ST susceptibility and odds ratios adjusted for socio-demographic characteristics, tobacco advertisement receptivity, warning label exposure, and sensation seeking.

**Results**—ST susceptibility was greatest among tobacco never-users who perceived flavored ST as easier to use. Adjusted odds of potential ST susceptibility ( 1 item) were 1.5-fold higher (95% confidence interval: 1.2, 1.8) among adolescents who perceived flavored ST as easier to use than unflavored ST.

**Conclusions**—ST flavors could contribute to perceptions that facilitate youth initiation. Alternatively, youth susceptible to ST use may perceive flavored varieties differently. Prospective

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#### Conflict of Interest Statement

All authors of this article declare they have no conflicts of interest.

studies are warranted to strengthen causal evidence and measure ST initiation according to perceived ease-of-use.

### Keywords

smokeless tobacco; adolescents; epidemiology; flavor

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## INTRODUCTION

Conventional smokeless tobacco (ST, oral moist snuff and chewing tobacco) carries health risks for users, including cancer,<sup>1-3</sup> oral diseases,<sup>1,3,4</sup> and, among adolescents, progression to cigarette smoking.<sup>5</sup> ST is used by over 8 million US adults<sup>1</sup> and another 1–2 million adolescents.<sup>6</sup> Among US high school boys, 11.9% use ST monthly.<sup>6</sup> In middle and high school, daily use is more common for ST than for any other tobacco product.<sup>7</sup> Concurrent ST use with cigarettes is increasing for adolescents<sup>8</sup> and young adults,<sup>9</sup> countering the prior national trend.<sup>10</sup>

Tobacco products with characterizing flavors, including ST, are viewed favorably among adult and adolescent tobacco users and are more appealing to non-tobacco users.<sup>11</sup> US regulation<sup>12</sup> prohibited cigarettes with characterizing flavors (exempting menthol), citing differential youth use<sup>13</sup> and more positive brand perceptions, expectancies, and use intentions.<sup>14</sup>

Not subject to equivalent regulation, ST is currently marketed in multiple flavors (eg, mint, fruit, or alcohol), including mentholated products. Rising national sales of flavored ST varieties accounted for nearly 60% of total recent growth in the moist snuff market.<sup>15</sup> Most adolescent ST users currently use flavored ST,<sup>16,17</sup> consistent with an industry strategy to position flavored, often lower-nicotine, ST “starter products” at the base of a graduation strategy targeting young or inexperienced users.<sup>18,19</sup>

Mentholated and/or flavored ST products may influence potential users’ perceptions and willingness to use. Perceptions and expectations are powerful predecessors of health-related intentions and behaviors,<sup>20</sup> and strongly predict future adolescent tobacco use.<sup>21,22</sup> Potential ST users may need to overcome negative taste and sensation expectations before experimentation. Adolescent users’ preferences for menthol, mint, or sweet-tasting ST<sup>23</sup> potentially relate to masking of tobacco taste or stronger sweet preferences at younger ages.<sup>24</sup>

This cross-sectional analysis of baseline (Wave 1) data from the Population Assessment of Tobacco and Health (PATH) study investigated the association between perceived ease-of-use of flavored ST and ST susceptibility among youth never-users of any tobacco or nicotine product. We hypothesized that ST susceptibility would be greater among participants who responded that flavored ST is easier to use than unflavored ST.

## METHODS

### Study population

Designed to respond to US Food and Drug Administration (FDA) regulatory priorities, PATH assessed perceptions and behaviors related to 10 types of combustible and non-combustible tobacco and nicotine products (cigarettes, dissolvable tobacco, electronic cigarettes, cigars, hookah, pipes, smokeless tobacco, snus, bidis, and kreteks). PATH enrolled a nationally representative sample of non-institutionalized, civilian US household members, who are never, current, or former tobacco users. Sampling followed a 4-stage, stratified probability design, with oversampling for young adults, African Americans, and tobacco users. The PATH youth sample (age: 12–17) enrolled 13,651 Wave 1 respondents from September 2013 to December 2014. Field-tested and validated questionnaires were administered using audio computer-assisted self-interview technology. Westat (Rockville, MD) administered the PATH study under contract with the US National Institutes of Health (NIH) and FDA.

### Measurement

The PATH youth questionnaire briefly describes ST, including product images and names of common brands. Participants who responded that they had ever seen or heard of ST, regardless of whether they had ever tried ST, were later asked the following: “Some smokeless tobacco comes in flavors like menthol, mint, clove, spice, candy, fruit, chocolate, alcohol (such as wine or cognac), or other sweets. Is flavored smokeless tobacco easier to use, about the same, or harder to use than unflavored smokeless tobacco?” Response options included: “easier to use,” “about the same,” “harder to use,” and “don’t know.”

Three PATH items measured ST expectations and intentions: “Have you ever been curious about using smokeless tobacco?” “Do you think you will try smokeless tobacco soon?” and “If one of your best friends were to offer you smokeless tobacco, would you use it?” Each item featured 4 Likert-type responses (from “very curious/definitely yes” to “not at all curious/definitely not”). Any response other than “not at all curious/definitely not” was categorized as potentially susceptible to ST initiation. Analogous measures for cigarettes have been shown to predict future adolescent smoking in multiple settings.<sup>21,25,26</sup> We separately examined each item and a fourth composite item that categorized any response other than “not at all curious/definitely not” for any of the 3 items as potentially susceptible to ST.

### Statistical Methods

The present analysis included all baseline youth respondents who reported never having tried any of the 10 tobacco products in the PATH questionnaire and who provided responses to the flavored ST ease-of-use item and at least one ST susceptibility item (N = 7,718). Full-sample weights were used to account for complex sampling design and non-response via trimming and raking. Weighting was performed using balanced repeated replication.<sup>27</sup>

Multiple imputation (MI) by chained equations (model-based approach using socio-demographic predictors) was performed for missing covariates (1.4% of covariate data),

with 10 imputations combined using standard methods.<sup>28</sup> MI was used in classifying never-use status across tobacco products: whereas missing never-use status did not exceed 0.9% for any one product, 2.0% of respondents (N = 273) were missing data for 1 product.

Model-based standardized marginal prevalences<sup>29</sup> of ST susceptibility according to perceived flavored ST ease-of-use were obtained from weighted survey logistic regression models, with differences compared by chi-squared tests, adjusting standard errors for sample design<sup>27</sup> and MI.<sup>28</sup> Adjusted relative odds of ST susceptibility (independent variable: flavored ST is “easier to use” vs. all other responses) were calculated from weighted survey logistic models that included *a priori*-defined plausible confounding variables: age, sex, race/ethnicity (Asian, Black/African American, Hispanic/Latino, White, other), urban residence, season (fall, winter, spring, summer), parental education (>high school diploma vs. high school diploma or less), ST warning label exposure (never in past-30 days vs. rarely or more), tobacco advertisement receptivity (endorsed a favorite tobacco advertisement vs. has no favorite), and sensation seeking (composite score of liking frightening things, willingness to break rules, and preference for exciting and unpredictable friends). Odds ratios (ORs) were considered statistically significant if 95% confidence intervals, adjusted for sampling design and MI, excluded the null value (OR: 1).

Two sensitivity checks assessed robustness of findings to eligibility criteria: 1) analyses stratified by sex; and 2) including current or former (ever) users of non-ST tobacco or nicotine products but with model adjustment for other product use (yes/no).

## RESULTS

The weighted prevalence of ever-use of any tobacco or nicotine product was 21.1%. Compared to tobacco ever-users, never-users were, on average, younger (14.2 years vs. 15.5 years), more likely to be female (49.6% vs. 45.4%), less likely to identify as non-Hispanic White (53.5% vs. 58.3%), and less likely to have parental education attainment of high school diploma or less (34.6% vs. 42.2%). Among tobacco never-users, 20.2% perceived that flavored ST was “easier to use” than unflavored ST. Others reported the ease-of-use of flavored ST as “about the same” (44.3%), “harder” (5.8%), or “don’t know” (29.6%).

Responding that flavored ST was easier to use was positively and statistically significantly associated with ST susceptibility (Figure 1). The prevalence of each ST susceptibility outcome was greatest among tobacco never-users who perceived flavored ST as easier to use than unflavored ST.

Adjusted for socio-demographics, sensation seeking, ST warning label exposure, and tobacco advertisement receptivity, perceived flavored ST ease-of-use remained significantly, independently associated with ST susceptibility (Table 1). The adjusted odds of having been curious about ST were approximately 1.7-fold higher among adolescent tobacco never-users who perceived flavored ST to be easier to use than unflavored ST. The adjusted odds of any ST susceptibility were approximately 1.5-fold higher when perceiving flavored ST as easier to use (Table 1). Results were similar when stratified by sex or including tobacco ever-users. For example, for the composite outcome any ST susceptibility, fully adjusted odds ratios

were: girls (OR: 1.47; 95% CI: 1.11, 1.95), boys (OR: 1.56; 95% CI: 1.20, 2.04), and including non-ST tobacco ever-users (OR: 1.50; 95% CI: 1.23, 1.85).

## DISCUSSION

Internal tobacco industry documents consistently associated flavored ST products with inexperienced users.<sup>18,30</sup> Tobacco manufacturers viewed flavored cigarettes as a way to reduce harshness and increase appeal to younger users.<sup>15</sup> ST and other non-cigarette tobacco products frequently feature the same sweeteners<sup>31</sup> and chemical flavorings<sup>32</sup> found in popular candies. Among adult ST users, mint flavor was implicated in prior ST initiation and maintenance.<sup>33</sup> Youth shown tobacco packages with or without a flavor descriptor (primarily snus and dissolvable tobacco) were more likely than older adults to associate the flavor descriptor with better taste, more appeal, and reduced health risks.<sup>34</sup>

The present findings suggest that flavored smokeless tobacco is associated with adolescents' curiosity, future expectations, and willingness to try ST products. Causality is uncertain without knowledge of the temporal sequence between perceived ST ease-of-use and ST susceptibility in these cross-sectional data. The observed associations are consistent with a plausible hypothesis that flavors in ST may counteract perceived unpleasantness or unappealing taste, lowering a psychological barrier to initiation. It is also possible that youth susceptible to using ST for reasons unrelated to flavors independently perceived flavored varieties as easier to use. Thus, respondents with preexisting positive views of about smokeless tobacco might have been inclined to positive attitudes about flavored products. The directionality and causal nature of this association awaits examination longitudinally in future PATH study waves.

Among other limitations, respondents were classified as potentially susceptible to ST use even if endorsing "probably not" (as opposed to "definitely not") in the susceptibility items. This threshold for susceptibility was shown to predict initiation when used for cigarettes.<sup>21,25,26</sup> However, susceptibility does not necessarily dictate future behavior. It is likely that many youth who reported positive views about flavored ST ease-of-use will not become future ST users. Furthermore, ST questionnaire items were asked only of individuals who reported that they had heard of ST, excluding a group of potential respondents with presumably low ST susceptibility. Finally, unmeasured confounding cannot be ruled out, although associations were robust to statistical adjustment for variables known to predict ST use and susceptibility.

This study advantageously featured a large, nationally representative sample. Main analyses were restricted to never-users of any tobacco to avoid confounding by experiences with flavored or unflavored non-ST products, although results were consistent when other product users were included. The ST susceptibility measure has shown predictive validity in other settings, and the survey questionnaire had been rigorously pilot tested.

Other areas for research include understanding of what specific aspects of ST flavors are most associated with product appeal to youth, such taste or a perception that flavored tobacco is not as harmful or potent as unflavored varieties. Additional studies of adults

should assess whether similar perceptions about flavored ST contribute to ST initiation beyond adolescence. Importantly, prospective studies are warranted to quantify actual ST initiation according to perceived flavored ST ease-of-use. Finally, perceptions and appeal of snus smokeless tobacco products should be considered. Frequently flavored, not widely used among US adolescents presently,<sup>16,35</sup> but plausibly associated with less harm than conventional ST, it is unknown whether snus initiation in place of conventional ST or combustible products is associated with product flavors or might occur with enough frequency to offer a net population benefit.

## IMPLICATIONS FOR TOBACCO REGULATION

In this nationally representative sample of US adolescents, the perception that flavored ST was “easier to use” was associated with potential susceptibility to ST initiation among individuals who had never tried a tobacco product. If causal, regulation to limit or ban the use of smokeless tobacco characterizing flavors or non-characterizing sweeteners could reduce perceived product acceptability among adolescents, which in turn, could result in fewer youth initiating ST use. Regulatory policy may also consider whether flavor restrictions might impede youth or adults from switching or substituting away from combustible tobacco products in balance with the clear health benefits of preventing ST initiation among tobacco non-users.

### Human Subjects Statement

The PATH study protocol received approval from the Westat Institutional Review Board and an NIH Certificate of Confidentiality. Parental consent was requested on behalf of participating youth, who provided assent. Youth who completed the questionnaire were given \$25. The UCSF Institutional Review Board approved the present analysis of de-identified restricted-use PATH data (Study #16-18682).

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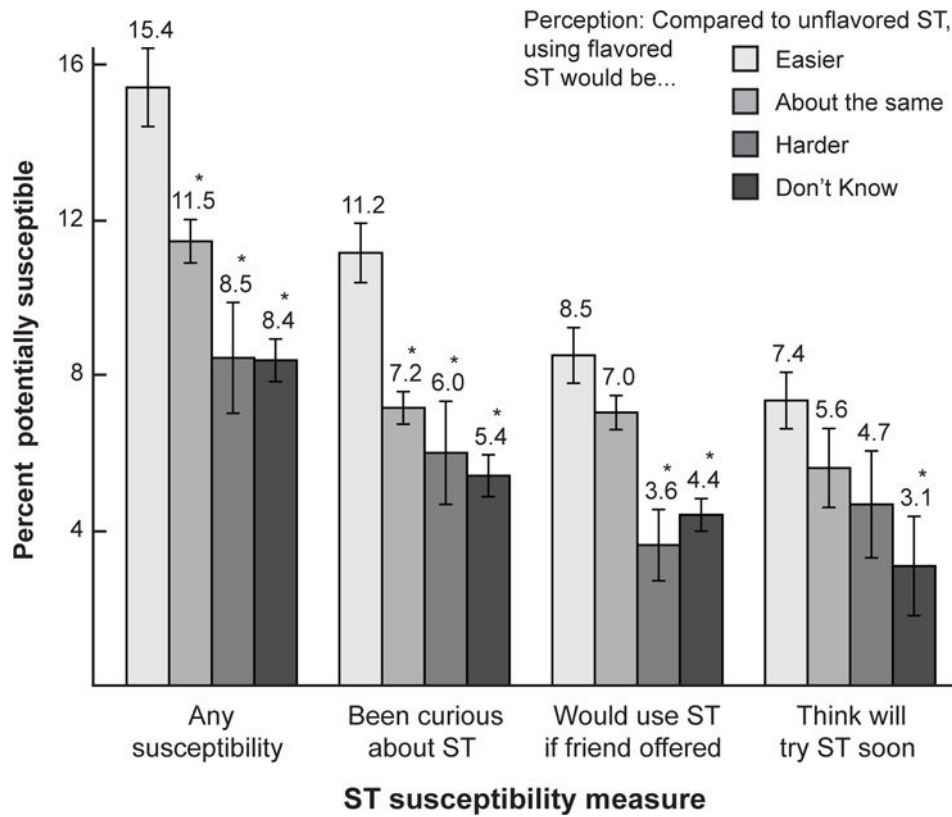
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**Figure 1.**

Prevalence of smokeless tobacco (ST) susceptibility according to perceived ease-of-use of flavored smokeless tobacco among youth tobacco never-users.

Among youth participants (age: 12–17) in the baseline wave of the Population Assessment of Tobacco and Health study who had never tried a tobacco or nicotine product, the prevalence of susceptibility to smokeless tobacco use was greatest among those who perceived that flavored smokeless tobacco would be “easier to use” than unflavored smokeless tobacco. Error bar markers show  $\pm 1$  standard error. Marginal percentages adjusted for sampling design and non-response.

\* $p < .05$  for difference in smokeless tobacco susceptibility from those responding that flavored smokeless tobacco is “easier to use”

Abbreviation: ST = smokeless tobacco

**Table 1**

Association between perceived ease-of-use of flavored smokeless tobacco and smokeless tobacco susceptibility among youth tobacco never-users.

Outcome (susceptibility measure):	Unadjusted OR <sup>a</sup> (95% CI)	Adjusted Model 1 <sup>b</sup> OR (95% CI)	Adjusted Model 2 <sup>c</sup> OR (95% CI)
Been curious about ST	1.83 (1.53, 2.19)	1.95 (1.61, 2.36)	1.71 (1.40, 2.09)
Think will try ST soon	1.65 (1.30, 2.08)	1.74 (1.35, 2.23)	1.51 (1.16, 1.97)
Would use ST if friend offered	1.51 (1.19, 1.91)	1.56 (1.21, 2.01)	1.36 (1.04, 1.78)
Any of the three	1.62 (1.36, 1.93)	1.71 (1.42, 2.05)	1.51 (1.23, 1.85)

<sup>a</sup>Relative odds of outcome in those responding that flavored smokeless tobacco is “easier to use” compared to those providing any other response

<sup>b</sup>Adjusted for age, sex, race/ethnicity, urban residence, season, and parental education

<sup>c</sup>Adjusted for all variables in Model 1, plus: sensation seeking, smokeless tobacco warning label exposure, and tobacco advertisement receptivity.

Abbreviations: CI = confidence interval, OR = odds ratio, ST = smokeless tobacco