



Original investigation

# A National Comparison of Dual Users of Smokeless Tobacco and Cigarettes and Exclusive Cigarette Smokers, 2015–2016

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## Abstract

**Introduction:** While smoking rates have declined, use of smokeless tobacco (ST) has remained constant. ST is heavily marketed to cigarette smokers, and many ST users smoke cigarettes. This study provides updated comparisons of the characteristics, smoking behaviors, and perceptions of US adult dual ST and cigarette users and exclusive cigarette smokers in 2015–2016.

**Methods:** Data were from nationally representative, cross-sectional surveys from 2015 and 2016. Adult smokers reported past 30-day use of ST, current cigarette smoking, risk perceptions, smoking, and quitting behaviors. We estimated Rao–Scott  $\chi^2$  and adjusted odds ratios (AORs) to compare dual users and exclusive smokers.

**Results:** Dual users were more likely to be younger, reside in nonmetropolitan statistical areas (MSA) and outside the Northeast United States. Adjusting for covariates, dual users did not differ significantly from exclusive smokers on most smoker characteristics, including number of past year quit attempts. Dual users were more likely to report past 30-day use of novel tobacco products (AORs 2.90 [little cigars and cigarillos] to 11.02 [hookah]). Dual users who reported at least 1 past year cigarette quit attempt were more likely than exclusive smokers to report using ST, traditional cigars, hookah, or heat-not-burn as a past year quit method (AOR: 9.54 [95% CI: 3.22 to 28.23]).

**Conclusions:** Smokers who use ST are more likely than exclusive smokers to attempt to quit smoking cigarettes using other tobacco products. These findings may be attributed to increasing use prevalence of novel products. We recommend further monitoring to assess polytobacco use and differences among these populations.

**Implications:** Many current ST users smoke cigarettes and ST promotions often target cigarette smokers. As the FDA considers ST regulations and implements a nicotine centered regulatory framework, it is imperative to evaluate how these policies and promotion of ST as potentially reduced risk products impact dual and polytobacco use. Our study found that many dual users engage in novel tobacco use in general and as a cessation method. Consideration of ST and polytobacco use among smokers may be helpful in the development of forthcoming FDA regulations, messaging, and interventions.

## Introduction

Although cigarette smoking prevalence has declined in the United States from 20.9% in 2005 to 15.1% in 2015,<sup>1</sup> rates of smokeless tobacco (ST) use have not seen a similar decline,<sup>2,3</sup> remaining at a prevalence of 2.3% in 2015.<sup>3</sup> ST is commonly marketed for use in smoke-free environments, as complementary to cigarettes, and advertisements appear to suggest that ST may facilitate cigarette smoking reduction or cessation.<sup>4-7</sup> Furthermore, tobacco companies introduced novel ST products (eg, snus, dissolvable tobacco) to the US market in the early to mid-2000s and have increased promotion of ST, particularly toward cigarette smokers since 2006.<sup>4,6,7</sup> Thus, high rates of cigarette smoking among ST users are not surprising, and dual use of ST and cigarettes is particularly prevalent among younger adults, males, and those with lower income and educational attainment.<sup>8-13</sup>

Despite the fact that ST is arguably less harmful than cigarettes and snus has been credited with smoking reductions in Sweden, there is much discussion about the harm reduction potential of ST in the United States.<sup>5,14-17</sup> Recent studies suggest that while US dual users of ST and cigarettes are more likely to report past year cigarette quit attempts, they may be less successful in quitting compared to exclusive smokers.<sup>7,18,19</sup> Furthermore, longitudinal studies have found that dual users of ST and cigarettes are likely to continue using both products and that few exclusive cigarette smokers transition to exclusive ST use.<sup>20,21</sup> This is particularly concerning as the health hazards of cigarette smoking have been well documented and smoking is associated with delivery of numerous carcinogens and increased risk of tobacco-related mortality and morbidity.<sup>22</sup> While use of ST is generally considered less harmful than smoking it is also associated with negative health risks.<sup>17,19,22-24</sup> Moreover, although the health effects of dual use of ST and cigarettes, specifically, are understudied, the available literature reports negative health effects such as elevated risk of chronic inflammatory diseases, cardiovascular disease, and cancer.<sup>23-28</sup>

Little information exists on the characteristics of dual users of ST and cigarettes or the motivations and reasons for using ST among cigarette smokers. Such information is needed to inform tobacco control efforts. Additionally, most recent studies on dual use of ST and cigarettes have utilized data collected in 2011 or earlier.<sup>7,10,18,29-32</sup> However, since 2011, there has been widespread use of combustible and other noncombustible tobacco products such as e-cigarettes, and ST related prevention campaigns (eg, the FDA's Real Cost Campaign).<sup>33,34</sup> Moreover, in 2016 the US Food and Drug Administration (FDA) extended their regulatory authority to cover all tobacco products and is presently considering ST-specific regulations, a tobacco product standard to limit the amount of the carcinogen N-nitrosornicotine (NNN) in ST and a modified risk tobacco product application (MRTP) for snus, which could influence the uptake of ST.<sup>35-37</sup> Thus, this study aimed to provide updated comparisons of the demographic characteristics, smoker characteristics, and perceptions of US adult dual ST and cigarette users and exclusive cigarette smokers in 2015–2016.

## Methods

### Sample

This study used data from the cross-sectional, 2015 (August–September), and 2016 (September–October) Tobacco Products and Risk Perceptions Surveys conducted by the Georgia State University Tobacco Center of Regulatory Science (TCORS). Participants were

recruited from GfK's KnowledgePanel, a probability-based web panel representative of noninstitutionalized US adults. A total of 6051 and 6014 participants completed the 2015 and 2016 surveys, respectively, and additional details of the surveys can be found elsewhere.<sup>9</sup> Data from both survey years were pooled to improve the precision of the estimates. Participants completed the 2015 main survey in 25 min (median) and received a cash-equivalent of \$5 for their participation or \$10 if they had not completed the survey within the first 13 days of data collection. Participants completed the 2016 main survey in 26 min (median) and received \$5 cash-equivalent for their participation. This study was approved by the Georgia State University Institutional Review Board (approval #H14028, May 15, 2014) who granted a waiver of informed consent.

## Measures

### Tobacco Use Status

Respondents who reported past 30-day use of chewing tobacco, dip, snuff, snus, or dissolvable tobacco were considered current ST users. Respondents who reported having smoked at least 100 cigarettes in their lifetime and currently smoking every day or some days were considered current cigarette smokers. Dual users of ST and cigarettes were defined as current cigarette smokers who also reported current ST use, whereas exclusive cigarette smokers were defined as current cigarette smokers who did not report current ST use. Participants also reported past 30-day use of other tobacco products (OTP): electronic nicotine delivery systems (ENDS), traditional cigars, little cigars and cigarillos, hookah, and heat-not-burn products. Two groups of cigarette smokers comprised the analytic sample for this study: current cigarette smokers who currently use ST (dual users,  $n = 116$ ) and current smokers who do not currently use ST (exclusive cigarette smokers,  $n = 2452$ ).

### Cigarette Smoker Characteristics and Behaviors

Respondents reported average number of cigarettes smoked per day (CPD); age at cigarette smoking initiation (“Think about the first time you smoked cigarettes. How old were you at that time?”); anticipated length of smoking at initiation (“When you first started smoking cigarettes, how long did you think you would continue to smoke?”, response options ranged from “a few days” to “longer than 5 years”, “I didn't think about it” and “I don't remember”); quit intentions (“What best describes your plans regarding quitting smoking cigarettes?”, response options included “intend to quit- in the next 7 days, next month, next 6 months, next year, someday, but not within the next year” and “never plan to quit”); and cigarette cravings (“Do you ever have strong cravings to smoke cigarette?” yes/no). Respondents reported the number of past year cigarette quit attempts and past year quit methods. Participants from the 2016 survey responded to “In the past 12 months, have you used [quit method] to try to quit smoking?” For 2015 survey participants, we used responses to a similar, albeit more restrictive, item: “Now, think about the last time you tried to quit smoking. When you last tried to quit smoking, did you do [quit method]?” Participants were allowed to select more than one quit method.

### Addiction and Harm Perceptions

Respondents reported several tobacco-related perceptions.

1. Perceived cigarette addiction: “Do you consider yourself addicted to cigarettes?” Response options were “not at all,” “yes, somewhat addicted,” “yes, very addicted,” and “I don't know.”

2. Smoker regret: “If you had it to do over again, would you start smoking cigarettes?” Participants provided responses on a 5-point Likert scale, “strongly disagree” to “strongly agree.”
3. Lung cancer risk of the average smoker: “Imagine the average cigarette smoker. How much higher is that person’s risk of getting lung cancer, compared to those who have never used any tobacco or electronic vapor product?” with a 7-point response scale ranging from “about the same” (0) to “much higher” (6).
4. Personal lung cancer risk: “How much higher is your risk of getting lung cancer, compared to those who have never used any tobacco or electronic vapor product?” with a 7-point response scale ranging from “about the same” (0) to “much higher” (6).
5. Belief that nicotine is the main addictive substance in tobacco products: “To what extent, if at all, do you agree that nicotine is the main substance in tobacco that makes people become addicted to tobacco products?” Responses were provided on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree” in addition to an “I don’t know” option.
6. Perceived harm of ENDS and hookah in comparison to cigarettes: “Is (using electronic vapor products/smoking hookah) less harmful, about the same, or more harmful than smoking regular cigarettes?” In the 2015 survey, participants responded to these items with a 3-point Likert type scale: “less harmful,” “about the same level of harm,” and “more harmful” in addition to an “I don’t know” option, whereas 2016 survey participants responded with a 5-point Likert type scale ranging from “much less harmful” to “much more harmful” in addition to an “I don’t know” option. The 2016 response options were collapsed to a 3-point Likert type scale for consistency with the 2015 response options such that the “much less/more harmful” were combined with the “less/more harmful” response options, respectively.

### Demographic Characteristics

Demographic characteristics included sex, age, race/ethnicity, income, education, region, metropolitan statistical area (MSA), and self-perceived health were obtained from profile surveys administered by GfK to KnowledgePanel panelists. All demographic characteristics were examined as categorical variables. See [Table 1](#) for categories used in the analyses.

### Statistical Analyses

We compared dual users and exclusive cigarette smokers on smoker characteristics, addiction and harm perceptions, and demographic characteristics using Rao–Scott  $\chi^2$  tests and multivariable logistic regression models. We used SAS 9.4 (Cary, NC) to obtain weighted point estimates (proportions from Rao–Scott  $\chi^2$  tests and adjusted odds ratios [AORs] from multivariable logistic regression models) and 95% confidence intervals (CIs). For all analyses, a  $p$ -value  $<.05$  was considered statistically significant.

### Results

In 2015–2016, 0.8% (95% CI: 0.6 to 1.0) of US adults were dual users of ST and cigarettes, and 12.8% (95% CI: 12.2 to 13.5) were exclusive cigarette smokers ([Table 1](#)). Following adjustment for all other demographic characteristics, residing in a non-MSA area, Midwest, South, or West and having received some college education (vs. less than a high school education) was associated with higher odds of dual use while reporting very good or good health

(vs. excellent health) and being aged 45 or older (vs. 18–29) was associated with lower odds of dual use ([Table 1](#)). No statistically significant association was observed between dual users and exclusive smokers by sex, race/ethnicity, or income in adjusted analyses.

In unadjusted analyses, having made at least 1 past year cigarette quit attempt was associated with higher odds of dual use (OR: 1.95 [95% CI: 1.11 to 3.43], [Supplementary Table S1](#)) and 44.6% of dual users reported two or more past quit year compared to 29.9% of exclusive smokers (unreported); however, this association was no longer statistically significant in multiple regression analyses ([Table 2](#)). Similarly, cigarette quit intentions, daily cigarette smoking, CPD, and cigarette cravings were not associated with higher odds of dual use in adjusted analyses ([Table 2](#)). However, initiating cigarette smoking after age 18 was associated with higher odds of dual use (AOR: 2.25 [95% CI: 1.24 to 4.09]) following adjustment for demographic characteristics.

Among participants who reported a past year cigarette quit attempt, the following quit methods were associated with higher odds of dual use in adjusted analyses: use of nicotine replacement therapy (NRT) (AOR: 3.00 [95% CI: 1.41 to 6.38]), having received help from a quit line, smoking cessation website, or health care professional (AOR: 3.05 [95% CI: 1.14 to 8.16]), and use of ST, traditional cigars, hookah, or heat-not-burn (AOR: 9.54 [95% CI: 3.22 to 28.23]). Additionally, current use of all OTP (traditional cigars, little cigars or cigarillos, hookah, and ENDS) were found to be robust predictors of dual use (AORs: 2.90–11.02, [Table 2](#)) and those who reported current use of two or more OTP had higher odds of dual use (AOR: 5.53 [95% CI: 2.94 to 10.40]) following adjustment for demographic characteristics.

Dual users and exclusive smokers did not differ significantly in their self-reporting of perceived cigarette addiction, smoking regret, hookah, or ENDS comparative harm ([Table 3](#)). However, those who reported that they did not know if nicotine was the main addictive substance in tobacco products had lower odds of dual use (AOR: 0.35 [95% CI: 0.14 to 0.85]) following adjustment for demographic characteristics. Respondents who perceived that the average smoker’s risk of lung cancer was moderately higher (AOR: 2.66 [95% CI: 1.09 to 6.53]) and that their own personal risk of lung cancer was slightly higher (AOR: 3.75 [95% CI: 1.42 to 9.91]) than never tobacco or ENDS users’ risk of lung cancer, had higher odds of dual use ([Table 3](#)).

### Discussion

Our findings indicate that dual users of ST and cigarettes differ from exclusive smokers in several ways. Dual users had different demographic characteristics than exclusive smokers: those who were younger, initiated smoking after age 18, resided in non-MSA areas or outside of the Northeast United States, and reported being in excellent health (as opposed to good or very good health) were more likely to be dual users. However, dual users did not significantly differ from exclusive smokers in their smoking or quitting behaviors (CPD, daily/nondaily smoking, number of cigarette quit attempts in the past year) and most harm perceptions following adjustment for demographic characteristics. These findings suggest that dual use interventions and communications may be more effective if they are region specific and targeted toward younger adults and smokers who initiated use in young adulthood.

Previous studies that compared dual users of ST and cigarettes with exclusive cigarette smokers have yielded mixed findings in

**Table 1.** Demographic Characteristics Among Exclusive Cigarette Smokers and Dual Users of ST and Cigarettes, 2015–2016

Characteristic	Exclusive Cigarette Smokers		Dual Users		Outcome: Dual Use AOR (95% CI)
	N = 2452		N = 116		
	%	(95% CI)	%	(95% CI)	
Overall	12.8	12.2 to 13.5	0.8	0.6 to 1.0	
Sex					
Male	47.8	45.0 to 50.7	58.2	45.9 to 70.6	1.60 (0.93 to 2.76)
Female	52.2	49.3 to 55.0	41.8	29.4 to 54.1	Ref
Age					
18–29	20.1	17.5 to 22.7	37.4	25.3 to 49.5	Ref
30–44	29.1	26.5 to 31.7	38.7	26.8 to 50.5	0.73 (0.40 to 1.36)
45–59	32.7	30.1 to 35.3	17.2	9.3 to 25.2	<b>0.31 (0.15 to 0.65)</b>
60+	18.0	16.2 to 19.9	6.7	0.0 to 13.9	<b>0.09 (0.04 to 0.21)</b>
Race/ethnicity					
White, NH	59.8	56.8 to 62.7	48.6	36.5 to 60.7	Ref
Black, NH	17.3	14.8 to 19.7	17.4	7.5 to 27.4	1.53 (0.74 to 3.18)
Other, NH	7.5	5.7 to 9.4	8.6	0.6 to 16.6	1.07 (0.41 to 2.76)
Hispanic	15.4	13.2 to 17.6	25.4	14.0 to 36.8	1.29 (0.66 to 2.53)
Education					
<High school	22.4	19.6 to 25.3	16.3	5.7 to 27.0	Ref
High school	36.1	33.5 to 38.8	30.3	19.1 to 41.6	1.77 (0.67 to 4.71)
Some college	27.5	25.2 to 29.8	38.4	26.7 to 50.1	<b>2.59 (1.05 to 6.39)</b>
College degree+	13.9	12.2 to 15.7	14.9	7.5 to 22.4	2.20 (0.81 to 6.02)
Income					
<\$25K	30.8	28.2 to 33.4	27.1	15.7 to 38.5	Ref
\$25K–\$49.99K	25.1	22.7 to 27.5	26.6	16.4 to 36.7	1.41 (0.73 to 2.75)
\$50K–\$74.99K	15.7	13.7 to 17.6	24.6	13.6 to 35.5	1.85 (0.91 to 3.75)
\$75K–\$99.99K	11.7	9.9 to 13.4	10.5	4.1 to 16.8	1.19 (0.53 to 2.67)
\$100K+	16.7	14.4 to 19.0	11.3	3.4 to 19.3	0.98 (0.37 to 2.56)
MSA category					
MSA	84.3	82.2 to 86.3	74.1	63.1 to 85.2	Ref
Non-MSA	15.7	13.7 to 17.8	25.9	14.8 to 36.9	<b>2.61 (1.39 to 4.92)</b>
USA region					
Northeast	16.9	14.9 to 18.9	5.4	1.1 to 9.6	Ref
Midwest	23.9	21.7 to 26.2	21.4	12.7 to 30.1	<b>2.84 (1.05 to 7.69)</b>
South	38.6	35.7 to 41.4	44.0	31.5 to 56.4	<b>2.93 (1.05 to 8.19)</b>
West	20.6	18.2 to 23.0	29.3	18.4 to 40.2	<b>4.69 (1.73 to 12.67)</b>
Self-perceived physical health					
Excellent	6.3	4.9 to 7.7	17.5	7.0 to 28.1	Ref
Very good	28.5	26.0 to 31.1	26.2	15.5 to 37.0	<b>0.42 (0.18 to 0.95)</b>
Good	41.3	38.5 to 44.1	33.2	21.9 to 44.5	<b>0.45 (0.21 to 1.00)</b>
Fair	18.9	16.6 to 21.2	20.7	11.5 to 29.8	0.79 (0.33 to 1.91)
Poor	4.9	3.7 to 6.2	2.3	0.0 to 4.6	0.39 (0.11 to 1.43)

ST, smokeless tobacco; CI, confidence interval; AOR, adjusted odds ratio; NH, non-Hispanic; K, 1000; MSA, metropolitan statistical area. Adjusted odd ratios are adjusted for sex, age, race/ethnicity, income, education, region, MSA, and self-perceived physical health. Boldface indicates statistical significance at the  $p < .05$  level. Weighted percent are reported.

regards to cigarette quit attempts and quit intentions. For example, a higher proportion of dual users in our study reported at least 1 past year cigarette quit attempt compared to exclusive smokers which is similar to Messer et al.<sup>18</sup> However, unlike Messer et al., we did not find a statistically significant association with past year quit attempts and dual use in adjusted analyses, which is consistent with findings from Kalkhoran et al.<sup>18,29</sup> Notably, Messer et al.'s analyses adjusted for cigarette dependence in addition to demographic characteristics, while the analyses of the present study and Kalkhoran et al. only adjusted for demographic characteristics.<sup>18,29</sup> Similarly, Wetter et al.<sup>31</sup> found significant interactions with nicotine dependence and tobacco use group such that smoking fewer cigarettes per day was associated with greater likelihood of abstinence at follow-up among exclusive smokers but not among dual users. Furthermore, the present

study did not find an association between dual use and cigarette quit intentions, which is similar to Kalkhoran et al. but inconsistent with a study conducted by McClave–Regan and Berkowitz which only reports unadjusted findings.<sup>10,29</sup>

Although the reason for these inconsistencies is unclear, they could be attributed to several factors. For example, in comparison to Messer et al.'s study, the dual user sample sizes of the present study and Kalkhoran et al.'s study are small and it is possible that limited statistical power is responsible for the differences. Additionally, as previously mentioned, prior dual use studies vary in their reporting of unadjusted and adjusted findings as well as the number and type of covariates considered in analyses (eg, Messer et al. adjusted for nicotine dependence and demographic characteristics while other studies only adjusted for demographic characteristics). Thus, it is

**Table 2.** Comparisons of Smoker Characteristics Among Exclusive Cigarette Smokers and Dual Users of ST and Cigarettes, 2015–2016

Characteristic/Predictors	Exclusive Cigarette Smokers		Dual Users		Outcome: Dual Use AOR <sup>a</sup> (95% CI)
	N = 2452		N = 116		
	%	(95% CI)	%	(95% CI)	
Cigarette smoking frequency					
Daily smoker	70.6	67.9 to 73.3	61.3	49.4 to 73.3	0.88 (0.51 to 1.54)
Nondaily smoker	29.4	26.7 to 32.1	38.7	26.7 to 50.6	Ref
Mean cigarettes smoked/day					
0–10	60.1	57.4 to 62.8	64.0	52.8 to 75.2	Ref
11–20	32.6	30.0 to 35.2	28.9	18.2 to 39.5	1.31 (0.72 to 2.35)
≥21	7.4	6.1 to 8.6	7.2	2.6 to 11.7	1.82 (0.83 to 3.98)
Strong cigarette cravings					
Yes	72.7	70.1 to 75.3	74.7	64.0 to 85.5	1.38 (0.77 to 2.47)
No or I don't know	27.3	24.7 to 29.9	25.3	14.5 to 36.0	Ref
Age at cigarette initiation					
≤18	82.2	80.0 to 84.3	71.6	59.7 to 83.4	Ref
>18	17.8	15.7 to 20.0	28.4	16.6 to 40.3	<b>2.25 (1.24 to 4.09)</b>
Anticipated length of smoking at initiation					
A few days	7.6	6.2 to 9.1	6.3	2.5 to 10.1	1.13 (0.50 to 2.55)
A few months	7.0	5.5 to 8.5	7.3	1.8 to 12.8	1.14 (0.45 to 2.88)
Less than a year	8.1	6.5 to 9.8	16.2	6.3 to 26.0	2.08 (0.98 to 4.39)
1–5 years	8.3	6.7 to 9.9	11.8	3.2 to 20.4	1.68 (0.65 to 4.29)
Longer than 5 years	2.9	1.8 to 3.9	5.9	1.2 to 10.6	2.17 (0.79 to 5.98)
I didn't think about it	50.0	47.2 to 52.9	37.1	25.3 to 48.8	Ref
I don't remember	16.0	13.9 to 18.2	15.5	5.7 to 25.3	1.41 (0.63 to 3.17)
Past year cigarette quit attempts					
0	53.0	49.9 to 56.1	36.6	23.9 to 49.4	Ref
1+	47.0	43.9 to 50.1	63.4	50.5 to 76.1	1.26 (0.56 to 2.86)
Cigarette quit intentions					
Within next month	16.4	14.2 to 18.5	11.4	4.9 to 17.9	0.75 (0.29 to 1.93)
Within next 6 months	16.7	14.6 to 18.8	33.0	21.0 to 45.1	1.95 (0.81 to 4.70)
Within 1 year	16.9	14.8 to 18.9	11.6	4.9 to 18.3	0.73 (0.28 to 1.93)
Someday, not within next year	36.0	33.2 to 38.7	28.8	18.0 to 39.5	0.84 (0.37 to 1.91)
Never plan to quit	14.1	12.1 to 16.1	15.2	5.4 to 24.9	Ref
Past year cigarette quit methods <sup>b</sup>					
Cold Turkey	71.8	67.5 to 76.1	60.9	41.6 to 80.3	0.52 (0.21 to 1.31)
Reduced no. of cigarettes	72.5	68.3 to 76.8	59.3	42.1 to 76.5	0.58 (0.25 to 1.31)
Switched cigarette brand	24.9	19.8 to 29.9	35.3	17.7 to 52.8	1.46 (0.61 to 3.51)
Quit line, websites, or doctor	20.0	15.1 to 24.9	40.8	19.3 to 62.3	<b>3.05 (1.14 to 8.16)</b>
Nicotine replacement therapy	37.7	32.5 to 42.9	57.8	38.4 to 77.2	<b>3.00 (1.41 to 6.38)</b>
Switched to ENDS	31.2	24.9 to 37.4	35.4	14.7 to 56.1	1.23 (0.41 to 3.72)
Partial substitution with ENDS	47.5	41.2 to 53.7	35.2	16.4 to 54.0	0.56 (0.20 to 1.54)
Little cigars and cigarillos	10.2	6.8 to 13.6	21.4	7.5 to 35.2	2.02 (0.69 to 5.89)
ST/traditional cigars/hookah/ heat-not-burn	9.2	5.0 to 13.4	51.9	33.4 to 70.4	<b>9.54 (3.22 to 28.23)</b>
Past 30-day OTP use <sup>c</sup>					
Traditional cigars	5.5	4.2 to 6.8	27.2	15.5 to 38.9	<b>4.72 (2.45 to 9.07)</b>
Little cigars and cigarillos	11.7	9.8 to 13.6	36.0	23.7 to 48.2	<b>2.90 (1.57 to 5.39)</b>
Hookah	2.9	1.9 to 3.9	30.6	18.3 to 43.0	<b>11.02 (5.17 to 23.49)</b>
ENDS	17.4	15.2 to 19.5	44.0	31.6 to 56.3	<b>3.11 (1.82 to 5.32)</b>
No. of OTP currently used					
0	70.9	68.3 to 73.5	43.0	31.1 to 54.8	Ref
1	22.1	19.7 to 24.5	20.2	10.5 to 29.9	1.17 (0.62 to 2.19)
2+	7.0	5.6 to 8.4	36.8	24.6 to 49.1	<b>5.53 (2.94 to 10.40)</b>

ST, smokeless tobacco; CI, confidence interval; AOR, adjusted odds ratio; ENDS, electronic nicotine delivery systems; OTP, other tobacco products.

<sup>a</sup>Odds are adjusted for sex, age, race/ethnicity, income, education, region, metropolitan statistical area (MSA), and self-perceived physical health. Boldface indicates statistical significance at the  $p < .05$  level. Weighted percent are reported.

<sup>b</sup>Reference group is “no” to the past year quit method.

<sup>c</sup>Reference group is “no” to past 30-day use of the OTP.

also possible that the differences between study findings could be attributed to unmeasured confounding or effect measure modification as well as statistical suppression. These inconsistencies further

highlight the need for additional research of the factors associated with dual use of ST and cigarettes and exclusive smoking and we recommend that future studies account for smoker characteristics



**Table 3.** Comparisons of Addiction and Harm Perceptions Among Exclusive Cigarette Smokers and Dual Users of ST and Cigarettes, 2015–2016

Characteristic/Predictor	Exclusive Cigarette Smokers		Dual Users		Outcome: Dual Use AOR (95% CI)
	N = 2439		N = 115		
	%	(95% CI)	%	(95% CI)	
Perceived cigarette addiction					
Very addicted	38.4	35.7 to 41.1	31.8	20.3 to 43.3	1.10 (0.51 to 2.37)
Somewhat addicted	43.6	40.7 to 46.4	51.0	38.6 to 63.3	1.37 (0.68 to 2.77)
Not at all or I don't know	18.0	15.7 to 20.4	17.2	8.0 to 26.5	Ref
Nicotine main addictive substance					
Strongly/somewhat agree	63.3	60.5 to 66.1	54.6	42.3 to 67.0	Ref
Neither disagree nor agree	14.2	12.0 to 16.3	20.2	10.7 to 29.6	1.42 (0.71 to 2.86)
Strongly/somewhat disagree	11.8	10.0 to 13.7	21.5	10.3 to 32.6	1.30 (0.68 to 2.46)
I don't know	10.7	9.0 to 12.4	3.7	0.9 to 6.5	<b>0.35 (0.14 to 0.85)</b>
Smoking regret					
Strongly/somewhat agree	69.5	66.7 to 72.3	58.9	46.2 to 71.6	1.00 (0.49 to 2.04)
Neither disagree nor agree	20.4	17.9 to 22.8	22.0	11.2 to 32.8	Ref
Strongly/somewhat disagree	10.1	8.4 to 11.9	19.1	7.8 to 30.5	1.15 (0.45 to 2.96)
Average smoker lung cancer risk					
0—about the same	11.0	9.2, 12.9	11.5	2.6 to 20.3	0.90 (0.35 to 2.34)
1	2.5	1.6 to 3.3	2.0	0.0 to 4.6	1.10 (0.24 to 4.93)
2	6.2	4.5 to 7.8	12.4	4.0 to 20.9	<b>2.66 (1.09 to 6.53)</b>
3	16.0	13.9 to 18.1	14.2	5.6 to 22.8	1.12 (0.52 to 2.43)
4	14.2	12.3 to 16.1	18.3	8.7 to 27.8	2.05 (0.99 to 4.27)
5	13.5	11.5 to 15.5	16.2	6.7 to 25.8	2.05 (0.89 to 4.74)
6—much higher	36.6	33.9 to 39.3	25.4	15.8 to 35.1	Ref
Personal lung cancer risk					
0—about the same	10.7	8.8 to 12.6	12.2	3.2 to 21.2	0.91 (0.35 to 2.38)
1	2.6	1.7 to 3.4	6.3	1.3 to 11.3	<b>3.75 (1.42 to 9.91)</b>
2	6.9	5.3 to 8.5	10.9	3.2 to 18.6	2.25 (0.88 to 5.72)
3	19.6	17.4 to 21.9	20.9	9.9 to 32.0	1.20 (0.55 to 2.61)
4	15.8	13.7 to 17.9	12.3	5.2 to 19.4	1.03 (0.44 to 2.38)
5	10.7	9.0 to 12.4	12.1	4.1 to 20.1	1.94 (0.74 to 5.07)
6—much higher	33.8	31.1 to 36.4	25.3	15.3 to 35.3	Ref
Hookah comparative harm					
More harmful than cigarettes	7.5	5.8 to 9.2	13.1	4.6 to 21.7	1.78 (0.73 to 4.35)
About the same level of harm	37.0	34.0 to 40.0	31.7	20.3 to 43.0	Ref
Less harmful than cigarettes	8.9	7.1 to 10.6	20.4	8.4 to 32.3	1.57 (0.71 to 3.47)
I don't know	46.6	43.5 to 49.8	34.8	22.7 to 46.9	1.17 (0.61 to 2.25)
ENDS comparative harm					
More harmful than cigarettes	4.4	2.9 to 5.8	10.0	1.4 to 18.6	2.82 (0.88 to 8.98)
About the same level of harm	32.2	29.4 to 35.0	27.6	16.7 to 38.4	Ref
Less harmful than cigarettes	35.0	32.2 to 37.8	38.3	26.1 to 50.4	1.17 (0.63 to 2.19)
I don't know	28.4	25.8 to 31.1	24.1	13.6 to 34.7	1.27 (0.61 to 2.65)

ST, smokeless tobacco; CI, confidence interval; AOR, adjusted odds ratio; ENDS, electronic nicotine delivery systems. In the regression model (AOR column) the outcome was dual use of ST and cigarettes and the odds adjust for sex, age, race/ethnicity, income, education, region, metropolitan statistical area (MSA), and self-perceived physical health. Boldface indicates statistical significance at the  $p < .05$  level. Weighted percent are reported.

such as nicotine dependence as well as demographic characteristics in their analyses.

The overall results of this study suggest that dual users of ST and cigarettes are in fact polytobacco users who engage in use of multiple tobacco products, potentially for smoking cessation purposes, and a diverse range of cessation methods. Although the specific health effects of polytobacco use are understudied, polytobacco use likely confers increased health risks compared to use of a single tobacco product, and high rates of OTP use may inhibit smoking cessation due to the potential for increased nicotine dependence.<sup>11,23,25,31</sup> Moreover, our findings suggest that dual users are people looking for various ways to quit and are more open to using different ways of help—from doctors and NRT to ST and hookah. These findings

highlight the need to communicate to dual users the differences in efficacy of various types of “cessation aids” and to steer them toward FDA-approved cessation methods.

The FDA recently announced the agency's new nicotine centered regulatory framework and proposed nicotine product standard.<sup>37</sup> More specifically, the FDA will consider the continuum of risk for nicotine-containing products, the possible influence of noncombustible products, and the potential for smokers to use noncigarette tobacco products in combination with or as a replacement to cigarettes to maintain their nicotine dependence.<sup>38</sup> Although ST is not completely harmless it is arguably less harmful than cigarettes, especially low-nitrosamine ST such as snus.<sup>18,39,40</sup> However, despite currently using ST, the dual users in our sample reported smoking at

the same rates as exclusive smokers and perceived cigarette addiction and cravings similar to exclusive cigarette smokers. They also reported current use of both combustible and noncombustible OTP at levels higher than their exclusive smoker counterparts.

Moreover, we found that although dual users and exclusive cigarette smokers did not differ in making past year quit attempts, dual users were more likely to try various quit methods in the past year compared to exclusive smokers: they reported being more likely to try to quit smoking by using NRT; receiving help from quit lines, cessation websites, or health care professionals; and using ST, traditional cigars, hookah, or heat-not-burn. Moreover, current use of OTP was associated with dual use and many dual users reported currently using two or more OTP. Recently, use of noncigarette tobacco products, particularly hookah and ENDS, has gained popularity, and smokers and nonsmokers alike commonly report polytobacco use.<sup>33,41-43</sup> For example, Sung et al.<sup>13</sup> found that 54.8% of current chewing tobacco users and 42.5% of current snuff users reported polytobacco use in 2010, 26.7% and 23.5% of whom, respectively, reported using both cigarettes and an OTP. Additionally, ST marketing and advertising often suggests that ST can aid with cigarette smoking reductions and smokers exhibit higher interest in ST for harm reduction and safety than for other reasons.<sup>44</sup> The use of multiple tobacco products, including ST, among cigarette smokers may be driven by a desire to quit smoking.<sup>43,45</sup>

These findings have regulatory implications for the US Food and Drug Administration (FDA) as it considers pending ST-related policies such as the proposed NNN ST product standard and reviews MRTP application for snus products submitted by the Swedish Match.<sup>36,37</sup> In weighing evidence about the population-level impact of these claims, the FDA needs to consider consumer perception studies on whether the proposed claims change the perceived risk of both ST products and of smoking. Findings from previous studies comparing the proposed modified risk claims for snus to the current warning labels, suggest that the proposed claims, one of which indicates that snus “presents substantially lower risks to health than cigarettes,”<sup>37</sup> are associated with reduced harm perceptions of ST (snus<sup>46,47</sup> and moist snuff<sup>48</sup>) and increased likelihood of using snus.<sup>46,47</sup>

In the present study, we found that dual users and exclusive smokers did not differ in perceptions of their own addiction to cigarettes, perceived harms of cigarettes, or most smoking and cessation behaviors. Moreover, previous studies indicate that dual users of ST and cigarettes are likely to continue dual use/less likely to quit tobacco use and may be more nicotine dependent than exclusive smokers.<sup>20,21,31,49</sup> For example, Tam et al.’s<sup>21</sup> systematic review of longitudinal ST-cigarette use transition studies noted that nearly half of adult male dual users remained dual users after follow-up and that around one-third actually transitioned to exclusive smoking. Although approval of the proposed modified risk claims might confer increased rates of snus use, cigarette smokers who transition to dual use with ST may not experience changes in their smoking behaviors or achieve smoking cessation. Our findings further bolster the need for additional research related to dual use transitions and cessation messaging that emphasizes quitting among dual users. However, it is important to note that more research is needed to more thoroughly understand the population-level impact of modified risk claims. Moreover, the present study did not measure perceived risks of ST or of dual use, and future research should evaluate this.

### Limitations

This study has several strengths including a nationally representative sample, use of recent (2015–2016) data, and comparisons of perceptions as well as smoking and cessation behaviors of dual users and exclusive smokers. Nevertheless, this study is subject to several limitations. Firstly,

the present study is subject to the inherent limitations of cross-sectional data and we are unable to make causal inferences or assess temporality due to the observational nature of this study. Similarly, the data are based on self-report and there may be potential recall bias, with respect to reporting of use behaviors. However, the validity of self-reported ST use has been confirmed in a previous study.<sup>50</sup> Despite pooling 2 years of data our sample size of dual users is somewhat small ( $n = 116$ ) and consequently, the sample size of polytobacco users (dual users who engaged in past 30-day use of OTP) is also small ( $n = 59$ ). Although this may affect the precision of our estimates as denoted by the reported confidence intervals and resulted in several of our nonsignificant findings, the sample size reflects the overall prevalence of dual use in the population and is consistent with a previous study.<sup>10</sup> These results offer an update on the estimate of dual use of ST and cigarettes in a national sample. Future studies should oversample dual users to more accurately evaluate their tobacco use behavior, perceptions, and the extent of OTP use among this population. In the present study, we defined current ST use as use of chewing tobacco, dip, snuff, snus, or dissolvable tobacco in the past 30 days, which may limit the comparability of our findings with other studies that define current ST use differently or assess a smaller range of ST products.<sup>30</sup> Lastly, while the present study examined a limited number of nicotine dependence measures (mean number of cigarettes smoked per day and self-perceived cigarette addiction), we did not have direct measures that assessed the degree to which current smokers found ST to satisfy their nicotine cravings or to be an adequate substitute to cigarettes. We recommend that future studies of dual use of ST and cigarettes include additional measures of nicotine dependence such as time to first cigarette, measures of craving satisfaction, and examine reasons for ST use, polytobacco use, and the absolute and relative harm perceptions of alternative and novel tobacco products.

### Conclusions

Our results suggest that many dual users of ST and cigarettes currently use novel tobacco products and engage in use of noncigarette tobacco products as a cessation method at rates higher than exclusive smokers. We recommend further national monitoring of dual use of ST and cigarettes to better assess the differences between dual users and exclusive smokers and to further investigate the role of polytobacco use among this population, especially considering the high rates of OTP use among exclusive and dual ST users. Our findings may aid the development of forthcoming ST- and OTP-related messaging and guide FDA regulation of nicotine levels, ST and emerging tobacco products alike.

### Supplementary Material

Supplementary data are available at *Nicotine & Tobacco Research* online.

### Funding

This work was supported by the National Institute on Drug Abuse at the National Institutes of Health; and the US Food and Drug Administration, Center for Tobacco Products (P50 DA036128 to MPE). The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the US Food and Drug Administration.

### Declaration of Interests

MPE receives and TFP previously received research funding support from Pfizer, Inc. (“Diffusion of Tobacco Control Fundamentals to Other Large Chinese Cities” Michael Eriksen, Principal Investigator). The other authors declared that they have no conflicts of interest.

## Supplement Sponsorship

This supplement was sponsored by the Center for the Evaluation and Coordination of Training and Research for Tobacco Regulatory Science (5U54CA189222).

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