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The Association of Newly Emerging Smokeless Tobacco Products with Quit Attempts and Intention-to-quit Smoking by Income

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Abstract

Introduction: The literature highlighted several gray areas relating to the association between smokeless tobacco (ST) use, especially newer ST products, and cessation across income groups. The existing research further emphasized the potential role of dental providers in mediating this relationship. Focusing on current smokers from the 2010-2011 Tobacco Use Supplement to the Current Population Survey, this paper investigated the association between use of new ST products with quit attempts, intention-to-quit, and intention-to-quit conditional on a previous quit attempt across income groups. Analyses controlled for dental advice to quit.

Methods: Three outcomes were explored: any annual quit attempts, intention-to-quit, and intention-to-quit conditional on any quit attempts. Multiple logistic regressions were run for the full study sample and stratified by income, controlling for any use of newly emerging ST products, dental advice to quit, smoking behaviors, and sociodemographic characteristics.

Results: Use of ST products was not significantly associated with quit attempts but positively associated with intention-to-quit smoking for the full sample and across stratified income groups. This association disappeared once conditioning intention-to-quit on previous quit attempts. Advised cessation by a dentist was largely significant and positively associated with cessation behaviors across all outcomes explored.

Conclusions: Relative to smokers who do not use ST products, dual users were more likely to intend to quit although no difference was observed in actualized quit attempts. The relationship was particularly strong for the higher income group. The results further emphasized the role of dental providers in mediating this relationship.

Keywords: Smoking cessation; Smokeless tobacco; Income; Dentist

Introduction

Between 2005 and 2014, the overall prevalence of cigarette smoking among U.S. adults declined from 20.9% to 16.8% [1]. In response to stricter smoking policies and diminishing cigarette use, tobacco companies have expanded smokeless tobacco (ST) product lines, promoting ST products as alternatives to traditional cigarettes [2]. From 2000-2011, ST sales increased by nearly $1 billion; companies also increased associated advertising/promotional spending, boosting expenditure by $227 million [3]. While ST use, including consumption of traditional products like chewing tobacco and snuff, declined throughout 1980-1999, usage of these products has increased since 2000 [1,4]. The 2014 National Survey on Drug Use and Health indicated that 3.3% of all U.S. individuals aged 12 and older identified as a current ST user [4].

In 2009, the US Food and Drug Administration (FDA) received petitions from major tobacco companies like Philip Morris and RJ Reynolds to endorse ST as a harm reduction product [5,6]. Among those who have ever used ST products, 50% of respondents from a nationally representative telephone survey cited harm reduction or use as a cessation aid as a reason for trying ST products; 30% of respondents believed that the products were less harmful than traditional cigarettes [7]. Data from a nationally representative consumer-based survey found that 7.5%, 2.1%, and 45.2% of dual users, cigarette-only users, and ST-only users, respectively, believed ST products to be less harmful than cigarettes [7].

Perceptions of ST products as a safer alternative to traditional combustible tobacco products and the benefits of ST products as an effective cessation tool have given rise to the dual use of ST products and cigarettes, especially among younger, non-Hispanic white males [6,8-9]. Evidence of ST products as an effective smoking cessation tool has yet to be established; however, recent nationally representative studies have yielded mixed results. While some research suggested a positive association between ST use and quit attempts, dual users also have lower rates of successful cessation [10-12] and higher rates of relapse compared to exclusive smokers [9]. Some literature has shown that ST use may be a stepping-stone to combustible cigarette use. For instance, a longitudinal study found that, while exclusive

smokers rarely switched solely to ST products, ST users were more likely to switch to cigarettes or dual use [13].

Within this context, it is important to identify factors that mediate the relationship between ST and cessation. Specifically, research has indicated that socioeconomic status is associated with both cigarette smoking and ST use [14]. Drawing on the nationally representative 2008 Consumer Styles survey data, McClave-Regan and Berkowitz found that dual users were almost five times more likely to report an annual income of less than $15,000 compared to users of only ST products (25.9% vs. 5.2%); dual users were more likely to fall into the < $15,000 income category compared to cigarette only smokers (25.9% vs. 19.0%) [6]. The literature has also suggested that, among ST users, income and cessation were negatively associated. For instance, using 2008-2012 data collected from exclusive ST users registered with the Oklahoma Tobacco Helpline, Mushtaq and colleagues found higher income smokers (annual income >$20,000) were 1.74 times more likely to abstain from tobacco for at least 30 days [15-16].

In this context, the role of health and dental care providers is worth considering. In particular, dental providers have a unique ability to offer cessation assistance to patients. In 2008, an estimated 23.1% U.S. adults who did not receive outpatient care visited a dentist. Furthermore, given its association with oral cancer and oropharyngeal cancer, dentists have the opportunity to serve as an authority on ST products [17]. Between 2010-2011, data from a large nationally representative US survey suggested that adult tobacco users were significantly less likely to be advised to quit during a dental visit (31.2%) than an outpatient physician visit (64.8%) [18]. The data further indicated that only 24% of dental patients who are tobacco users report receiving at least one form of assistance beyond advice to quit [18]. Not surprisingly, dentists report higher rates of inquiry. By some estimates, 90% of dental providers report inquiring about tobacco use, although the same study found that only 76% counseled patients and 45% routinely offer cessation advice [19]. Advice to quit appears to be a function of patient sociodemographic characteristics [20]. Regardless, if cessation advice in dental settings were maximized, the benefits could be enormous. A systematic review revealed that interventions by dental professionals potentially increased abstinence rates among cigarette smokers and ST users alike [21]. Moreover, given that patterns in cessation advice and smoking participation vary across sociodemographic groups, stratified analyses targeting specific subgroups could help inform more effective cessation interventions among dental patients.

The literature highlighted several gray areas relating to the relationship between ST use, especially newer ST products, and cessation across income groups. The existing research further emphasized the potential role of dental providers in mediating this relationship. Focusing on current smokers from the 2010-2011 Tobacco Use Supplement to the Current Population Survey (TUS-CPS), this paper explored the relationship between new ST products and dental visits with any quit attempts in the past year, intention-to-quit smoking, and intention-to-quit smoking months conditional on a previous quit attempt. Analyses were run for the population as whole and stratified by median U.S. family income during this period (≤ $50,000 and > $50,000).

Methods

Data source

This work drew on the most recent TUS-CPS data (2010/2011). The data include information relating to sociodemographic characteristics and smoking behaviors, including smoking patterns, cessation efforts, and tobacco-related norms and policies [22]. Most interviews were completed by telephone. Only self-respondents (approximately 80%) were eligible to answer the full set of TUS questions. The sample comprised current smokers aged ≥18. Given that all individuals included in the sample identified as current smokers, those who reported use of ST products were necessarily dual users.

Dependent variables

Any annual quit attempt: Among all current smokers, including occasional and everyday smokers, an individual was categorized as making a quit attempt if they reported having quit smoking one day or longer in the last 12 months with the intention-to-quit smoking [23-24].

Intention-to-quit smoking: Among all current smokers, an individual was categorized as intending to quit smoking if they indicated that they were "seriously considering quitting smoking within the next 6 months [23-24]".

Intention-to-quit smoking conditional on a previous quit attempt: The literature suggests that ST products are used both as a cessation aid as well as a means of smoking in otherwise restricted, smoke-free areas [6]. To help capture the association between ST use and desired cessation, intention-to-quit analyses were run for the full sample and among those who made a quit attempt in the last 12 months.

Explanatory variables

Any use of new ST products: The 2010-11 TUS-CPS probed, "Tobacco companies are developing new smokeless tobacco products, in various shapes, such as a pellet, a toothpick size stick, and a film strip, made from finely ground flavored tobacco that dissolves. Some common brands are Camel Orbs, Strips and Sticks. Have you tried any new smokeless tobacco products?" Respondents who answered "yes" to this question were categorized as having ever used new ST products.

Advised to quit smoking by dental provider: The TUS-CPS inquired, "In the past 12 months, have you seen a dentist?" Among those who visited a dentist, the TUS-CPS then asked, "During the past 12 months, did any dentist advise you to stop smoking?" Based on responses to these questions, a variable was constructed indicating whether an individual visited a dentist in the past 12 months and was advised to quit (yes/no).

Usual cigarette type: Following previous work [24], a categorical variable was created indicating whether an individual usually smoked menthol cigarettes, non-menthol cigarettes or had no usual type.

Cigarettes per day (CPD): Among everyday smokers, the TUS-CPS probed, "On the average, about how many cigarettes do you now smoke each day?" Among occasional smokers, CPD was constructed from two TUS-CPS questions, which asked (1) "On how many of the

Table 1: Descriptive statistics for sociodemographic and smoking behaviors among current smokers aged 18+ from the 2010/2011 Tobacco Use Supplement to the Current Population Survey.

	Full sample		Subsamples				
			Family income ≤ 50,000		Family income >50,000		
	(N=25,209)		(N=16998)		(N=8,211)		
	N	%	N	%	N	%	p-value[a]
Gender	25,209		16,998		8,211		< 0.001*
Male		54.3		52.6		57.8	
Female		45.7		47.4		42.2	
Age	25,209		16,998		8,211		< 0.001*
18 to 34		34.5		36.5		30.3	
35 to 49		29.9		28.2		33.5	
50 to 64		27.6		26.2		30.5	
65+		8.1		9.2		5.7	
Race/ethnicity	25,209		16,998		8,211		< 0.001*
Non-Hispanic White		74.3		70.8		81.7	
Non-Hispanic Black		11.4		14.0		5.9	
Hispanic		9.2		10.3		6.9	
Non-Hispanic Asian		2.3		1.8		3.3	
Non-Hispanic Other		2.8		3.1		2.2	
Education	25,209		16,998		8,211		< 0.001*
≤High school graduate		57.6		64.2		43.4	
Some college		30.6		28.5		35.1	
College graduate		11.8		7.2		21.5	
Family income	25,209		16,998		8,211		
< $25,000		37.2					
$25,000-$49,999		30.8					
$50,000-$74,999		16.1					
$75,000+		16.0					
Marital status	25,209		16,998		8,211		< 0.001*
Married		39.8		31.8		56.9	
Widowed/divorced		23.5		27.1		15.9	
Separated		4.4		5.3		2.5	
Never married		32.2		35.8		24.7	
Geographic region	25,209		16,998		8,211		< 0.001*
Northeast		18.4		17.1		21.0	
Midwest		27.5		27.9		26.7	
South		33.9		35.4		30.8	
West		20.2		19.6		21.4	
Typically smoke 30 minutes within walking	25,029		16,873		8,156		< 0.001*
Yes		50.5		53.0		45.4	
No		47.4		44.8		52.8	
No usual pattern		2.0		2.1		1.8	
Usual cigarette type	25,112		16,930		8,182		< 0.001*
Non-menthol		69.3		67.6		72.7	
Menthol		28.0		29.4		25.1	

	Full sample		Subsamples				
			Family income ≤ 50,000		Family income >50,000		
	(N=25,209)		(N=16998)		(N=8,211)		
	N	%	N	%	N	%	p-valueª
No usual type		2.7		3.0		2.2	
Cigarettes per day	24,722		16,660		8,062		< 0.001*
< 10		51.3		51.2		51.7	
10-14		10.7		10.1		12.0	
15+		37.9		38.7		36.3	
Smoking status	25,209		16,998		8,211		< 0.001*
Everyday smoker		81.0		81.9		79.2	
Occasional smoker		19.0		18.1		20.8	
Ever used a new smokeless tobacco product	24,753		16,671		8,082		0.841
No		98.2		98.2		98.1	
Yes		1.8		1.8		1.9	
Visited a dentist and was advised to quit	24,591		16,579		8,012		< 0.001*
No		87.1		89.1		82.9	
Yes		12.9		10.9		17.1	
Any annual quit attempts	24,977		16,831		8,146		0.173
No		62.9		62.6		63.4	
Yes		37.2		37.4		36.6	
Intend to quit in the next 6 months	24,147		16,233		7,914		< 0.001*
No		60.0		60.7		58.3	
Yes		40.1		39.3		41.7	

All percentages were weighted.

a. P-values result from a series of bivariate chi-squared tests, comparing the distribution of each categorical variable across family income groups (≤$50,000 vs. >$50,000).

*indicates significance. Significant if p-value less than the Bonferroni threshold of 0.01 (the nominal significance level divided by the number of pair wise comparisons = 0.01/1).

past 30 days did you smoke cigarettes?" and (2) "On the average, on those days, how many cigarettes did you usually smoke each day?" Based on these questions CPD was calculated as follows: [number of days smoked x number of cigarettes smoked on those days]/30. Finally, a categorical measure was constructed by creating three CPD groupings: <10, 10-14, and >15.

Nicotine dependence: The literature suggests that nicotine dependence can be proxied by how soon an individual smokes their first cigarette after waking [25]. Mirroring previous work, a categorical variable was constructed indicating whether a respondent reported typically smoking their first cigarettes within 30 minutes of waking (yes/no/no usual pattern) [24].

Smoking status: A categorical variable was created reflecting whether an individual was an occasional or everyday smoker.

Sociodemographic variables: We controlled for a variety of sociodemographic characteristics including gender, age [18 to 34, 35 to 49, 50 to 64, 65+], race/ethnicity [non-Hispanic white, non-Hispanic Black, non-Hispanic Asian, non-Hispanic Other, or Hispanic], highest level of educational attainment [high school graduate or less, some college, college graduate or more], family income [< $25,000, $25,000-$49,999, $50,000-$74,999, $75,000+], marital status [never

married, married, widowed, divorced/separated], and geographic region [Northeast, South, Midwest, West].

Study sample

We began with all current smokers ages 18 and older (n = 25,209). The study sample excluded observations with missing information for the dependent variable (dropping 1,123 observations) and explanatory variables (losing an additional 3,177 observations). The final study sample contained 20,909 observations, comprising 3,667 occasional and 17,242 everyday smokers. According to the US Department of Commerce, in 2010 and 2011, the median family income in the United States was $51,144 and $50,502, respectively [26]. Of the total population, 14,079 individuals have a total family income ≤$50,000 and 6,830 have a family income above this threshold.

Statistical analysis

Analyses were conducted in Stata 14.0 [27] and accounted for survey design of the data by incorporating replicate weights with Fay's balanced repeated replication [28-29]. A series of chi-squared tests assessed differences in each outcome and explanatory variable across income groups (≤ $50,000 vs. >$50,000). For each of the three dependent variables, multiple logistic regressions were run both for the full sample and stratified by income. Following previous work

Table 2: Multiple regression analyses exploring factors associated with any quit attempts among current smokers aged 18+ from the 2010/2011 Tobacco Use Supplement to the Current Population Survey.

				Subsamples				
	Full sample			Family income ≤ $50,000			Family income > $50,000	
	(N=20909)			(N=14079)			(N=6830)	
	AOR(95% CI)	p-value		AOR(95% CI)	p-value		AOR(95% CI)	p-value
Gender								
Male	1.01	(0.93,1.08)	0.873	0.99	(0.91,1.09)	0.908	1.04	(0.90,1.19)	0.589
Female	REF							
Age								
18 to 34	REF							
35 to 49	0.89	(0.81,0.99)	0.026	0.86	(0.76,0.96)	0.007	1.00	(0.83,1.21)	0.982
50 to 64	0.85	(0.77,0.94)	0.001*	0.82	(0.72,0.92)	0.001*	0.94	(0.77,1.13)	0.494
65+	0.69	(0.59,0.81)	<0.001*	0.69	(0.57,0.82)	<0.001*	0.67	(0.48,0.93)	0.018
Race/ethnicity								
Non-Hispanic White	REF							
Non-Hispanic Black	1.11	(0.96,1.27)	0.156	1.07	(0.92,1.24)	0.385	1.32	(0.98,1.78)	0.068
Hispanic	0.88	(0.76,1.02)	0.082	0.85	(0.71,1.01)	0.063	1.00	(0.79,1.27)	0.982
Non-Hispanic Asian	0.89	(0.67,1.18)	0.408	1.07	(0.74,1.55)	0.720	0.71	(0.47,1.07)	0.102
Non-Hispanic Other	1.14	(0.93,1.39)	0.208	1.13	(0.89,1.45)	0.310	1.12	(0.71,1.78)	0.616
Education								
<High school graduate	1.06	(0.94,1.19)	0.359	1.07	(0.91,1.26)	0.418	1.03	(0.87,1.22)	0.707
Some college	1.24	(1.09,1.40)	0.001*	1.23	(1.03,1.46)	0.021	1.25	(1.04,1.49)	0.016
College graduate	REF							
Family income								
< $25,000	0.95	(0.87,1.04)	0.285					
$25,000-$49,999	0.82	(0.74,0.91)	<0.001*					
$50,000-$74,999	0.83	(0.74,0.94)	0.003*					
$75,000+	REF							
Marital status								
Married	REF							
Widowed/divorced	0.96	(0.87,1.05)	0.331	0.99	(0.88,1.10)	0.796	0.88	(0.74,1.05)	0.156
Separated	1.01	(0.85,1.20)	0.925	1.04	(0.84,1.28)	0.739	0.92	(0.63,1.35)	0.678
Never married	0.90	(0.81,0.99)	0.026	0.88	(0.78,0.99)	0.037	0.98	(0.82,1.18)	0.850
Geographic region								
Northeast	REF							
Midwest	1.08	(0.97,1.22)	0.173	1.04	(0.90,1.20)	0.592	1.14	(0.93,1.39)	0.208
South	0.91	(0.81,1.03)	0.135	0.86	(0.74,0.99)	0.040	1.03	(0.86,1.23)	0.779
West	1.04	(0.90,1.19)	0.608	0.92	(0.77,1.09)	0.338	1.28	(1.06,1.53)	0.010
Typically smoke 30 minutes within walking								
Yes	0.84	(0.77,0.92)	<0.001*	0.86	(0.78,0.95)	<0.001*	0.80	(0.68,0.93)	<0.001*
No	REF							
No usual pattern	0.40	(0.28,0.57)	<0.001*	0.37	(0.24,0.57)	<0.001*	0.51	(0.29,0.89)	<0.001*
Usual cigarette type								
Nonmenthol	REF							
Menthol	1.00	(0.91,1.08)	0.920	0.99	(0.89,1.10)	0.830	1.01	(0.87,1.18)	0.860

	Full sample			Subsamples					
				Family income ≤ $50,000			Family income > $50,000		
	(N=20909)			(N=14079)			(N=6830)		
	AOR(95% CI)		p-value	AOR(95% CI)		p-value	AOR(95% CI)		p-value
No usual type	0.93	(0.72,1.19)	0.550	0.99	(0.73,1.33)	0.932	0.75	(0.48,1.19)	0.224
Cigarettes per day									
< 10	REF								
10-14	0.85	(0.75,0.96)	0.008	0.87	(0.75,1.02)	0.096	0.81	(0.65,0.99)	0.042
15+	0.55	(0.50,0.60)	<0.001*	0.55	(0.49,0.61)	<0.001*	0.54	(0.46,0.63)	<0.001*
Smoking status									
Everyday smoker	REF								
Occasional smoker	1.61	(1.46,1.77)	<0.001*	1.70	(1.53,1.90)	<0.001*	1.44	(1.21,1.71)	<0.001*
Ever used a new smokeless tobacco product									
No	REF								
Yes	1.06	(0.84,1.34)	0.603	1.03	(0.75,1.40)	0.864	1.17	(0.79,1.73)	0.423
Visited a dentist and was advised to quit									
No	REF								
Yes	1.55	(1.41,1.71)	<0.001*	1.53	(1.33,1.76)	<0.001*	1.58	(1.33,1.88)	<0.001*
Constant	0.79	(0.66,0.94)	0.007	0.82	(0.65,1.03)	0.088	0.56	(0.43,0.74)	0.000

All analyses accounted for survey design of the data by incorporate replicate weights with Fay's balanced repeated replication. *Indicates that AOR is significance (≤) at Bonferroni-adjusted threshold: 0.0100 (=0.01/1) for covariates with one comparison group (gender, smoking status, use of new ST product, advise to quit by dentist), 0.0050 (=0.01/2) for covariates with 2 comparison groups (educational attainment, smoke 30 minutes within waking, cigarette type, CPD), 0.0033 (0.01/3) for covariates with three comparison groups (age, income, marital status, geographic region), and 0.0025 (=0.01/4) for covariates with four comparison groups (race/ethnicity).

exploring smoking cessation outcomes using TUS-CPS data [24], Bonferroni-adjusted significance levels were used to account for multiple comparisons.

Results

Sociodemographic characteristics and smoking behaviors

The full sample was predominately male (54.3%), between the ages of 18-34 (34.5%), non-Hispanic White (74.3%), had a high school education or less (57.6%), had a family income of less than $25,000 (37.2%), was married (39.8%), and lived in the Southern portion of the US (33.9%) (Table 1). Half of smokers reported typically smoking their first cigarette within 30 minutes of waking (50.5%). Individuals usually smoked non-menthol cigarettes (69.3%), smoking fewer than 10 cigarettes on days when they did smoke (51.3%). Bivariate analyses revealed significant differences in the distribution of smoking behaviors across income groups. Those with above median income were less likely to smoke within 30 minutes of waking (45.4% vs. 53.0%), more likely to smoke non-menthol cigarettes (72.7% vs. 67.6%), and more likely to smoke a middling number of CPD (10-14) (12.0% vs. 10.1%). Individuals with above median income were more likely to report being an occasional smoker (20.8% vs. 18.1%). The overall prevalence of use of new ST products was quite low, with only 1.8% of the full sample reporting any experience with these products. No significant differences were observed across income groups.

Advised to quit by a dentist

In the full sample, in the below-median and the above-median groups, respectively, 12.9%. 10.9%, and 17.1% of respondents

reported visiting a dentist and being advised to quit smoking in the past 12 months. A chi-squared test indicated that these differences were significant.

Prevalence of quit attempts and intention-to-quit

In the full sample, 37.2% of respondents reported at least one quit attempt in the last 12 months; 40.1% reported intending to quit smoking in the next 6 months. Bivariate analyses highlighted significant distinctions across income groups in terms of intention-to-quit. While 39.3% of individuals with median or below median income reported intending to quit smoking in the next 6 months, 41.7% of those with above median income intended to do so.

Factors associated with quit attempts

In the full sample and in each sub-analysis, typically smoking one's first cigarette within 30 minutes of waking or having no usual pattern of when one's first cigarette was smoked were negatively associated with quit attempts (p<0.001). While there was no evidence that cigarette type was associated with quit attempts, smoking 15+ CPD was also negatively associated with quit attempts for the full sample and each income groups (p<0.001). Occasional smokers were more likely to experience a quit attempt regardless of income level (p<0.001). Although use of new ST products was unassociated with quit attempts, being advised to quit by a dentist within the last 12 months was positively associated with having at least one quit attempt over the same period (p<0.001). The regression results further suggested an inverse relationship between income and quit attempts in the full sample analysis. In the full sample analysis, individuals with some college education had higher odds of a quit attempt relative to

Table 3: Multiple regression analyses exploring factors associated with intention-to-quit smoking ($\leq$ 6 months) among current smokers aged 18+ from the 2010/2011 Tobacco Use Supplement to the Current Population Survey.

	Full sample (N=20909)			Subsamples					
				Family income $\leq$ $50,000 (N=14079)			Family income> $50,000 (N=6830)		
	AOR(95% CI)		p-value	AOR(95% CI)		p-value	AOR(95% CI)		p-value
Gender									
Male	1.02	(0.95,1.09)	0.567	0.99	(0.92,1.07)	0.809	1.10	(0.97,1.25)	0.129
Female	REF								
Age									
18 to 34	REF								
35 to 49	1.09	(0.99,1.20)	0.075	1.10	(0.98,1.24)	0.119	1.07	(0.92,1.25)	0.364
50 to 64	1.13	(1.02,1.25)	0.016	1.09	(0.97,1.23)	0.156	1.22	(1.02,1.44)	0.028
65+	0.82	(0.71,0.95)	0.007	0.86	(0.72,1.02)	0.079	0.68	(0.50,0.94)	0.021
Race/ethnicity									
Non-Hispanic White	REF								
Non-Hispanic Black	1.22	(1.07,1.39)	0.004	1.19	(1.03,1.37)	0.018	1.27	(0.93,1.73)	0.134
Hispanic	0.86	(0.76,0.98)	0.022	0.83	(0.71,0.98)	0.028	0.96	(0.73,1.26)	0.752
Non-Hispanic Asian	0.79	(0.59,1.05)	0.097	0.75	(0.52,1.10)	0.145	0.83	(0.54,1.28)	0.407
Non-Hispanic Other	1.28	(1.04,1.57)	0.021	1.24	(0.99,1.56)	0.065	1.29	(0.86,1.92)	0.216
Education									
<High school graduate	0.92	(0.81,1.03)	0.154	0.93	(0.79,1.10)	0.409	0.89	(0.75,1.05)	0.170
Some college	1.11	(0.98,1.26)	0.105	1.11	(0.93,1.33)	0.253	1.11	(0.93,1.32)	0.244
College graduate	REF								
Family income									
< $25,000	0.97	(0.89,1.06)	0.515						
$25,000-$49,999	0.94	(0.85,1.04)	0.214						
$50,000-$74,999	0.98	(0.88,1.10)	0.784						
$75,000+	REF								
Marital status									
Married	REF								
Widowed/divorced	0.95	(0.86,1.04)	0.241	0.96	(0.87,1.07)	0.456	0.93	(0.79,1.10)	0.402
Separated	0.89	(0.75,1.06)	0.184	0.94	(0.78,1.13)	0.507	0.70	(0.47,1.04)	0.079
Never married	0.89	(0.81,0.98)	0.014	0.90	(0.80,1.01)	0.072	0.88	(0.75,1.03)	0.114
Geographic region									
Northeast	REF								
Midwest	1.01	(0.89,1.14)	0.878	1.00	(0.85,1.19)	0.970	1.00	(0.84,1.18)	0.963
South	0.88	(0.78,0.99)	0.027	0.84	(0.72,0.98)	0.027	0.97	(0.82,1.15)	0.714
West	1.13	(0.99,1.29)	0.065	1.11	(0.93,1.33)	0.239	1.17	(0.97,1.42)	0.108
Typically smoke 30 minutes within walking									
Yes	0.90	(0.83,0.97)	<0.001*	0.93	(0.85,1.02)	0.138	0.81	(0.70,0.94)	<0.001*
No	REF								
No usual pattern	0.45	(0.32,0.63)	<0.001*	0.40	(0.27,0.59)	<0.001*	0.66	(0.39,1.14)	0.135
Usual cigarette type									
Nonmenthol	REF								
Menthol	0.98	(0.91,1.07)	0.714	1.02	(0.92,1.14)	0.714	0.92	(0.80,1.05)	0.206

	Full sample			Subsamples					
				Family income ≤ $50,000			Family income> $50,000		
	(N=20909)			(N=14079)			(N=6830)		
	AOR(95% CI)		p-value	AOR(95% CI)		p-value	AOR(95% CI)		p-value
No usual type	0.60	(0.46,0.78)	<0.001*	0.70	(0.52,0.94)	0.019	0.36	(0.22,0.60)	<0.001*
Cigarettes per day									
< 10	REF								
10-14	1.05	(0.93,1.18)	0.441	1.02	(0.88,1.19)	0.769	1.10	(0.89,1.35)	0.390
15+	0.61	(0.56,0.67)	<0.001*	0.60	(0.53,0.68)	<0.001*	0.65	(0.55,0.76)	<0.001*
Smoking status									
Every day smoker	REF								
Occasional smoker	1.69	(1.53,1.86)	<0.001*	1.81	(1.60,2.04)	<0.001*	1.49	(1.27,1.75)	<0.001*
Ever used a new smokeless tobacco product									
No	REF								
Yes	1.57	(1.25,1.96)	<0.001*	1.33	(1.01,1.76)	0.045	2.23	(1.45,3.42)	<0.001*
Visited a dentist and was advised to quit									
No	REF								
Yes	1.73	(1.55,1.92)	<0.001*	1.82	(1.57,2.11)	<0.001*	1.60	(1.35,1.90)	<0.001*
Constant	0.76	(0.62,0.91)	0.004	0.74	(0.58,0.93)	0.011	0.73	(0.56,0.94)	0.015

All analyses accounted for survey design of the data by incorporate replicate weights with Fay's balanced repeated replication. *Indicates that AOR is significance (≤) at Bonferroni-adjusted threshold: 0.0100 (=0.01/1) for covariates with one comparison group (gender, smoking status, use of new ST product, advise to quit by dentist), 0.0050 (=0.01/2) for covariates with 2 comparison groups (educational attainment, smoke 30 minutes within waking, cigarette type, CPD), 0.0033 (0.01/3) for covariates with three comparison groups (age, income, marital status, geographic region), and 0.0025 (=0.01/4) for covariates with four comparison groups (race/ethnicity).

those with a college degree; however, this relationship did not extend to the sub-analyses. Finally, in the full sample and the ≤$50,000 income group, older individuals experienced a lower odds of any quit attempts relative to those aged 18-34 (Table 2).

Factors associated with intention-to-quit

While most sociodemographic characteristics were insignificant, smoking behaviors were consistently associated with intention-to-quit. Smoking within 30 minutes of waking in the full sample and among those with a family income of >$50,000 was negatively associated with intention-to-quit (p<0.001). Similarly, relative to those who do not usually smoke their first cigarette within 30 minutes of waking, having no usual pattern when one's first cigarette was smoked was negatively associated with intention-to-quit within the full sample and among those with a family income a ≤$50,000 (p<0.001). Compared to those to those who typically smoke non-menthol cigarettes, having no usual type was negatively associated with intention-to-quit among the full sample and among those with a family income of ≤$50,000 (p<0.001). Relative to those who smoke <10 CPD, smoking 15+ CPD was negatively associated with intention-to-quit for the full sample and all income groups (p<0.001). Occasional smokers were consistently more likely to intend-to-quit compared to everyday smokers (p<0.001). Among the full sample and among those with a family income of >$50,000, users of new ST products were more likely to intend-to-quit (p<0.001). For all groups, dentist advice to quit was positively associated with intention-to-quit (p<0.001).

Factors associated with intention-to-quit conditional on any quit attempts

While the covariates relating to smoking within 30 minutes of waking were no longer significant, the findings relating to cigarette type, CPD, and smoking status were consistent with the unconditioned intention-to-quit models (Table 3-4). The ST indicator was also significant in all models. That said, based on the traditional 0.05 significance threshold, use of new ST products was indeed significant and positively associated with intention-to-quit for the full sample (p=0.042) and among those with a family income >$50,000 (p=0.037). While advice to quit by a dentist was positively associated with intention-to-quit for all groups in the unconditioned model, the result was only significant for the full sample (p<0.001) and among the ≤$50,000 income group (p<0.001) when considering intention-to-quit among smokers with at least one quit attempt in the last 12 months.

Discussion

The literature highlighted several gray areas relating to the relationship between ST use, especially newer ST products, and cessation across income groups. The existing research further emphasized the potential role of dental providers in mediating this relationship. The findings from this work indicated, despite the small participation rate, a nuanced relationship between emerging ST products and a cadre of cessation outcomes. While the results suggested no association between ST use and annual quit attempts, the results revealed a positive and significant association between ST use and intention-to-quit within the full sample and among the higher

Table 4: Multiple regression analyses exploring factors associated with intention-to-quit smoking ($\leq$ 6 months) conditional on any quit attempts among current smokers aged 18+ from the 2010/2011 Tobacco Use Supplement to the Current Population Survey.

	Full sample			Subsamples					
				Family income < $50,000			Family income> $50,000		
	(N=20909)			(N=14079)			(N=6830)		
	AOR(95% CI)		p-value	AOR(95% CI)		p-value	AOR(95% CI)		p-value
Gender									
Male	1.18	(1.04,1.33)	0.010*	1.11	(0.96,1.29)	0.153	1.38	(1.11,1.70)	0.004*
Female	REF								
Age									
18 to 34	REF								
35 to 49	1.20	(1.02,1.41)	0.024	1.31	(1.07,1.60)	0.011	0.94	(0.71,1.26)	0.693
50 to 64	1.32	(1.09,1.59)	0.004*	1.33	(1.06,1.66)	0.013	1.22	(0.88,1.69)	0.234
65+	0.98	(0.76,1.27)	0.890	1.07	(0.80,1.44)	0.637	0.73	(0.40,1.31)	0.287
Race/ethnicity									
Non-Hispanic White	REF								
Non-Hispanic Black	1.39	(1.11,1.75)	0.004	1.36	(1.06,1.73)	0.015	1.44	(0.88,2.33)	0.144
Hispanic	0.89	(0.71,1.12)	0.309	0.91	(0.70,1.19)	0.496	0.84	(0.54,1.31)	0.442
Non-Hispanic Asian	0.56	(0.36,0.86)	0.009	0.56	(0.31,1.03)	0.063	0.55	(0.30,1.00)	0.051
Non-Hispanic Other	1.15	(0.81,1.63)	0.444	1.11	(0.76,1.63)	0.597	1.18	(0.58,2.41)	0.651
Education									
<High school graduate	0.76	(0.62,0.94)	0.010	0.79	(0.59,1.07)	0.123	0.76	(0.54,1.05)	0.099
Some college	0.89	(0.72,1.11)	0.311	0.96	(0.71,1.32)	0.818	0.81	(0.59,1.12)	0.204
College graduate	REF								
Family income									
< $25,000	0.96	(0.82,1.13)	0.620						
$25,000-$49,999	1.06	(0.87,1.29)	0.556						
$50,000-$74,999	0.98	(0.78,1.25)	0.891						
$75,000+	REF								
Marital status									
Married	REF								
Widowed/divorced	0.90	(0.76,1.06)	0.207	0.91	(0.75,1.10)	0.310	0.92	(0.68,1.26)	0.614
Separated	0.88	(0.66,1.18)	0.386	0.91	(0.67,1.23)	0.528	0.68	(0.33,1.40)	0.288
Never married	0.97	(0.81,1.15)	0.715	1.00	(0.82,1.22)	0.984	0.86	(0.63,1.17)	0.328
Geographic region									
Northeast	REF								
Midwest	0.96	(0.78,1.17)	0.654	0.93	(0.73,1.18)	0.546	1.00	(0.72,1.39)	0.985
South	0.91	(0.75,1.11)	0.368	0.87	(0.70,1.09)	0.233	1.05	(0.76,1.45)	0.757
West	1.19	(0.97,1.47)	0.091	1.22	(0.94,1.59)	0.133	1.12	(0.79,1.60)	0.511
Typically smoke 30 minutes within walking									
Yes	0.94	(0.83,1.07)	0.353	0.96	(0.81,1.12)	0.574	0.89	(0.69,1.13)	0.324
No	REF								
No usual patter	1.13	(0.56,2.29)	0.736	0.84	(0.38,1.83)	0.652	6.25	(1.16,33.66)	0.033
Usual cigarette type									
Nonmenthol	REF								
Menthol	0.92	(0.79,1.06)	0.231	0.99	(0.82,1.19)	0.891	0.77	(0.61,0.97)	0.028

	Full sample			Subsamples					
				Family income < $50,000			Family income> $50,000		
	(N=20909)			(N=14079)			(N=6830)		
	AOR(95% CI)		p-value	AOR(95% CI)		p-value	AOR(95% CI)		p-value
No usual type	0.47	(0.31,0.70)	<0.001*	0.61	(0.38,0.98)	0.042	0.14	(0.06,0.34)	<0.001*
Cigarettes per day									
< 10	REF								
10-14	1.03	(0.83,1.28)	0.765	1.09	(0.84,1.40)	0.530	0.93	(0.66,1.31)	0.664
15+	0.68	(0.57,0.80)	<0.001*	0.68	(0.55,0.83)	<0.001*	0.68	(0.51,0.91)	0.009
Smoking status									
Everyday smoker	REF								
Occasional smoker	1.80	(1.52,2.13)	<0.001*	1.90	(1.54,2.34)	<0.001*	1.61	(1.20,2.17)	0.002*
Ever used a new smokeless tobacco product									
No	REF								
Yes	1.51	(1.01,2.25)	0.042	1.28	(0.78,2.09)	0.331	2.67	(1.06,6.72)	0.037
Visited a dentist and was advised to quit									
No	REF								
Yes	1.34	(1.15,1.57)	<0.001*	1.54	(1.24,1.90)	<0.001*	1.08	(0.82,1.43)	0.584
Constant	2.26	(1.62,3.16)	0.000	1.98	(1.32,2.99)	0.001	2.89	(1.78,4.67)	0.000

All analyses accounted for survey design of the data by incorporate replicate weights with Fay's balanced repeated replication. *Indicates that AOR is significance ($\leq$) at Bonferroni-adjusted threshold: 0.0100 (=0.01/1) for covariates with one comparison group (gender, smoking status, use of new ST product, advise to quit by dentist), 0.0050 (=0.01/2) for covariates with 2 comparison groups (educational attainment, smoke 30 minutes within waking, cigarette type, CPD), 0.0033 (0.01/3) for covariates with three comparison groups (age, income, marital status, geographic region), and 0.0025 (=0.01/4) for covariates with four comparison groups (race/ethnicity).

income (>$50,000) group; nevertheless, this association disappeared once the sample was limited to those with a previous quit attempt in the last 12 months, suggesting that the link between ST use and cessation among those who want to quit may be tenuous. That said, although the results in the conditioned analyses for the lower income group were far from significant by any measure, the results relating the full sample (p=0.042) and the higher income group (p=0.037) were significant under conventional criteria (p<0.05). Taken together, the findings provided some evidence of an association between use of emerging ST products among dual users and intention-to-quit smoking, particularly among higher income groups.

These findings resonate with existing work. While some researchers have found no evidence associating dual cigarette use with decreased quit attempts [30], others have found that dual users were more likely to have tried to quit cigarettes during the past year [31]. Relative to smokers who do not use ST products, previous studies found that that dual users are more likely to endorse cessation-behaviors [32], which resonates with the findings of the current study that revealed that ST users were more likely to intend to quit. Nevertheless, these studies did not explore the unique impact of these associations across income groups; this study begins to unravel the association of use of newly emerging ST products with quit attempts and intention-to-quit.

The results further emphasized the role of dental providers in mediating this relationship. While research suggests that only 24% of dental patients who are tobacco users report receiving at least one form of assistance beyond advice to quit [18], the findings from the current work revealed the positive association of dental advice to quit

with all outcomes explored. These results parallel existing work that underlines that even brief counseling during a dental visit may be helpful in reducing tobacco consumption [33]. A dearth of studies explore the impact of dental advice across income groups. Although research indicates the advice to quit appears to be a function of patient sociodemographic characteristics [20], the findings from the current study highlighted the protective effect of cessation advice in a dental setting regardless of income level.

This study has several limitations worth mentioning. First, the data are cross-sectional, limiting the ability to draw causal inference. Second, the prevalence of use of new ST products was quite low. That said, despite the low prevalence rates, significant associations were found in the regression analyses, even when using the highly stringent Bonferroni adjusted significance level with a nominal p-value of 0.01. Third, while use of such a stringent significance threshold reduces the probability of Type I Error, the Bonferroni-adjustment enhances the probability of Type II Error, especially with strong nominal p-values [34-35]. Finally, although this study points to a positive association between intention-to-quit and use of newly emerging ST products, particularly among higher income smokers (>$50,000), the analyses did not explore the prevalence of successful cessation. Work by Messer and colleagues suggested that, relative to individuals who only smoke cigarettes, dual users (cigarettes plus ST product) were faster to relapse [31]. While they were more likely to quitting smoking compared to non-dual users, the authors found no evidence that dual users were more likely to report 30-day abstinence. On the other hand, additional research suggests that while products like snus might be negatively associated with quit attempts, these

products might adversely impact abstinence [36]. More research is needed understand how income and healthcare/dental provider advice mediate this relationship.

Historically, relative to physicians, dentists have been less comfortable tackling smoking cessation [37]. Perhaps a reflection of this fact, Healthy People 2020 has the stated goal of increasing tobacco screening in the dental setting, aiming for a 10% increase in the number of dentists asking patients about their tobacco use (52.9% to 58.2%) [38]. Moreover, across the board, cigarette-only and dual users appear to be using evidence based treatment at suboptimal levels [30].

Dentists are well-placed to engage in behavioral and educational interventions. As Kalkhoran found that, relative to smokers who do not use ST products, dual users were more likely to endorse cessation behaviors [32]. The authors emphasized that this provides an opening for clinicians to promote effective cessation interventions. Taking this a step further, the results from the current work highlight a nuanced relationship between ST use with quit attempts and intention-to-quit across income groups. The findings indicate that one-size-fits-all cessation strategies will not work. Cessation strategies reflecting one's risk factors and sociodemographic characteristics may be more effective than a more homogenous approach. Among both clinicians and patients, the relative safety of newly emerging ST products, such as electronic cigarettes, on remains ambiguous [39]; dentists can use this opportunity to educate on and discuss the relative risk of ST products with their patients. Such an educational intervention is of elevated importance among youth as positive attitudes and beliefs about both smoking and ST use during adolescence are positively associated with regular cigarette and ST use in adulthood [40].

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