Nicotine & Tobacco Research, 2015, 245–255
doi:10.1093/ntr/ntu103
Advance Access publication June 20, 2014
Original investigation

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Cigarette Users' Interest in Using or Switching to Electronic Nicotine Delivery Systems for Smokeless Tobacco for Harm Reduction, Cessation, or Novelty: A Cross-Sectional Survey of US Adults

Carla J. Berg PhD[1], Regine Haardoerfer PhD[1], Cam Escoffery DrPH[1], Pinpin Zheng PhD[2], Michelle Kegler DrPH[1]

[1]Department of Behavioral Sciences and Health Education, Emory University Rollins School of Public Health, Atlanta, GA; [2]Department of Preventive Medicine, School of Public Health, Fudan University, Shanghai, People's Republic of China

Corresponding Author: Carla J. Berg, PhD, Department of Behavioral Sciences and Health Education, Emory University School of Public Health, 1518 Clifton Rd, NE, Rm 524, Atlanta, GA 30322, USA. Telephone: 404-727-7589; Fax: 404-727-1369; E-mail: cjberg@emory.edu

Abstract

Introduction: We examined: (a) current (past 30-day) smokers' interest in using or switching to electronic nicotine delivery systems (ENDS) or smokeless tobacco for various reasons; (b) correlates of interest in these products; and (c) subgroups of current smokers in relation to interest in these products.
Methods: We conducted a cross-sectional survey assessing sociodemographics, tobacco use, interest in ENDS and smokeless tobacco among smokers, and knowledge about ENDS among 2,501 US adults recruited through an online consumer panel. We oversampled tobacco users (36.7% current cigarette smokers), ethnic minorities, and southeastern US state residents.
Results: On average, participants were more interested in ENDS than smokeless tobacco across all reasons provided. Additionally, they were less interested in either product because of their potential use in places prohibiting smoking or due to curiosity and more interested in reducing health risk or cigarette consumption or to aid in cessation. We documented high rates (27.9%) of misbeliefs about Food and Drug Administration approval of ENDS for cessation, particularly among current smokers (38.5%). Also, 27.2% of current smokers had talked with a health care provider about ENDS, with 18.0% reporting that their provider endorsed ENDS use for cessation. Furthermore, cluster analyses revealed 3 groups distinct in their interest in the products, sociodemographics, and smoking-related characteristics.
Conclusions: This study highlights higher interest in ENDS versus smokeless tobacco and greater interest in both for harm reduction and cessation than due to novelty or smoking restrictions. Developing educational campaigns and informing practitioners about caveats around ENDS as cessation or harm reduction aids are critical.

Introduction

The current study focuses on interest in using or switching to electronic cigarettes (or electronic nicotine delivery systems [ENDS]) or smokeless tobacco for various reasons and the distinct characteristics of those interested in ENDS or smokeless tobacco products. Tobacco harm reduction strategies, such as switching to other, lower risk tobacco products, are controversial (Gray & Henningfield,

2006). Those in opposition argue that promotion of these products might have a negative population health impact if nonsmokers use these products due to perceptions of relative safety or if they undermine existing smoke-free policies and ongoing efforts to denormalize smoking (Stratton, Shetty, Wallace, & Bondurant, 2001). Proponents maintain harm reduction strategies as a complementary practice to reduce tobacco-related harm (Stratton et al., 2001) and argue that the health burden of tobacco could be reduced if cigarette smokers switched to less harmful products (Rodu, 1994).

For current smokers, two alternative tobacco products that might reduce harm and aid in cessation include ENDS and smokeless tobacco products (Popova & Ling, 2013; Ramström & Foulds, 2006). ENDS are battery-powered devices in that vary in size and shape (i.e., some are roughly the shape and size of a cigarette and some are larger). They contain liquids in various flavors with varying levels of nicotine that are vaporized with inhalation on the ENDS without any combustion or smoke (Stead et al., 2012; US Food and Drug Administration, 2010). Smokeless tobacco products in the US market are chew, snus, and dissolvables. The latter two have been introduced into the US market in recent years and are spitless, smokeless tobacco products available in various flavors. A 2010 national survey of US adults found that 2% had tried ENDS, 5.1% snus, and 0.6% dissolvables (McMillen, Maduka, & Winickoff, 2012). In general, there have been dramatic increases in the use of ENDS (from 3.3% ever using them in 2010 (McMillen et al., 2012) to 8.1% in 2012 (Zhu et al., 2013)) with little increase in smokeless tobacco products (McMillen et al., 2012).

There have been several marketing strategies to promote these products. First, they have been marketed as novel new products with attractive packaging, flavoring (McMillen et al., 2012), and social appeal (Klein, 2008; Martinasek, McDermott, & Martini, 2011; Smith et al., 2011). They have also been marketed as an alternative to cessation or for use where smoking is not allowed (Etter, 2010; Gartner, Hall, Chapman, & Freeman, 2007). Moreover, these alternative tobacco products are marketed as safer alternatives to traditional cigarettes (Gray et al., 2005; Stepanov, Jensen, Hatsukami, & Hecht, 2008), and users of ENDS (Pearson, Richardson, Niaura, Vallone, & Abrams, 2012) and smokeless tobacco (Tomar, 2007; Tomar & Hatsukami, 2007) believe the products they consume are less harmful than cigarettes.

Finally, these products have been promoted to assist in cessation (Etter, 2010; Gartner, Hall, Chapman, et al., 2007). Some research has supported these assertions. ENDS have been found to alleviate cravings for cigarettes (Bullen et al., 2010; Cahn & Siegel, 2011; Caponnetto et al., 2013; Etter, Bullen, Flouris, Laugesen, & Eissenberg, 2011; Polosa et al., 2013; Vansickel & Eissenberg, 2013). In addition, ENDS may assist smokers (even those unmotivated for cessation) to quit or reduce cigarette consumption and may prevent relapse (Etter & Bullen, 2014; Polosa et al., 2011; Siegel, Tanwar, & Wood, 2011). Two randomized controlled trials (RCTs) to date have examined the effects of e-cigarette use on smoking cessation. One study of 657 people in Australia randomized to nicotine e-cigarettes, patches, and placebo e-cigarettes found that, at 6 months, verified abstinence was significantly higher (7.3%) among those using nicotine e-cigarettes versus those using patches (5.8%) and those using placebo e-cigarettes (4.1%) (Bullen et al., 2013). Another RCT found that smokers substantially reduced cigarettes per day (CPD) use from baseline by more than 50% in both participants provided nicotine-containing e-cigarettes and those not containing nicotine, and reductions in CPD were unrelated to the nicotine content in the cartridges (Caponnetto et al., 2013). These findings suggest the promise of e-cigarettes in potentially assisting in achieving cessation. The results of Vickerman, Carpenter, Altman, Nash, and Zbikowski (2013) are less optimistic; they found that nearly a third of 2,758 callers to six state tobacco quit lines had ever used e-cigarettes, with 61.7% of them using ENDS for less than 1 month. In addition, Hua, Alfi, and Talbot (2013) found a total of 405 different health-related effects (78 positive, 326 negative, 1 neutral) reported by ENDS users in three different online forums, with negative health-related effects occurring most frequently in the respiratory, neurological, sensory, and digestive systems while the positive health-related effects occurred solely in the respiratory system. Thus, the findings are mixed regarding whether ENDS are beneficial and their impact on smokers and ENDS users.

Of the range of smokeless tobacco products, snus has been most widely examined in relation to the potential for harm reduction. Snus may have reduced health risks compared to cigarettes (Rodu & Godshall, 2006). Moreover, one study of population health effects of snus in Sweden (Gartner, Hall, Vos, et al., 2007) documented that there was little difference in health-adjusted life expectancy between smokers who quit all tobacco and smokers who switched to snus. They estimated that, for net harm to occur, 14–25 ex-smokers and 14–25 people who have never smoked would need to start using snus to offset the health gain from every smoker who switched to snus. However, studies on effectiveness of ENDS and smokeless tobacco products in relation to cessation and harm reduction are in their infancy, they are not recognized by clinical practice guidelines, and greater evidence is needed prior to ENDS being promoted in this capacity (Cobb, Byron, Abrams, & Shields, 2010).

Research has retrospectively assessed reasons for using ENDS or snus (Zhu et al., 2013) among those who used either product. However, little published research has examined the characteristics of current smokers who might be interested in using an alternative tobacco product for harm reduction or cessation. Moreover, other reasons that smokers might be interested in using these products, such as to circumvent smoke-free policies or because of curiosity/intrigue, have received limited attention. Thus, we examined: (a) the extent to which current smokers report interest in using or switching to ENDS or smokeless tobacco for various reasons; (b) correlates of interest in using or switching to ENDS or smokeless tobacco; and (c) subgroups of current smokers in relation to their interest in these two products.

Methods

Participants

The current study is an analysis of a cross-sectional survey conducted by online panel survey company, Global Market Insite, Inc. (GMI), during a 3-week period (June 20, 2013 to July 9, 2013). GMI was founded in 1999 and has panels spanning millions of panelists in more than 200 countries and territories. GMI's average panel membership duration is approximately 9 months to a year, with participants completing 1.7 surveys per month on average. GMI's surveys are conducted via E-mail and online, and participation rates are on average 32%, with a 2% incomplete rate.

Procedures

All procedures were approved by Emory University's Institutional Review Board. Eligible participants were individuals living in the United States, English speaking, and 18–65 years old. We attempted to oversample individuals who used a tobacco product in the past year, ethnic minorities, and those from the southeastern US states. Participants were recruited for the study using two methods, daily

E-mail invitations sent to GMI panelists directing them to the study and targeted E-mail invitations to panelists known to meet some of the study criteria. Once panelists entered the study survey, they were presented with the informed consent page, indicating that participation was strictly voluntary and that they were able to withdraw from the research at any time. Those that consented were directed to screening questions to assess eligibility. If the quota for a particular subgroup was filled, panelists with those characteristics were no longer recruited. Participants were compensated with points that could be exchanged for items or gift cards within GMI's system.

Overall, 5,429 participants began the eligibility screening portion of the survey for this study, 1,248 did not meet the study criteria (i.e., were ineligible), 1,182 were ineligible because of full quotas, 252 discontinued at some point before completing the eligibility screening portion of the survey, 243 were eligible but discontinued the survey, and 3 participants' responses were removed from the data by the survey company during their quality check process ensuring that no participant completes the survey more than once. This resulted in a final study sample size of 2,501. This final sample size had complete data given the nature of the online survey infrastructure requiring answers to each question before moving on to the next. Of the 2,501, 36.7% (n = 918) were current (past 30-day) smokers.

Measures

Demographic Variables

We assessed age, gender, race/ethnicity, education level, household income, employment status, marital status, and whether children were in the home.

Tobacco Use Variables

We assessed ever use and past 30-day use of cigarettes, ENDS, chew, snus, and dissolvables. Chew, snus, and dissolvables were also aggregated into variables indicating ever use and past 30-day use of any smokeless tobacco product.

Smoking-Related Characteristics

Among past 30-day cigarette smokers, we assessed age of first whole cigarette, age began regularly smoking, number of days of smoking in the past 30 days, average CPD on smoking days, use of menthol cigarettes, readiness to quit in the next 30 days, and any quit attempts in the past 12 months.

Knowledge About ENDS

To assess participant knowledge about ENDS, we developed two new items. All participants were also asked to indicate whether the following statement was true, false, or they did not know: "Electronic cigarettes are approved by the Food and Drug Administration (FDA) as a smoking cessation product." We also asked participants who reported smoking in the past 30 days, "Have you ever talked to your doctor or nurse about using electronic cigarettes to quit smoking?" with response options of "No; Yes, and they recommended that I try it; Yes, and they did not recommend that I try it; or Yes, but they didn't know about them or didn't make any recommendations."

Using or Switching to ENDS or Smokeless Tobacco

Participants who reported smoking in the past 30 days were also asked, "Would you ever USE or SWITCH to an electronic cigarette for any of these reasons?" with items listed in Table 1. Responses were recorded on a scale of 1 (*definitely would not*) to 9 (*definitely would*). The same set of questions was used in reference to using or switching to smokeless tobacco products. These were newly developed items designed for this study given the relatively new nature of this topic. Cronbach's alpha for the items pertaining to ENDS was .93; Cronbach's alpha for the items pertaining to smokeless tobacco products was .98. Using exploratory factor analyses, we found one factor for the ENDS items and smokeless tobacco items, respectively. Thus, we created an overall interest score for each of the tobacco products by adding the scores for each of the items.

Data Analyses

Participant characteristics were summarized using descriptive statistics, and bivariate analyses were conducted to examine differences between current smokers and nonsmokers using t test, analyses of variance (ANOVAs), and chi-square tests as appropriate. We then examined interest in ENDS versus smokeless tobacco products among current smokers. We examined smoker characteristics in relation to interest in ENDS and smokeless tobacco products, respectively, using bivariate statistics (i.e., t tests, ANOVAs, and point biserial correlations for categorical variables and Pearson correlations for continuous variables). We then conducted multivariate logistic regression using backward stepwise entry to identify predictors of interest in using or switching to ENDS and smokeless tobacco products. Finally, we conducted cluster analyses to characterize potential subgroups of smokers distinct in their level of interest in ENDS or smokeless tobacco products using K means cluster analysis, using the pseudo F statistic to indicate the number of clusters (Kanungo, Mount, Netanyahu, & Piatko, 2002). Specifically, we entered the variables listed in Table 2 in the cluster analyses. Because the survey was strategically designed to oversample smokers and other high-risk subgroups and because the study aimed to demonstrate relationships among participant characteristics rather than attempt to estimate any national prevalence statistics, no effort at weighting the sample was made. All statistics were conducted using SPSS 21.0 (IBM), and alpha was set at .05.

Results

Table 1 presents participant sociodemographics, smoking-related characteristics, and data related to interest in ENDS and smokeless tobacco products. Regarding lifetime use, 64.3% had used cigarettes, 13.4% had used ENDS, and 10.8% had used smokeless tobacco products. Of the 336 participants who ever tried an ENDS, 83.6% (n = 281) had tried cigarettes in their lifetime. Of the 271 participants who had ever tried smokeless tobacco, 67.5% (n = 183) had tried cigarettes as well. Regarding current use, 36.7% smoked cigarettes, 7.6% had used ENDS, and 5.6% had used smokeless tobacco. Of the 191 current ENDS users, 88.0% (n = 168) were current cigarette smokers. Of the 139 current smokeless tobacco users, 80.6% (n = 112) were current cigarette smokers.

Current smokers smoked an average of 22.50 (10.92) days of the past 30 and an average of 11.24 (SD = 9.16) CPD on smoking days, with 15.7% using menthol cigarettes. Regarding quitting intentions and behaviors, 14.1% of current smokers were ready to quit in the next 30 days, and 47.8% had made a quit attempt in the past year. Correlates of being a current cigarette smoker included younger age (p < .001), being male (p < .05), not being White (p < .001), having a high school or some college education versus a bachelor's degree (p < .001), being of lower income (p < .05), and having children in the home (p < .001). Current cigarette smokers were more likely to have

Table 1. Participant Characteristics, Tobacco-Related Behaviors, and Interest in ENDS and Smokeless Tobacco Products

				Among current smokers	
	All participants (N = 2,501)	Nonsmokers (n = 1,583)	Current smokers (n = 918)	Interest in ENDS	Interest in smokeless tobacco
Variable	N (%) or M (SD)	N (%) or M (SD)	N (%) or M (SD)	M (SD) or r	M (SD) or r
Sociodemographics					
Age (SD)	43.03 (14.38)	44.00 (14.79)	41.35 (13.50)***	−.15***	−.27***
Gender (%)			*	ns	***
Male	1,221 (48.8)	753 (47.6)	468 (51.0)	29.56 (11.76)	17.24 (14.25)
Female	1,280 (51.2)	830 (52.4)	450 (49.0)	30.11 (12.28)	13.10 (13.38)
Race/ethnicity (%)			***	**	***
White	1,710 (68.4)	1,117 (70.6)	593 (64.6)	29.02 (12.41)	13.24 (13.27)
Black	436 (17.4)	282 (17.8)	154 (16.8)	32.79 (11.17)	18.58 (15.29)
Other	355 (14.2)	184 (11.6)	171 (18.6)	29.96 (10.93)	19.00 (13.86)
Education (%)			***	ns	***
≤High school	561 (22.4)	321 (20.3)	240 (26.1)	30.75 (11.78)	13.37 (13.10)
Some college	1,025 (41.0)	612 (38.7)	413 (45.0)	29.07 (12.40)	13.19 (13.07)
≥Bachelor's degree	915 (36.6)	650 (41.1)	265 (28.9)	30.18 (11.58)	20.03 (14.96)
Household income (%)			*	ns	***
<$25,000	605 (24.2)	359 (22.7)	246 (26.8)	28.42 (12.56)	12.19 (12.52)
$25,000 to <$50,000	733 (29.3)	459 (29.0)	274 (29.8)	30.03 (11.90)	14.73 (14.02)
$50,000 to <$75,000	812 (32.5)	528 (33.4)	284 (30.9)	30.88 (11.66)	16.40 (14.15)
$75,000 or more	351 (14.0)	237 (15.0)	114 (12.4)	29.76 (11.82)	19.95 (14.92)
Employment status (%)			ns	ns	***
Employed full time	978 (39.1)	608 (38.4)	370 (40.3)	30.16 (11.56)	17.58 (14.46)
Employed part time	415 (16.6)	252 (15.9)	163 (17.8)	30.57 (12.37)	17.96 (15.31)
Other	1,108 (44.3)	723 (45.7)	385 (41.9)	29.19 (12.29)	11.77 (12.10)
Relationship status (%)			ns	*	ns
Married or living with a partner	1,059 (42.3)	901 (56.9)	541 (58.9)	30.46 (11.77)	15.76 (14.41)
Other	1,442 (57.7)	602 (43.1)	377 (41.1)	28.92 (12.32)	14.42 (13.32)
Children in the home (%)			***	***	***
No	1,650 (66.0)	1,111 (70.2)	539 (58.7)	28.39 (12.23)	12.70 (12.33)
Yes	851 (34.0)	472 (29.8)	379 (41.3)	31.88 (11.41)	18.78 (15.35)
Lifetime tobacco use			***[b]	[c]	[c]
Cigarettes (%)	1,608 (64.3)	709 (44.8)	918 (100.0)	–	–
ENDS (%)	336 (13.4)	55 (3.5)	281 (30.6)	.22***	.02[ns]
Chew (%)	215 (8.6)	84 (5.3)	131 (14.3)	.08*	.19***
Snus (%)	120 (4.8)	21 (1.3)	99 (10.8)	.10**	.23***
Dissolvables (%)	55 (2.2)	8 (0.5)	47 (5.1)	.14***	.28***
Any smokeless tobacco (%)	271 (10.8)	88 (5.6)	183 (19.9)	.11***	.29***
Past 30-day use			***[b]	[c]	[c]
Cigarettes (%)	918 (36.7)	0 (0.0)	918 (100.0)	–	–
ENDS (%)	191 (7.6)	23 (1.5)	168 (18.3)	.27***	.07*
Chew (%)	92 (3.7)	26 (1.6)	66 (7.2)	.12***	.31***
Snus (%)	68 (2.7)	4 (0.3)	64 (7.0)	.10**	.28***

Table 1. *Continued*

Variable	All participants (N = 2,501)	Nonsmokers (n = 1,583)	Current smokers (n = 918)	Among current smokers	
				Interest in ENDS	Interest in smokeless tobacco
	N (%) or M (SD)	N (%) or M (SD)	N (%) or M (SD)	M (SD) or r	M (SD) or r
Dissolvables (%)	40 (1.6)	3 (0.2)	37 (4.0)	.12***	.29***
Any smokeless tobacco (%)	139 (5.6)	27 (1.7)	112 (12.2)	.15***	.40***
Smoking-related characteristics					
Age of first cigarette (SD)[a]	–	–	16.66 (5.32)	.03[ns]	.09**
Age began regularly smoking (SD)[a]	–	–	18.90 (5.42)	.07[ns]	.12**
Days of cigarette use, past 30 days (SD)[a]	–	–	22.50 (10.92)	–.06[ns]	–.26***
Cigarettes per day (SD)[a]	–	–	11.24 (9.16)	–.01[ns]	–.17**
Menthol cigarette use (%)[a]	–	–		***	**
No			526 (57.3)	28.10 (12.48)	13.91 (13.11)
Yes			392 (42.7)	32.16 (10.95)	16.95 (14.90)
Ready to quit in next 30 days (%)[a]	–	–		ns	ns
No			789 (85.9)	29.55 (11.77)	15.26 (13.85)
Yes			129 (14.1)	31.51 (13.36)	14.93 (14.80)
Past year quit attempt (%)[a]	–	–		***	***
No			479 (52.2)	27.03 (12.53)	12.99 (12.52)
Yes			439 (47.8)	32.88 (10.62)	17.64 (15.06)
Knowledge about ENDS					
Believe ENDS FDA approved for cessation (%)			***	***	–
No	488 (19.5)	303 (19.1)	185 (20.2)	29.65 (11.82)	
Yes	699 (27.9)	346 (21.9)	353 (38.5)	32.31 (11.67)	
Don't know	1,314 (52.5)	934 (59.0)	380 (41.4)	27.61 (12.01)	
Talked to provider about ENDS (%)[a]	–	–		***	–
No			688 (72.8)	28.22 (12.47)	
Yes; recommended it			165 (18.0)	34.90 (8.45)	
Yes; did not recommend it			48 (5.2)	31.65 (11.42)	
Yes; made no recommendation			37 (4.0)	34.60 (10.51)	

ENDS = electronic nicotine delivery systems; FDA = US Food and Drug Administration; ns = not significant.

[a]Among current (past 30-day) smokers.

[b]Significant for all tobacco products.

[c]Point biserial correlations.

*p < .05; **p < .01; ***p < .001.

used ENDS and each of the smokeless tobacco products both in their lifetime and in the past 30 days ($p < .001$, respectively).

Knowledge About ENDS

In our sample, 27.9% of all participants believed that ENDS are approved by the FDA for smoking cessation, while a greater proportion of current smokers (38.5%) versus nonsmokers (21.9%) believed this misconception ($p < .001$). Among current smokers, although 72.8% had never talked to their doctor about ENDS, 18.0% of smokers reported that they had and that the doctor recommended it in comparison to the 9.2% that reported that they talked to their health care provider about ENDS and they did not recommend it (5.2%) or made no recommendation (4.0%). Among current smokers, those who used ENDS in the past 30 days (18.3%) were more likely to have talked to their doctor about ENDS, with higher proportions of current ENDS users reporting that their doctor did not recommend it (31.3%) or made no recommendation (32.4%) rather than recommend it (24.2%); 15.1% of ENDS users had not asked their doctors ($p < .001$). In addition, among current smokers, current ENDS users were more likely to believe that ENDS were approved by the FDA as a smoking cessation product (12.2% vs. 10.2% reporting that this was *false* or 4.3% saying *I don't know*; $p < .001$). Similar trends were found among lifetime ENDS users.

Interest in ENDS and Smokeless Tobacco

Table 2 shows data regarding average reported interest in using ENDS or smokeless tobacco among smokers for various reasons. There was greater interest in ENDS than smokeless tobacco for each of the reasons included ($p < .001$, respectively). The greatest interest for using them was to reduce health risk ($M = 6.23$ vs. 3.10 for ENDS and smokeless tobacco, respectively), to reduce cigarettes consumed ($M = 6.18$ vs. 3.09, respectively), and to quit smoking ($M = 6.17$ vs. 3.10, respectively). In contrast, there was lower average interest in using ENDS and smokeless tobacco because of being in a place they could not smoke ($M = 5.57$ vs. 3.02, respectively) or because they were curious or intrigued by the product ($M = 5.68$ vs. 2.91, respectively). In general, 20.9% ($n = 192$) were equally interested in both smokeless tobacco and ENDS, 68.0% ($n = 624$) were more interested in ENDS, and 11.1% ($n = 102$) were more interested in smokeless tobacco.

Correlates of Interest in ENDS

Table 2 indicates factors associated with interest in ENDS in the bivariate analyses. Of note, interest in ENDS was associated with believing that the FDA approved ENDS for cessation purposes ($p < .001$). Interest in ENDS was associated with having a conversation about ENDS with their provider (regardless of their recommendation), with having a doctor recommend the product or not making any recommendation be associated with higher interest in the product ($p < .001$). In the multivariate linear regression *not including factors related to knowledge about ENDS*, correlates of interest in ENDS included younger age ($\beta = -0.08$, $p = .005$), having children in the home ($\beta = 2.02$, $p = .01$), typically using menthol cigarettes ($\beta = 3.48$, $p < .001$), and having made a quit attempt in the past year ($\beta = 5.16$, $p < .001$; R-squared = .102). In the regression *including factors associated with knowledge regarding ENDS*, correlates of interest in ENDS included younger age ($\beta = -0.06$, $p = .04$), having children in the home ($\beta = 1.48$, $p = .05$), typically using menthol cigarettes ($\beta = 3.27$, $p < .001$), having made a quit attempt in the past year ($\beta = 3.27$, $p < .001$), talking to a health care provider about ENDS (regardless of the outcome; $\beta = 1.82$, $p < .001$), and believing that ENDS are approved by the FDA for cessation assistance ($\beta = -1.45$, $p = .001$; R-squared = .126).

Correlates of Interest in Smokeless Tobacco

Table 2 indicates factors associated with interest in smokeless tobacco products in the bivariate analyses. In the regression, correlates of interest in smokeless tobacco included younger age ($\beta = -0.17$, $p < .001$), being male ($\beta = -3.03$, $p = .001$), higher education ($\beta = 2.11$, $p = .001$), being employed ($\beta = -1.32$, $p = .009$), having children in the home ($\beta = 3.13$, $p = .001$), older age of beginning to smoke regularly ($\beta = 0.25$, $p = .003$), fewer smoking days in the past 30 days ($\beta = -0.29$, $p < .001$), typically using menthol cigarettes ($\beta = 1.77$, $p = .04$), and having made a quit attempt in the past year ($\beta = 3.08$, $p = .001$; R-squared = .228).

Characterizing Smokers in Relation to Interest in ENDS Versus Smokeless Tobacco

Table 3 shows the results of the cluster analysis. Cluster 1, or the "Moderates," represented 15.7% of current smokers and was characterized by being moderately interested in using or switching to ENDS or smokeless tobacco across all reasons (average range of 4–6 on a 9-point scale). Cluster 2, or the "Disinterested in Smokeless," represented 63.7% of current smokers and was characterized by moderate interest in ENDS (range of 5–6) but very low interest in smokeless tobacco products. Cluster 3, or the "Enthusiasts," represented 20.6% of current smokers and was characterized by high interest in both ENDS and smokeless tobacco products across all reasons (range of 7–8). Interestingly, the lowest average interest scores were in relation to using the alternative products in places where they could not smoke or due to curiosity about the product in all three clusters.

Table 2. Potential Reasons for Current Cigarette Smokers to Switch to ENDS or Smokeless Tobacco Products, $n = 918$

Reason	ENDS	Smokeless tobacco	r[a]
Because you were in a place that didn't allow smoking[b]	5.57 (2.82)	3.02 (2.86)	.31
To reduce your health risk	6.23 (2.64)	3.10 (2.94)	.26
To cut down on number of cigarettes you smoke	6.18 (2.70)	3.09 (2.90)	.26
To quit smoking	6.17 (2.72)	3.10 (2.94)	.26
Because you are curious or intrigued by the product[b]	5.68 (2.73)	2.91 (2.79)	.32
Overall interest	29.83 (12.01)	15.21 (13.98)	.30

ENDS = electronic nicotine delivery systems. On a scale of 1 (*definitely would not*) to 9 (*definitely would*). Cronbach's alpha for interest scales were 0.93 for ENDS and 0.98 for smokeless tobacco products. Interest in ENDS was higher than for smokeless tobacco products ($p < .001$).

[a]Correlations for all items referencing ENDS and smokeless tobacco, respectively, were significantly correlated ($p < .001$).

[b]Average interest scores for these two reasons were significantly lower than for the other three reasons for each product, respectively.

Table 3. Cluster Sociodemographics, Smoking-Related Characteristics, and Interest in ENDS and Smokeless Tobacco Products Among Current Smokers ($n = 918$)

Variable	Moderates ($n = 144$)	Disinterested in smokeless ($n = 585$)	Enthusiasts ($n = 189$)	
	N (%) or *M* (*SD*)	*N* (%) or *M* (*SD*)	*N* (%) or *M* (*SD*)	*p*
Sociodemographics				
Age (*SD*)	38.80 (13.07)	43.87 (13.49)	35.49 (11.60)	<.001
Gender (%)				<.001
Male	93 (64.6)	263 (45.0)	112 (59.3)	
Female	51 (35.4)	322 (55.0)	77 (17.1)	
Race (%)				<.001
White	76 (52.8)	421 (72.0)	96 (50.8)	
Black	26 (18.1)	84 (14.4)	96 (28.6)	
Other	42 (29.2)	80 (13.7)	49 (25.9)	
Education (%)				<.001
≤High school	35 (24.3)	169 (28.9)	36 (19.0)	
Some college	60 (41.7)	289 (49.4)	64 (33.9)	
≥Bachelor's degree	49 (34.0)	127 (21.7)	89 (47.1)	
Household income (%)				<.001
<$25,000	36 (25.0)	181 (30.9)	29 (15.3)	
$25,000 to <$50,000	45 (31.3)	177 (30.3)	52 (27.5)	
$50,000 to <$75,000	42 (29.2)	173 (29.6)	69 (36.5)	
$75,000 or more	21 (14.6)	54 (9.2)	39 (20.6)	
Employment status (%)				<.001
Employed full time	63 (43.8)	209 (35.7)	98 (51.9)	
Employed part time	28 (19.4)	88 (15.0)	47 (24.9)	
Other	53 (36.8)	288 (49.2)	44 (23.3)	
Relationship status (%)				.07
Married or living with a partner	77 (53.5)	340 (58.1)	124 (65.5)	
Other	67 (46.5)	245 (41.9)	65 (34.4)	
Children in the home (%)				<.001
No	81 (56.3)	385 (65.8)	73 (38.6)	
Yes	63 (43.8)	200 (34.2)	116 (61.4)	
Smoking-related characteristics				
Number of days of cigarette use, past 30 days (*SD*)	20.08 (11.52)	24.64 (9.93)	17.71 (11.51)	<.001
Cigarettes per day on smoking days (*SD*)	10.59 (9.57)	12.37 (9.27)	8.25 (7.70)	<.001
Menthol cigarette use (%)				.02
No	83 (57.6)	351 (60.0)	92 (48.7)	
Yes	61 (42.4)	234 (40.0)	97 (51.3)	
Ready to quit in next 30 days (%)				.09
No	132 (91.7)	498 (85.1)	159 (84.1)	
Yes	12 (8.3)	87 (14.9)	30 (15.9)	
Past year quit attempt (%)				<.001
No	77 (53.5)	336 (57.4)	66 (34.9)	
Yes	67 (46.5)	249 (42.6)	123 (65.1)	

Table 3. *Continued*

Variable	Moderates (n = 144) N (%) or M (SD)	Disinterested in smokeless (n = 585) N (%) or M (SD)	Enthusiasts (n = 189) N (%) or M (SD)	p
Knowledge About ENDS				
Believe ENDS FDA approved for cessation (%)				<.001
No	25 (17.4)	131 (22.4)	29 (15.3)	
Yes	52 (36.1)	180 (30.8)	121 (64.0)	
Don't know	67 (46.5)	274 (46.8)	39 (20.6)	
Talked to provider about ENDS (%)				<.001
No	97 (67.4)	482 (82.4)	89 (47.1)	
Yes; recommended it	37 (25.7)	56 (9.6)	72 (38.1)	
Yes; did not recommend it	7 (4.9)	17 (2.9)	24 (12.7)	
Yes; made no recommendation	3 (2.1)	30 (5.1)	4 (2.1)	
Interest in ENDS (SD)				
Because you were in a place that didn't allow smoking	4.69 (1.95)	5.14 (3.02)	7.56 (1.60)	<.001
To reduce your health risk	5.22 (1.90)	5.91 (2.87)	8.00 (1.16)	<.001
To cut down on number of cigarettes you smoke	5.26 (1.90)	5.83 (2.97)	7.95 (1.12)	<.001
To quit smoking	5.30 (1.91)	5.84 (2.99)	7.83 (1.35)	<.001
Because you are curious or intrigued by the product	4.88 (1.83)	5.25 (2.94)	7.63 (1.50)	<.001
Interest in smokeless tobacco (SD)				
Because you were in a place that didn't allow smoking	4.87 (1.84)	1.10 (0.47)	7.52 (1.44)	<.001
To reduce your health risk	5.19 (1.60)	1.08 (0.41)	7.78 (1.27)	<.001
To cut down on number of cigarettes you smoke	5.18 (1.48)	1.08 (0.39)	7.70 (1.29)	<.001
To quit smoking	5.18 (1.65)	1.09 (0.49)	7.72 (1.34)	<.001
Because you are curious or intrigued by the product	4.68 (1.73)	1.08 (0.42)	7.22 (1.89)	<.001

ENDS = electronic nicotine delivery systems; FDA = US Food and Drug Administration. Post-hoc tests found significant differences in all groups except between Clusters 1 and 3 in terms of number of days of smoking, Clusters 1 and 2 in terms of CPD, and Clusters 1 and 2 in terms of interest in ENDS in places where smoking is not allowed and because of intrigue or curiosity.

The Moderates were the least distinct in terms of sociodemographic and smoking-related characteristics. The Disinterested in Smokeless was the oldest of the three groups, was composed of the greatest proportion of females, the smallest proportion of Blacks, and the smallest proportion of those with at least a BA degree, had lower incomes, were less likely to be employed, and were the least likely to have children in the home. Conversely, the Enthusiasts reflected the opposite characteristics. The Disinterested in Smokeless smoked the most frequently and the greatest CPD, were the least likely to use menthol cigarettes, and were the least likely to have made a quit attempt in the past year. On the other hand, the Enthusiasts smoked the fewest days, the least CPD, were the most likely to use menthol cigarettes, and were the most likely to have made a recent quit attempt. The Disinterested in Smokeless were the least likely to believe that ENDS were approved for smoking cessation, whereas the Enthusiasts were the most likely to believe that they were. The Disinterested in Smokeless were also the least likely to have had a discussion with their health care provider about ENDS (17.6% had), whereas 52.9% of Enthusiasts had, with 38.1% having their provider recommend that they try it.

Discussion

The current study examined interest in using or switching to ENDS and smokeless tobacco for various reasons among current smokers and characterized distinct subgroups of current smokers based on their level of interest in these products. Of note, there were high dual use rates of cigarettes and both ENDS and smokeless tobacco, which has been documented previously (Bombard, Pederson, Nelson, & Malarcher, 2007; Enofe, Berg, & Nehl, 2014; Rath, Villanti, Abrams, & Vallone, 2012). On average, participants were more interested in ENDS than smokeless tobacco across all reasons assessed. In general, being younger, being Black, having children, being a menthol smoker, and recently attempting to quit were associated with interest in both products. Prior research has similarly shown that these groups are more likely to use alternative products (Pepper & Brewer, 2013; Sterling, Berg, Thomas, Glantz, & Ahluwalia, 2013; Sutfin, McCoy, Morrell, Hoeppner, & Wolfson, 2013; Vander Weg et al., 2008). Having children (Mendel, Berg, Windle, & Windle, 2012) and having made recent quit attempts (Biener & Abrams, 1991) have been associated with greater interest in quitting, which was among the reasons for using these products that were assessed. Interestingly, however, readiness to quit was not related to interest in either product.

Additional factors associated with interest in smokeless tobacco included being male, higher socioeconomic status, being employed, age of smoking initiation, and cigarette consumption (i.e., number of days smoked and CPD). The lower appeal of smokeless tobacco may indicate that specific nuanced subgroups of the population are interested in these products. Moreover, this sample had the greatest familiarity with chew rather than some of the newer emerging smokeless tobacco products (snus, dissolvables), as reflected by the lifetime and past 30-day use rates, both in this study and in other nationally representative studies (McMillen et al., 2012). Conversely, the general population has become increasingly aware of ENDS (38.5%–57.9% from 2010 to 2012) with use rates tripling from 2.1% to 6.2% in the same time frame (King, Alam, Promoff, Arrazola, & Dube, 2013).

In addition, current smokers were more interested in reducing health risk or cigarette consumption or to aid in smoking cessation and were less interested in either product because of the potential to use them where smoking is prohibited or due to product novelty/intrigue. This is important given the concerns about whether using them for these latter reasons might curtail the potential for harm reduction or increase a smoker's total nicotine exposure. However, we did not assess nonsmokers' interest in using these tobacco products because of curiosity or the intrigue of the products, which would have provided some insight regarding the risk of nonsmokers initiating their use.

We also documented high rates (27.9%) of misbeliefs about FDA approval of ENDS for smoking cessation, particularly among current smokers (38.5%). In addition, roughly a quarter of current smokers had talked with a health care provider about ENDS, with 18.0% reporting that their provider endorsed the use of ENDS for cessation. These findings suggest that there is a great need to inform the general population as well as health care providers about the caveats of using ENDS for this purpose

Furthermore, cluster analyses revealed three groups distinct in their level of interest in the products. The Disinterested in Smokeless was the largest of the subgroups and reflected the interest ratings of the broad sample of smokers. However, the Moderates were moderate both in their interest in both products and in their sociodemographic and smoking-related characteristics, and the Enthusiasts were highly interested in both products. It would have been interesting to compare interest in these products relative to traditional nicotine replacement therapy or other smoking cessation aids to determine if there was something specific about alternative tobacco products versus these traditional aids; perhaps, the Moderates were generally more resistant to trying all types of assistance and the Enthusiasts were more open to trying all types of assistance. This may be the case given that the Enthusiasts were also the most likely to have had conversations with a health care provider about ENDS and were more likely to believe in the evidence-based or FDA endorsement for ENDS.

Future research should examine cessation rates and harm reduction outcomes (e.g., changes in biomarkers of nicotine, smoking reduction) related to using these alternative tobacco products compared to other forms of cessation assistance (e.g., nicotine replacement, behavioral counseling) among current smokers. Moreover, qualitative research is needed to examine reasons for uptake among both smokers and nonsmokers, and research is needed regarding risk and trajectories of uptake of these products. In practice, clinicians and policy makers must be aware of the changing terrain of tobacco use in order to conduct assessments, counsel tobacco users, and craft tobacco control policies and educational campaigns that address the changing context of tobacco use.

Limitations

This sample was drawn from a consumer panel population oversampling racial/ethnic minorities, recent tobacco users, and those from southeastern US states, thus limiting its generalizability. Also, the cross-sectional nature of this study and the self-reported assessments limit the extent to which we can make causal attributions or account for bias. In addition, we did not specify the type of smokeless tobacco products about which we were inquiring nor did we define what ENDS or smokeless tobacco products were, which may have impacted the way that people naïve to these products responded. Finally, we did not assess interest in using traditional cessation resources (e.g., pharmacotherapy, behavioral interventions) in order to examine whether those who were interested in these products were interested in other resources.

Conclusions

The current study documented the rates of interest from current smokers in ENDS and smokeless tobacco, showing higher average interest in ENDS than smokeless tobacco. In addition, we found less interest in using these products in places that prohibit smoking or due to curiosity about the product and more interested related to reducing health risk or cigarette consumption or to aid in cessation. We documented high rates of misbeliefs about FDA approval of ENDS for cessation and that health care providers may be recommending them to aid in cessation or harm reduction. These findings will help to further inform educational campaigns regarding these products as well as clinical practice guidelines regarding how to communicate with smokers about resources and alternatives to aid in cessation.

Funding

This work was supported by the Centers for Disease Control and Prevention (3 U48 DP001909-04S1 to Principal Investigator (PI): CJB), the National Cancer Institute (U01CA154282-01 to PI: MK; 1K07CA139114-01A1 to PI: CJB), and the Georgia Cancer Coalition (PI: CJB). The funders had no role in the analyses or interpretation of the study or its results.

Declaration of Interests

None declared.

Acknowledgments

We would like to thank GMI for preparing and administering this assessment.

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