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Dual Use of Smokeless Tobacco or E-cigarettes with Cigarettes and Cessation

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Abstract

Objectives—To evaluate predictors of dual use of cigarettes with smokeless tobacco or e-cigarettes.

Methods—Adult smokers (N = 1324) completed online cross-sectional surveys. Logistic regression evaluated predictors of dual use and cigarette quit attempts.

Results—Smokeless tobacco dual use was associated with past attempts to quit smoking by switching to smokeless products. E-cigarette dual use was associated with using stop-smoking medication and strong anti-tobacco industry attitudes. Ever use of stop-smoking medication was associated with quit attempts among dual e-cigarette users and cigarette-only users.

Conclusions—Dual users are more likely than cigarette-only users to endorse certain cessation-related attitudes and behaviors. This may provide an opportunity for clinicians or others to discuss evidence-based strategies for smoking cessation.

Keywords

smoking cessation; tobacco; electronic cigarettes

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Human Subjects Statement

The study protocol was approved by the Committee on Human Research (the IRB) at the University of California San Francisco.

Conflict of Interest Statement

All authors declare that there are no conflicts of interest.



Use of electronic cigarettes (e-cigarettes) is increasing,^{1,2} and use of smokeless tobacco products has failed to decline in the United States. Dual use of smokeless tobacco and cigarettes is prevalent in many states,³ and is more common among younger males.⁵ E-cigarette use is higher in current smokers than former smokers or nonsmokers.⁶ Potential reasons for dual use include: (1) promotion of smokeless tobacco and e-cigarettes where smoke-free air policies prevent cigarette smoking;⁷ (2) consumer beliefs that these products are safer than cigarettes;⁸ or (3) perceptions that these products aid smoking cessation.⁹

Some smokeless tobacco use has been associated with malignancies¹⁰ and cardiovascular disease.^{11,12} Higher risk of myocardial infarction is seen in dual users of smokeless tobacco and cigarettes compared to cigarette users alone.¹³ Whereas some support promoting smokeless tobacco products as safer alternatives to cigarettes, others suggest that this is unlikely to result in population-level reductions in health risks.¹⁴ Furthermore, dual use of smokeless tobacco and cigarettes may encourage some to defer cessation, and dual users are less likely to intend to quit than those who smoke cigarettes only.^{15,16}

E-cigarette use is most common among current smokers, males, and young adults.^{6,17,18} Whereas users perceive e-cigarettes as less harmful than cigarettes, useful for reducing cigarette consumption, and beneficial for smoking cessation,^{8,9,19} multiple longitudinal studies have not shown use to contribute to smoking cessation.²⁰⁻²² E-cigarettes may be legally classified as tobacco products in the US unless marketed with therapeutic claims²³ and all major US cigarette companies have e-cigarette subsidiaries or have developed their own e-cigarette brands.²⁴ The widespread marketing of e-cigarettes by tobacco companies may threaten tobacco industry denormalization campaigns, which are initiatives that inform the public about the role of the tobacco industry in the spread of tobacco-related diseases. Examples of tobacco industry denormalization efforts include education about the tobacco industry's use of deceptive marketing or predatory targeting. Tobacco industry denormalization has been an effective tobacco control strategy, helping to prevent youth smoking and encourage smoking cessation.^{25,26}

To educate and counsel individuals using multiple tobacco products effectively, identification of factors associated with concurrent use is important, as motivations for use also may influence smoking cessation behavior. We aimed to examine associations among perceived harm of tobacco products, willingness to try smokeless tobacco, past quitting behaviors, and anti-tobacco industry attitudes and (1) dual use of cigarettes and smokeless tobacco products, or (2) dual use of cigarettes and e-cigarettes. Secondary analyses evaluated predictors of past year quit attempts among dual users.

METHODS

Data Collection and Sample Selection

We conducted a cross-sectional survey of 1324 current adult cigarette smokers (individuals over age 18 who had smoked over 100 cigarettes lifetime and were smoking within 30 days of survey administration). Data were collected in November 2011 from a nationally representative panel maintained by the Knowledge Networks company (now GfK). Panel participants were recruited through address-based sampling to help capture households

without telephone landlines. GfK surveys are completed online; households lacking online access are provided with computers and free Internet access if recruited into the panel. For their participation, panel members earn points for entering raffles or sweepstakes through which they can win prizes. Of the 7776 panel members invited to complete the online survey, 4525 (58%) completed the screening and 1836 (41%) current or former cigarette smokers qualified to participate; 100% of those qualified completed the study questionnaire. Data from the 1324 current cigarette smokers were used in the present study. Figure 1 shows how the eligible participants were selected for inclusion into the study.

Main Measures

Demographic variables—Participants reported sex, race/ethnicity (coded as “white race” and “other” for analysis), age, level of education (dichotomized into “high school or less” and “at least some college” for analyses), region of residence, and household income.

Use of cigarettes and alternative tobacco products—Participants who reported smoking cigarettes on all of the past 30 days were characterized as “daily smokers” and those who reported smoking on 1-29 days were characterized as “nondaily smokers.” Participants also reported the average number of cigarettes smoked per day on days that they smoke.

Current users of smokeless tobacco were defined as individuals who endorsed past 30-day use of loose leaf chewing tobacco, moist snuff, or snus; current users of e-cigarettes were defined as persons reporting e-cigarette use on at least one of the past 30 days. The question about past 30-day use of e-cigarettes did not specify for what purpose or for what substance the e-cigarettes were being used. Participants were classified into one of 3 mutually exclusive groups: (1) current dual users of smokeless tobacco products and cigarettes (“dual smokeless users”); (2) current dual users of e-cigarettes and cigarettes (“dual e-cigarette users”); and (3) current cigarette users only (“cigarette-only users”). Eleven participants reported current use of all 3 products (cigarettes, smokeless tobacco, and e-cigarettes); these participants were excluded from analyses due to the small sample size and to maintain mutually exclusive groups.

Attitudes about smokeless tobacco use and risk perceptions—Willingness to try smokeless tobacco when unable to smoke was assessed on a 9-point Likert scale with response options ranging from “not at all” to “extremely.” A composite score for whether a participant would ever use or switch to smokeless tobacco for health-related reasons of (1) reducing health risk, (2) cutting down on number of cigarettes smoked, or (3) quitting smoking, was created by summing the mean score of each question, where each item was assessed by a 9-point Likert scale with response options ranging from “definitely wouldn’t” to “definitely would.”

Participants were asked to what extent new smokeless products such as snus cause heart attack/stroke, cancer, or oral cancer, and how harmful new smokeless tobacco products are to general health, in their opinion, on a 7-point Likert scale with response options ranging from “not at all harmful” to “extremely harmful.” They also reported whether they felt at risk of developing cancer from new smokeless tobacco products and whether their health

will suffer from using these products. Reporting for these items used a 9-point Likert scale with response options ranging from “not at all” to “extremely.” A composite score was created by calculating the sum of standardized variables created from the 6 questions noted above (Cronbach’s $\alpha = .88$). Participants reported perceived harms of smoking cigarettes to general health on a 7-point Likert scale with response options ranging from “not at all harmful” to “extremely harmful.”

Tobacco industry denormalization attitudes—Attitudes toward tobacco companies were evaluated with a set of measures that was similar to, but not identical to those used in past studies.^{27,28} Participants reported agreement with each of the following statements on a 9-point Likert scale: “I would like to see tobacco companies go out of business;” “Tobacco companies cannot be trusted to tell the truth;” and “Tobacco companies should be allowed to sponsor school activities or sporting events” (reverse coded). A composite score of the means of the 3 items was first calculated, and those with a mean score in the top quartile (ie, greater than 7) were considered to have a strong anti-industry attitude.

Quit intent and attempts—Participants reported intentions to quit smoking (never intend to quit, may intend to quit but not in the next 6 months, intend to quit in the next 6 months, intend to quit in the next 30 days), whether they had tried to quit smoking intentionally for at least one day during the past year, whether they had ever used stop-smoking medication such as nicotine replacement therapies or non-nicotine medications, and whether they ever tried to quit smoking by switching to chewing tobacco, snuff, or snus.

Data Analysis

Descriptive analyses of cigarette-only users, dual smokeless users, and dual e-cigarette users were performed. Factors associated with quit attempts also were analyzed in each group. Univariate and multivariate logistic regression procedures were used to evaluate associations between various covariates and being a dual user of (1) smokeless tobacco products and (2) e-cigarettes, relative to the reference group of cigarette-only users. Covariates used in analyses included: being a daily or nondaily smoker and number of cigarettes per day, as previous studies have shown dual users of snus and cigarettes to smoke fewer cigarettes per week than persons who do not use snus;²⁹ willingness to use smokeless tobacco products for health-related reasons, and risk perceptions about tobacco products, because some individuals report using alternative tobacco products due to concerns about the health risks of cigarettes;⁸ willingness to use smokeless tobacco when smoking is prohibited as smokeless tobacco products and e-cigarettes often are marketed for use in such situations;⁷ previous quit attempts, as some smokers use alternative tobacco products for assistance with smoking cessation;⁹ and tobacco industry denormalization attitudes, which have had negative associations with smoking and positive associations with attempts to quit.²⁷ Dual users were compared to cigarette-only users in analyses. Following the guidelines of Hosmer and Lemeshow,³⁰ all variables with $p < .25$ in univariate logistic regressions were evaluated in multivariate models controlling for sex, race, age, education, region of residence, income, and all other significant factors. Analyses were performed with Stata version 13 (Stata Corp, College Station, TX). The small numbers of females who were dual smokeless users in the

sample ($N = 7$) resulted in several zero cells, so Firth's penalized likelihood estimation as implemented in the Stata command `-firthlogit-` was used.

RESULTS

Characteristics of Study Population

Table 1 shows the characteristics of the study population. Approximately 13% of participants used cigarettes with at least one alternative tobacco product; 4.6% were dual smokeless users and 8.0% were dual e-cigarette users. Males more frequently reported smokeless tobacco dual use. Dual users were generally younger, were non-Hispanic Whites, and possessed less formal education than cigarette-only users.

Predictors of Being a Dual User of Alternative Tobacco Products and Cigarettes

Table 2 shows predictors associated with dual smokeless or dual e-cigarette use. In addition to these variables, we also evaluated the association between demographic factors (sex, race/ethnicity, age, education, region of residence, and household income) and being a dual smokeless or dual e-cigarette user. There was an association between male sex ($OR = 4.17$, 95% CI [1.65-10.53]) and being a dual smokeless user compared to being a cigarette-only user, and an association between white race (1.90, [1.06-3.40]) and being a dual e-cigarette user compared to being a cigarette-only user. Other demographics were not statistically significant (data not shown).

Predictors of Having Made a Quit Attempt in the Past Year

Table 3 shows the statistically significant predictors of having made a quit attempt in the preceding year among cigarette-only users, dual smokeless users, and dual e-cigarette users. For these analyses, the intention to quit variable was dichotomized into "intention to quit in the next 6 months" and "no intention to quit in the next 6 months" because of small cell sizes.

DISCUSSION

Smokeless tobacco products and e-cigarettes often are promoted as substitutes for cigarettes in smoke-free environments;⁷ dual users report use in these situations.¹⁵ We found dual smokeless users and dual e-cigarette users were more willing to try smokeless tobacco when unable to smoke. With increases in comprehensive clean air policies, use of non-cigarette tobacco products to circumvent these policies also may increase, thereby undermining quit attempts among dual users.

Being an e-cigarette dual user was associated with ever use of stop-smoking medication, and past use of medication was associated with having made a quit attempt among e-cigarette dual users. One explanation for these findings is that current smokers may try e-cigarettes to assist with smoking cessation, as many current smokers report using these products to help reduce the number of cigarettes smoked or to quit smoking.^{1,8,9} One randomized control trial showed that e-cigarettes were not more effective than nicotine patches in helping patients quit, and reported low rates of smoking cessation among the nicotine patch users.³¹

Considering the lack of regulation of e-cigarettes³² and the paucity of studies on long-term health effects, current clinical evidence for promoting e-cigarettes as a cessation tool is lacking. However, because e-cigarette use may signal greater openness to using assisted quit methods, physicians should assess whether their cigarette-smoking patients also are using e-cigarettes, as this may indicate readiness to quit and open opportunities to discuss evidence-based options for smoking cessation. On the other hand, the fact that dual e-cigarette users were more likely to have made a quit attempt in the past year by using nicotine replacement therapy, but were not more likely to intend to quit in the next 6 months, may suggest e-cigarette use by smokers is associated with deferring quit attempts. Some studies have shown that smokers who use e-cigarettes are less likely to quit than those who do not use e-cigarettes;^{21,22} therefore, product use patterns and cessation intentions in dual e-cigarette users should be assessed carefully.

Because having tried to quit by switching to smokeless tobacco was strongly associated with smokeless tobacco dual use, smokeless tobacco use among smokers may be motivated by a desire to quit. Clinicians should ask about interest in quitting smoking when current smokers report smokeless tobacco use.

Believing cigarettes or smokeless tobacco are harmful to health was not associated with dual use of smokeless tobacco or e-cigarettes and cigarettes. This is in contrast to e-cigarette users, many of whom view e-cigarettes as a healthier alternative to cigarette smoking.³³ One possible explanation is that health concerns were not the primary motivation for use of smokeless tobacco or e-cigarettes in the sample of cigarette smokers that we surveyed.

Tobacco industry denormalization has been shown to decrease smoking initiation and increase intentions to quit among smokers,²⁵ with associations between attitudes against the tobacco industry and intentions to quit in adults³⁴ and young adults.²⁷ In this study, strong tobacco industry denormalization attitudes were associated with dual use of e-cigarettes and cigarettes. Some people may not view e-cigarettes as tobacco products, or may view e-cigarette sellers as different from ones they associate with the tobacco industry, despite the fact that cigarette companies increasingly own e-cigarette companies or are marketing their own e-cigarette brands.²⁴ This is similar to a prior study showing that hookah users were more likely to hold tobacco industry denormalization attitudes³⁵ and less likely to view these products as tobacco products. Because strong tobacco industry denormalization attitudes were associated with quit attempts among cigarette-only users, the impact of denormalization messages on e-cigarette use, cigarette use, and cessation behaviors among dual users should be explored further.

Limitations

This study has a number of limitations. First, the study population was limited to current smokers, so results cannot be generalized to former smokers. Because participants reported any past 30-day use of smokeless tobacco or e-cigarettes, it is not clear whether use was experimentation or regular. Questions about situational use of smokeless tobacco and health effects of smokeless tobacco were limited to the specific use of smokeless tobacco (not e-cigarettes); therefore, whereas e-cigarette users were more willing to use smokeless tobacco in smoke-free environments, in future studies it would be more appropriate to ask e-cigarette

dual users about their willingness to use e-cigarettes in smoke-free environments. Due to the small sample size, we did not perform analysis of the 11 individuals reporting current use of all 3 product types (cigarettes, smokeless tobacco, and e-cigarettes); however, such an analysis in a larger sample would be another important population to study if user rates of multiple tobacco products increase. Finally, because this was an online self-report survey, findings are subject to reporting bias.

Conclusions

Increases in comprehensive clean air policies, concerns about health effects of cigarettes, and desires to quit smoking all may contribute to increased use of alternative tobacco products by current smokers. Compared to cigarette-only smokers, dual users may perceive and use non-cigarette products as they are marketed: for when they cannot smoke and with perceived smoking cessation utility. E-cigarette or smokeless tobacco use by a cigarette smoker may signal interest in quitting, and it is important for clinicians to address the use of these products with their patients as it may provide an opportunity to discuss cessation intentions and to encourage the use of evidence-based strategies for smoking cessation.

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References

1. Dockrell M, Morrison R, Bauld L, McNeill A. E-cigarettes: prevalence and attitudes in Great Britain. *Nicotine Tob Res.* 2013; 15(10):1737–1744. [PubMed: 23703732]
2. Centers for Disease Control and Prevention. Notes from the field: electronic cigarette use among middle and high school students – United States, 2011–2012. *MMWR Morb Mortal Wkly Rep.* 2013; 62(35):729–730. [PubMed: 24005229]
3. Centers for Disease Control and Prevention. State-specific prevalence of cigarette smoking and smokeless tobacco use among adults – United States, 2009. *MMWR Morb Mortal Wkly Rep.* 2010; 59(43):1400–1406. [PubMed: 21048561]
4. Bhattacharyya N. Trends in the use of smokeless tobacco in United States, 2000–2010. *Laryngoscope.* 2012; 122(10):2175–2178. [PubMed: 22777912]
5. Tomar SL, Alpert HR, Connolly GN. Patterns of dual use of cigarettes and smokeless tobacco among US males: findings from national surveys. *Tob Control.* 2010; 19(2):104–109. [PubMed: 20008157]
6. Pearson JL, Richardson A, Niaura RS, et al. e-Cigarette awareness, use, and harm perceptions in US adults. *Am J Public Health.* 2012; 102(9):1758–1766. [PubMed: 22813087]
7. Mejia AB, Ling PM. Tobacco industry consumer research on smokeless tobacco users and product development. *Am J Public Health.* 2010; 100(1):78–87. [PubMed: 19910355]
8. Goniewicz ML, Lingas EO, Hajek P. Patterns of electronic cigarette use and user beliefs about their safety and benefits: an Internet survey. *Drug Alcohol Rev.* 2013; 32(2):133–140. [PubMed: 22994631]
9. Etter JF. Electronic cigarettes: a survey of users. *BMC Public Health.* 2010; 10:231. [PubMed: 20441579]
10. Boffetta P, Hecht S, Gray N, et al. Smokeless tobacco and cancer. *Lancet Oncol.* 2008; 9(7):667–675. [PubMed: 18598931]
11. Boffetta P, Straif K. Use of smokeless tobacco and risk of myocardial infarction and stroke: systematic review with meta-analysis. *BMJ.* 2009; 339:b3060. [PubMed: 19690343]

12. Piano MR, Benowitz NL, Fitzgerald GA, et al. Impact of smokeless tobacco products on cardiovascular disease: implications for policy, prevention, and treatment. A policy statement from the American Heart Association. *Circulation*. 2010; 122(15):1520–1544. [PubMed: 20837898]
13. Teo KK, Ounpuu S, Hawken S, et al. Tobacco use and risk of myocardial infarction in 52 countries in the INTERHEART study: a case-control study. *Lancet*. 2006; 368(9536):647–658. [PubMed: 16920470]
14. Mejia AB, Ling PM, Glantz SA. Quantifying the effects of promoting smokeless tobacco as a harm reduction strategy in the USA. *Tob Control*. 2010; 19(4):297–305. [PubMed: 20581427]
15. McClave-Regan AK, Berkowitz J. Smokers who are also using smokeless tobacco products in the US: a national assessment of characteristics, behaviours and beliefs of ‘dual users’. *Tob Control*. 2011; 20(3):239–242. [PubMed: 21172853]
16. Wetter DW, McClure JB, de Moor C, et al. Concomitant use of cigarettes and smokeless tobacco: prevalence, correlates, and predictors of tobacco cessation. *Prev Med*. 2002; 34(6):638–648. [PubMed: 12052025]
17. Regan AK, Promoff G, Dube SR, Arrazola R. Electronic nicotine delivery systems: adult use and awareness of the ‘e-cigarette’ in the USA. *Tob Control*. 2013; 22(1):19–23. [PubMed: 22034071]
18. King BA, Alam S, Promoff G, et al. Awareness and everuse of electronic cigarettes among U.S. Adults, 2010–2011. *Nicotine Tob Res*. 2013; 15(9):1623–1627. [PubMed: 23449421]
19. Etter JF, Bullen C. Electronic cigarette: users profile, utilization, satisfaction and perceived efficacy. *Addiction*. 2011; 106(11):2017–2028. [PubMed: 21592253]
20. Grana RA, Popova L, Ling PM. A longitudinal analysis of electronic cigarette use and smoking cessation. *JAMA Internal Med*. 2014; 174(5):812–813. [PubMed: 24664434]
21. Adkison SE, O’Connor RJ, Bansal-Travers M, et al. Electronic nicotine delivery systems: international tobacco control four-country survey. *Am J Prev Med*. 2013; 44(3):207–215. [PubMed: 23415116]
22. Vickerman KA, Carpenter KM, Altman T, et al. Use of electronic cigarettes among state tobacco cessation quitline callers. *Nicotine Tob Res*. 2013; 15(10):1787–1791. [PubMed: 23658395]
23. D.C. Circuit U.S. Court of Appeals. *Sottera, Inc. v. Food & Drug Administration*. 2010. 627 F.3d 891
24. Grana RA, Benowitz N, Glantz SA. E-cigarettes: a scientific review. *Circulation*. 2014; 129(19):1972–1986. [PubMed: 24821826]
25. Malone RE, Grundy Q, Bero LA. Tobacco industry denormalisation as a tobacco control intervention: a review. *Tob Control*. 2012; 21(2):162–170. [PubMed: 22345240]
26. Farrelly MC, Heaton CG, Davis KC, et al. Getting to the truth: evaluating national tobacco countermarketing campaigns. *Am J Public Health*. 2002; 92(6):901–907. [PubMed: 12036775]
27. Ling PM, Neilands TB, Glantz SA. The effect of support for action against the tobacco industry on smoking among young adults. *Am J Public Health*. 2007; 97(8):1449–1456. [PubMed: 17600255]
28. Ling PM, Neilands TB, Glantz SA. Young adult smoking behavior: a national survey. *Am J Prev Med*. 2009; 36(5):389–394.e2. [PubMed: 19269128]
29. Lund KE, McNeill A. Patterns of dual use of snus and cigarettes in a mature snus market. *Nicotine Tob Res*. 2013; 15(3):678–684. [PubMed: 22990221]
30. Hosmer, D.; Lemeshow, S. *Applied Logistic Regression*. John Wiley and Sons; New York, NY: 2000.
31. Bullen C, Howe C, Laugesen M, et al. Electronic cigarettes for smoking cessation: a randomised controlled trial. *Lancet*. 2013; 382(9905):1629–1637. [PubMed: 24029165]
32. Benowitz NL, Goniewicz ML. The regulatory challenge of electronic cigarettes. *JAMA*. 2013; 310(7):685–686. [PubMed: 23856948]
33. Dawkins L, Turner J, Roberts A, Soar K. ‘Vaping’ profiles and preferences: an online survey of electronic cigarette users. *Addiction*. 2013; 108(6):1115–1125. [PubMed: 23551515]
34. Hammond D, Fong GT, Zanna MP, et al. Tobacco denormalization and industry beliefs among smokers from four countries. *Am J Prev Med*. 2006; 31(3):225–232. [PubMed: 16905033]

35. Lee YO, Bahreinifar S, Ling PM. Understanding tobacco-related attitudes among college and noncollege young adult hookah and cigarette users. *J Am Coll Health*. 2014; 62(1):10–18. [PubMed: 24313692]

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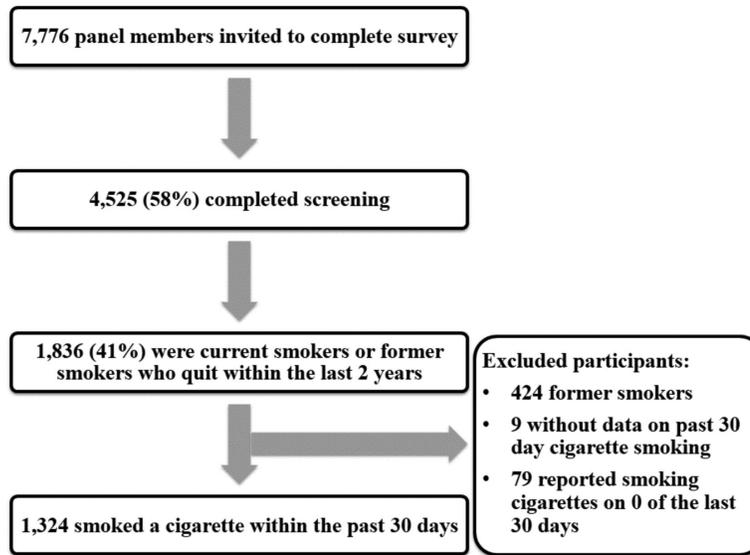


Figure 1. Participant Eligibility and Criteria for Inclusion in this Study

Table 1

Characteristics of Study Population

	Total (N = 1324)	Cigarette Only User (N = 1147)	Dual Smokeless User (N = 61)	Dual E-cigarette User (N = 105)
Male, N (%)	615 (46.45)	520 (45.34)	54 (88.52)	34 (32.38)
Race/ethnicity, N (%)				
White	985 (74.4)	842 (73.41)	50 (81.97)	88 (83.81)
Black, Non-Hispanic	136 (10.27)	123 (10.72)	1 (1.64)	8 (7.62)
Other, Non-Hispanic	32 (2.42)	29 (2.53)	2 (3.28)	0
Hispanic	123 (9.29)	109 (9.50)	7 (11.48)	7 (6.67)
2+ race, Non-Hispanic	48 (3.63)	44 (3.84)	1 (1.64)	2 (1.90)
Education, N (%)				
Less than high school	140 (10.57)	119 (10.37)	11 (18.03)	9 (8.57)
High school	545 (41.16)	469 (40.89)	19 (31.15)	53 (50.48)
Some college	414 (31.27)	353 (30.78)	22 (36.07)	35 (33.33)
Bachelor's or higher	225 (16.99)	206 (17.96)	9 (14.75)	8 (7.62)
Age, N (%)				
18-29	185 (13.97)	144 (12.55)	17 (27.87)	20 (19.05)
30-44	298 (22.51)	257 (22.41)	21 (34.43)	17 (16.19)
45-59	583 (44.03)	518 (45.16)	16 (26.23)	47 (44.76)
>60	258 (19.49)	228 (19.88)	7 (11.48)	21 (20)
Region, N (%)				
Northeast	198 (14.95)	168 (14.65)	6 (9.84)	21 (20)
Midwest	368 (27.79)	319 (27.81)	13 (21.31)	32 (30.48)
South	500 (37.76)	433 (37.75)	28 (45.90)	36 (34.29)
West	258 (19.49)	227 (19.79)	14 (22.95)	16 (15.24)
Income, N (%)				
<\$25,000	434 (32.78)	370 (32.26)	24 (39.34)	34 (32.38)
\$25,000-\$59,999	507 (38.29)	448 (39.06)	14 (22.95)	45 (42.86)
>\$60,000	383 (28.93)	329 (28.68)	23 (37.70)	26 (24.76)
Average cigarettes/day, N (%)				
<5	236 (17.88)	203 (17.74)	15 (24.59)	15 (14.42)
6-10	346 (26.21)	307 (26.84)	12 (19.67)	22 (21.15)
11-20	563 (42.65)	483 (42.22)	27 (44.26)	51 (49.04)
>20	175 (13.26)	151 (13.20)	7 (11.48)	16 (15.38)
Nondaily smoker, N (%)	277 (20.92)	233 (20.31)	20 (32.79)	19 (18.10)

Table 2

Predictors of Dual Use of Cigarettes and Smokeless Tobacco or E-cigarettes

Variables	Predictors of Dual Smokeless Use (N = 1191) ^a		Predictors of Dual E-cigarette Use (N = 1241) ^a	
	Univariate OR (95% CI)	Multivariate ^b aOR (95% CI)	Univariate OR (95% CI)	Multivariate ^b aOR (95% CI)
Ever used stop-smoking medication	0.98 (0.58,1.66)	--	2.48 (1.64,3.75)***	1.95 (1.23,3.07)**
Tried to quit by switching to smokeless tobacco	46.47 (25.33,85.24)***	18.17 (8.59,38.40)***	0.77 (0.23,2.53)	--
Willingness to try smokeless tobacco when unable to smoke	1.43 (1.29,1.57)***	1.32 (1.14,1.54)***	1.20 (1.12,1.29)***	1.11 (1.02,1.22)*
Willingness to switch to smokeless tobacco	1.19 (1.08,1.30)***	1.01 (0.86,1.18)	1.22 (1.13,1.31)***	1.09 (0.99,1.20)
Believe that cigarettes are harmful to health	0.94 (0.76,1.15)	--	1.09 (0.92,1.29)	--
Believe that smokeless tobacco are harmful to health	0.99 (0.95,1.02)	0.99 (0.94,1.04)	1.00 (0.97,1.03)	--
Made quit attempt >1 day in preceding year	1.93 (1.12,3.31)*	1.53 (0.70,3.37)	1.81 (1.19,2.74)**	1.35 (0.84,2.18)
Intention to quit smoking				
Never expect to quit	Ref	--	Ref	--
May quit in future, not in next 6 months.	0.61 (0.27,1.39)	0.36 (0.12,1.12)	2.93 (1.05,8.19)*	1.97 (0.68,5.71)
Will quit in next 6 mo.	1.43 (0.62,3.29)	0.72 (0.21,2.43)	3.49 (1.20,10.15)*	1.67 (0.53,5.25)
Will quit in next mo.	0.87 (0.25,2.99)	0.48 (0.08-2.71)	4.79 (1.47,15.59)**	2.48 (0.69,8.90)
Strong Anti-industry attitude	0.89 (0.49-1.62)	--	2.39 (1.59,3.59)***	1.95 (1.24,3.06)**
Nondaily smoker	1.91 (1.10,3.33)*	2.24 (0.95,5.29)	0.87 (0.52,1.45)	--
Cigarettes smoked per day	0.99 (0.96,1.02)	--	1.01 (0.99,1.02)	--

Note.* **p < .05,**** **p < .01,***** **p < .001**

^a the total number of participants in multivariate analyses is reduced due to missing data. Dual e-cigarette users are excluded from the model of predictors of dual smokeless use, and dual smokeless users were excluded from the model of predictors of dual e-cigarette use. The reference group for each model was cigarette-only users.

^b multivariate logistic regressions controlling for age, sex, level of education, race/ethnicity, region of residence, and household income

Table 3

Predictors of Having Made a Quit Attempt in the Past Year

Variables	Cigarette Only Users (N = 1117) ^a		Dual Smokeless Users (N = 60) ^a		Dual E-cigarette Users (N = 101) ^a	
	Univariate OR (95% CI)	Multivariate ^b aOR (95% CI)	Univariate OR (95% CI)	Multivariate ^b aOR (95% CI)	Univariate OR (95% CI)	Multivariate ^b aOR (95% CI)
Ever used stop-smoking medication	1.38 (1.09,1.76)**	1.63 (1.21,2.19)**	3.04 (0.93,9.94)	4.70 (0.90,24.49)	3.14 (1.35,7.29)**	3.33 (1.01,11.02)*
Tried to quit by switching to smokeless tobacco	1.51 (0.81,2.83)	1.50 (0.70,3.17)	1.14 (0.38,3.41)	--	1.12 (0.10,12.84)	--
Willingness to try smokeless tobacco when unable to smoke	1.04 (0.998,1.09)***	1.01 (0.94,1.08)	0.69 (0.53,0.91)**	0.74 (0.54,1.01)	0.94 (0.82,1.08)	--
Willingness to switch to smokeless tobacco	1.09 (1.04,1.13)***	1.07 (1.01,1.14)*	0.94 (0.74,1.19)	--	1.02 (0.89,1.17)	--
Believe that cigarettes are harmful to health	1.38 (1.24,1.52)***	1.09 (0.96,1.23)	0.99 (0.64,1.54)	--	1.30 (0.93,1.82)	1.02 (0.61,1.71)
Believe that smokeless tobacco are harmful to health	1.04 (1.02,1.05)***	1.02 (0.998,1.04)	1.05 (0.71,1.55)	--	1.05 (0.98,1.11)	--
Intention to quit smoking in next 6 months ^c	6.87 (5.06,9.31)***	4.96 (3.56,6.91)***	3.91 (1.20,12.75)*	3.46 (0.71,16.86)	3.02 (1.20,7.58)*	2.11 (0.69,6.48)
Strong Anti-industry attitude	2.94 (2.23,3.88)***	1.74 (1.24,2.43)**	0.73 (0.22,2.42)	--	4.79 (1.95,11.76)**	3.34 (0.98,11.39)
Nondaily smoker	4.08 (2.94,5.65)***	3.14 (2.10,4.70)***	0.96 (0.31,2.96)	--	13.5 (1.72,105.87)*	7.90 (0.63,99.3)
Cigarettes smoked per day	0.96 (0.95,0.97)***	0.98 (0.96,0.998)*	0.99 (0.94,1.04)	--	0.96 (0.92,1.004)	0.94 (0.88,1.01)

Note.

* p < .05,

** p < .01,

*** p < .001

^a the total number of participants in multivariate analyses is reduced due to missing data^b multivariate logistic regressions controlling for age, sex, level of education, race/ethnicity, region of residence, and household income^c the intention to quit smoking variable was dichotomized due to small cell sizes in dual smokeless tobacco users and dual e-cigarette users