Published in final edited form as:

Prev Med. 2020 November ; 140: 106285. doi:10.1016/j.ypmed.2020.106285.

Prospective associations between nicotine beliefs and tobacco-related susceptibility, curiosity, and use in U.S. adults

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Abstract

Low harm perceptions of tobacco products have been associated with use of those products in youth and adults, but this relationship has not been assessed for nicotine beliefs. This study used data from a national sample of adults aged 18–40 in Wave 9 (Spring 2016) of the Truth Initiative Young Adult Cohort Study to examine correlations and prospective associations between the latent classes of nicotine beliefs and susceptibility, curiosity, and use of tobacco products in 3,122 adults who also completed Wave 10 (Fall 2016). At Wave 9, four latent classes of beliefs characterized the role of nicotine in the health risks of smoking: Class 1, large role, 51%; Class 2, large role/don't know, 9.4%; Class 3, small role in health, 32.5%; and Class 4, none/small role in cancer, 7.5%. Latent classes of nicotine beliefs were highly correlated with susceptibility and curiosity to use cigarettes, e-cigarettes, and hookah, as well as past 30-day use of a range of tobacco products at Wave 9 among never users. Classes 3 and 4 had the highest prevalence of past 30-day tobacco use; never users in these classes reported the greatest susceptibility to try cigarettes, hookah, and e-cigarettes at Wave 9. Class 4 had higher odds of increased e-cigarettes use at follow-up compared

CRedit author statement

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CONFLICT OF INTEREST

The authors have no other conflicts to disclose. No financial disclosures were reported by the authors of this paper.

to Class 1. There were few prospective associations between nicotine beliefs latent class, susceptibility, and curiosity at Wave 10. Nicotine beliefs are associated with tobacco-related outcomes and, if assessed, may provide novel information to guide tobacco prevention and intervention efforts.

INTRODUCTION

In 2017, the U.S. Food and Drug Administration (FDA) articulated a comprehensive plan on tobacco and nicotine regulation (U.S. Food and Drug Administration, 2017), which has been reaffirmed in subsequent statements by the agency (U.S. Food and Drug Administration, 2019). This plan focuses on two key actions involving nicotine: 1) reducing nicotine levels in combustible cigarettes to make them minimally or non-addictive and 2) allowing for new forms of nicotine delivery to provide adult smokers with a source of nicotine with fewer health harms than cigarettes (U.S. Food and Drug Administration, 2019). Both of these actions center on nicotine – one on reducing nicotine in the most harmful form of tobacco and one on harnessing less harmful forms of nicotine to meet the needs of dependent adult smokers. The public health impact of FDA’s proposed nicotine reduction policy hinges on the extent to which tobacco users and non-users understand the harms of nicotine in relation to specific products (e.g., e-cigarettes, nicotine replacement therapy (NRT), reduced nicotine content (RNC) cigarettes) and how this influences decisions made by non-users to try a product and by users regarding cessation, product switching, or continued use.

Currently, there are widespread misperceptions of nicotine’s role in health harms that may undermine the success of FDA’s proposed nicotine policy. Approximately half of U.S. adults believe that nicotine causes cancer (O’Brien et al., 2017; Villanti et al., 2019b) and more than 60% of U.S. adults aged 18–40 reported that nicotine was responsible for a relatively or very large part of the health risks of smoking and the cancer caused by smoking (Villanti et al., 2019b). A number of studies have shown that smokers in the U.S and abroad have little knowledge of NRT and equate the harms of NRT use with the harms of cigarette smoking (Bansal et al., 2004; Borrelli and Novak, 2007; Cummings et al., 2004; Etter and Perneger, 2001; Ferguson et al., 2011; Shiffman et al., 2008; Wikmans and Ramstrom, 2010). Similar perceptions exist for e-cigarettes, with 46% of U.S. adults aged 18–40 reporting that long-term use of e-cigarettes is almost as harmful to health as smoking and 69% believing that e-cigarettes are equally or more likely to cause cancer and heart attack than cigarettes (Villanti et al., 2019b). In line with misperceptions about nicotine and nicotine products, adults in the general U.S. population believe, on average, that low nicotine cigarettes are likely to be less harmful than a typical cigarette (O’Brien et al., 2017) and nearly half of adult smokers believe that long-term exposure to very low nicotine content cigarettes would be less likely to cause cancer than smoking current cigarettes (Byron et al., 2018).

Few studies have examined how beliefs about nicotine, generally, relate to the uptake or continued use of various products, including NRT, e-cigarettes, and RNC cigarettes, but a number of studies support the premise that a relationship exists. In adults, lower harm perceptions about NRT are correlated with NRT use (Bansal et al., 2004) and recent studies in population samples of youth and adults demonstrate that lower relative harm perceptions

of tobacco products predict subsequent tobacco use behavior (Brose et al., 2015; Choi and Forster, 2014; Cooper et al., 2018; Elton-Marshall et al., 2020; Parker et al., 2018; Strong et al., 2019; Villanti et al., 2015). Greater beliefs that RNC cigarettes are less addictive and can help people quit, as well as higher cumulative false beliefs, were correlated with higher daily RNC cigarette consumption in a clinical study (Mercincavage et al., 2017). In contrast, findings from a 2015 population sample showed that nicotine perceptions were not associated with trying e-cigarettes (Wiseman et al., 2019). However, this study preceded dramatic changes in the e-cigarette market, including greater nicotine delivery in popular commercial products, like JUUL (Huang et al., 2019a).

Our previous work in U.S. adults aged 18–40 identified that people cluster into four latent classes based on their beliefs about nicotine: those who believe that nicotine causes cancer and plays a large part in smoking risks (Class 1); those who share the belief about nicotine's large part in causing smoking health harms, but were differentiated from Class 1 by "don't know" responses to nicotine's addictiveness and role in cancer (Class 2); those who believe that nicotine plays no role or a small part in health risks (Class 3); and those who believe that nicotine plays no role or a small part in health risks and that none or a very small part of cancer is caused by nicotine (Class 4; Villanti et al., 2019a). The goal of the current study was to examine whether these latent classes were associated with susceptibility and curiosity to use tobacco and tobacco use behavior. We hypothesized that young adults with mixed (Class 2) or low harm perceptions (Classes 3 and 4) of nicotine would become increasingly susceptible to try tobacco (among tobacco non-users) or to increase tobacco use frequency at six-month follow-up compared to those with high harm perceptions (Class 1).

METHODS

The current study leverages data from 3,122 participants aged 18–40 who completed Waves 9 (Spring 2016) and 10 (Fall 2016) of the Truth Initiative Young Adult Cohort Study (YA Cohort). The detailed methods of this study have been described elsewhere (Rath et al., 2012). The cohort was comprised of a nationally representative sample of young adults ages 18–34 at study entry drawn from GfK's KnowledgePanel® which is recruited via address-based sampling to provide a statistically valid representation of the U.S. population, including cell phone-only households. The survey was administered online in English and Spanish. The cohort was refreshed at each wave to retain the initial sample size. The panel recruitment rate was 13.2% for Wave 9 (2015). In 63.9% of the identified households, one member completed a core profile survey in which key demographic information was collected (profile rate). At each wave, only one panel member per household was selected at random to be part of the study sample, and no members outside the panel were recruited. The completion rate was 60.7% and the cumulative response rate (a product of these three rates) was 5.1% (Callegaro and DiSogra, 2008). Retention at Wave 10 was 76.1%. This study was approved by the Chesapeake Institutional Review Board, Inc. (Protocol #20036020; now Advarra). Online consent was collected from participants before survey self-administration.

Nicotine beliefs latent class

Four items addressing nicotine beliefs at Wave 9 were included in latent class models; detail on these analyses have been published elsewhere (Villanti et al., 2019a). Three items assessed nicotine's role in causing disease (i.e., "Nicotine is a cause of cancer"; "According to you, how large a part of the health risks of cigarette smoking comes from the nicotine itself?"; and "According to you, how large a part of the cancer caused by cigarette smoking comes from the nicotine itself?"), while the fourth evaluated the relationship between nicotine and addiction ("The claim that a cigarette brand is low in nicotine means that it is less addictive"). Participants completing both Waves 9 and 10 were classified into four latent classes of nicotine beliefs at Wave 9: Class 1 – Large role in health risks (n = 1,593; 51%); Class 2 – Don't know/large role in health risks (n = 293; 9.4%); Class 3 – Small role in health risks (n = 1,002; 32.5%); and Class 4 – None/small role in cancer (n = 234; 7.5%).

Outcomes

Outcomes included measures of susceptibility, curiosity, and use of several tobacco products assessed at Waves 9 and 10. Susceptibility and curiosity were captured for the three most prevalent products used by young adults (i.e., cigarettes, hookah, and e-cigarettes), to reduce survey burden of asking these items for all eight tobacco products assessed. Susceptibility to cigarettes and hookah was assessed using the three-item assessment developed by Pierce et al. for adolescents (Choi et al., 1997; Evans et al., 1995; Pierce et al., 1996; Pierce et al., 2005; Pierce et al., 1995). Items were "Will you smoke [cigarettes] soon?", "Will you smoke [cigarettes] any time in the next year?", and "If one of your best friends were to offer you [a cigarette], would you try it?" These items had the following response choices: "Definitely yes," "Probably yes," "Probably not," and "Definitely not." Susceptibility to e-cigarettes was assessed with two of these items ("Do you think that you will try an e-cigarette soon?" and "If one of your best friends were to offer you an e-cigarette, would you try it?"). Participants reporting "Definitely not" to all items were categorized as non-susceptible and all others were categorized as susceptible to the tobacco product assessed. Curiosity to smoke cigarettes has been shown to be an independent predictor of smoking initiation (Pierce et al., 2005) and was asked of cigarettes, hookah, or e-cigarettes (e.g., "Have you ever been curious about smoking a cigarette?") with the same four response choices. Again, those responding "definitely not" were categorized as not curious with all other respondents classified as curious.

Ever use of cigarettes, traditional cigars, pipes, little cigars/cigarillos/bidis, e-cigarettes, smokeless tobacco, snus, and hookah was assessed among all participants at Waves 9 and 10. Given low prevalence of pipe and snus use (<2%), these products were excluded from analyses, and use outcome variable were created for each of the remaining six tobacco products (cigarettes, e-cigarettes, cigars, little cigars/cigarillos/bidis, hookah, smokeless tobacco). New use of a tobacco product at Wave 10 was defined as switching from "never use" of a product at Wave 9 to "ever use" of that product at Wave 10.

Past 30-day use was assessed for each product among ever users by asking about the number of days they had used the product in the past 30 days. Wave 9 participants were randomized to a checklist of past 30-day use followed by an open-entry question, with 0–30 as response

limits for the products used, or a standalone item with the following response options: “0 days,” “1 or 2 days,” “3 to 5 days,” “6 to 9 days,” “10 to 19 days,” “20 to 24 days,” and “25 to 30 days” as part of a measurement experiment (Johnson et al., 2018). Findings from this experiment supported using the standalone items, which were then used exclusively in Wave 10 (Delnevo et al., 2017). Participants receiving the open-entry item were recoded into the seven categories for consistency with the Wave 10 measure. At both waves, participants who never used a tobacco product or reported no past 30-day use of any tobacco product were defined as not having any past 30-day tobacco use (“0 days”). Two variables were created: a dichotomous past 30-day use variable for each product (yes/no) and variable capturing increase in the number of days of reported use of each tobacco products between Waves 9 and 10. The increase in tobacco use variables were estimated by subtracting Wave 9 frequency from Wave 10 frequency for each product and creating a dichotomous variable for any increase in response category. New use among never users between waves was also defined as an increase in product use.

Covariates

Age (18–24; 25–34; 35+), gender, race/ethnicity, education, and household income were collected at each wave of the YA Cohort. These analyses used Wave 9 measures of these variables in line with the time at which the latent classes were modeled.

Analyses

Analyses assessed correlations and prospective associations between the four latent classes and three outcomes per product: susceptibility and curiosity for cigarettes, hookah, and e-cigarettes among never users of those products; and increased use of the six tobacco products at Wave 10. Susceptibility, curiosity, and increased use were modeled for each product using crude and adjusted logistic regression. All adjusted models accounted for age (18–24; 25–34; 35+), gender, race/ethnicity, education, and income at Wave 9. Adjusted models for product-specific susceptibility and curiosity at Wave 10 also controlled for Wave 9 susceptibility or curiosity, respectively. All analyses accounted for survey weighting using svy commands in Stata, version 16.1 and missing data were handled with list-wise deletion in accordance with Stata’s standard procedures.

RESULTS

More than three-fourths (77%) of the Wave 9 sample was retained at Wave 10, with those retained more likely to be older, non-Hispanic white, more highly educated, and have a higher income than those lost to follow-up (Supplemental Table 1). While the retained sample had a lower prevalence of past 30-day tobacco use, there was no difference in the distribution of the latent classes in those retained compared to those who were lost to follow-up. The resulting sample was largely aged 25–34 (57%) and non-Hispanic white (57%), with some college education (66%; Table 1). Approximately half of the sample was female (51%). Past 30-day use of tobacco products was generally low (2 – 4%), with the exception of cigarettes which was 14%. After eliminating Wave 10 drop-outs, Classes 1 and 2 were more likely to be non-Hispanic white in contrast to our earlier work (Villanti et al., 2019a). Consistent with our prior work, those in Classes 1 and 2 were less likely to have a college

education and those in Class 4 were more likely to be male. Nicotine beliefs remained largely consistent across both waves, with 63% to 70% agreement in responses between Waves 9 and 10 (Supplemental Table 2). Where there were changes in beliefs over time, they tended to shift toward the mean, with the responses to the nicotine beliefs items in each class becoming more similar at Wave 10, rather than more divergent.

Susceptibility, curiosity, and tobacco use at Wave 9

Susceptibility, curiosity, and past 30 day tobacco use at Wave 9 were correlated with nicotine beliefs latent classes, with the highest prevalence of ever or past 30-day tobacco use seen in Classes 3 and 4 (Supplemental Table 3). Crude and adjusted logistic regression models revealed patterns in the correlates of each latent class: compared to Class 1, Class 2 members who had never used hookah had a lower odds of reporting susceptibility (AOR 0.55, Table 2) or curiosity (AOR 0.62) to use hookah. Class 2 also had a lower odds of past 30-day smokeless tobacco use (AOR 0.08) than Class 1, but was otherwise similar to Class 1. Class 3 never users had higher odds of susceptibility to cigarettes (AOR 2.03), hookah (AOR 1.43), and e-cigarettes (AOR 1.56), as well as a higher odds of curiosity to use hookah (AOR 1.69) and e-cigarettes (AOR 1.60) than Class 1. This was consistent with higher odds of past 30-day hookah (AOR 2.20), e-cigarette (AOR 3.37), cigar (AOR 3.13), little cigar/cigarillo/bidi (AOR 1.99), and smokeless tobacco use (AOR 2.20) in the full sample of Class 3 members compared to Class 1 members. Never e-cigarette users in Class 4 had higher susceptibility (AOR 1.71) and curiosity (AOR 1.73) to use e-cigarettes than never users in Class 1, consistent with higher odds of e-cigarette use (AOR 9.69) in the full sample. Class 4 members also had higher odds of cigar (AOR 4.33) and smokeless tobacco use (AOR 3.85) than Class 1 members.

Susceptibility and curiosity to use cigarettes, e-cigarettes, and hookah at Wave 10

Wave 9 nicotine beliefs latent class was generally not predictive of susceptibility or curiosity to use cigarettes, e-cigarettes, or hookah at Wave 10 after controlling for these measures at Wave 9 (Table 3). Compared to Class 1, those in Class 2 were more likely to report susceptibility to cigarettes at Wave 10 (AOR 2.77, 95% CI 1.51 – 5.09), controlling for age, sex, race/ethnicity, education, income, and susceptibility at Wave 9. Class 2 members were also less curious to try e-cigarettes at Wave 10 (AOR 0.49, 95% CI 0.27, 0.90) than Class 1 members controlling for demographic covariates and curiosity at Wave 9. Despite the correlations between Classes 3 and 4 and these measures at Wave 9, there were no associations of note at Wave 10.

Increased tobacco product use at Wave 10

There were also few predictive associations between nicotine beliefs latent class and increased use of six tobacco products (Table 4). Compared to Class 1, Class 2 was marginally less likely to increase their use of cigars between Waves 9 and 10 (AOR 0.53, 95% CI 0.28, 0.99) in the adjusted model. Class 4, on the other hand, had an 86% higher odds of increasing e-cigarette use between waves (AOR 1.86, 95% CI 1.12, 3.07) compared to Class 1, even after controlling for demographic characteristics. Bivariate analyses suggested a relationship of similar magnitude between Class 4 membership and increased

little cigar/cigarillo/bidi use (OR 1.87, 95% CI 1.05, 3.34), but this association was attenuated after controlling for other covariates.

DISCUSSION

Previous studies have documented the prevalence of nicotine beliefs at the population level, but none have examined the prospective relationship between those beliefs and tobacco use behavior. Findings from our study suggest that latent classes of nicotine beliefs are highly correlated with susceptibility and curiosity to use cigarettes, e-cigarettes, and hookah, as well as past 30-day use of a range of tobacco products assessed at the same time point (Wave 9). However, there were few prospective associations between nicotine beliefs latent class, susceptibility, and curiosity at Wave 10 after controlling for these variables at Wave 9. Additionally, there were few associations between nicotine beliefs latent class and increased tobacco use at Wave 10.

Interestingly, patterns emerged by class that may better elucidate how nicotine beliefs latent classes may inform prevention or intervention strategies: first, Class 2, defined by perceiving a large role of nicotine in health risks of smoking, but responding “don’t know” to whether nicotine causes cancer or whether a low nicotine cigarette would be less addictive, was generally similar to Class 1, the largest class which was defined by perceiving a large role of nicotine in the health risks of smoking. Where Class 2 differed from Class 1, it generally favored Class 2 as a lower risk class. This was inconsistent with our hypotheses. The exception to this pattern was reporting a greater susceptibility to cigarette use in Class 2 than Class 1 at Wave 10, controlling for Wave 9 susceptibility, which was consistent with our predictions. Compared to Class 1, the absence of firm beliefs or knowledge about whether low nicotine cigarettes would be less addictive and about nicotine as a cause of cancer may explain greater openness to cigarette smoking among never smokers in Class 2.

In contrast, in the correlational analyses at Wave 9, Class 3, defined as perceiving a small role of nicotine in the health risks of smoking, was a higher risk class than Class 1, with higher odds of susceptibility to cigarettes, hookah, and e-cigarettes, higher odds of curiosity to use hookah and e-cigarettes, and higher past 30-day use of all products except cigarettes at Wave 9, consistent with our hypotheses. However, there were no differences between Class 3 and Class 1 on any of the outcomes assessed prospectively. Given that changes in nicotine beliefs tended to shift to greater harm over time in Class 3, the lack of associations at Wave 10 could be explained by Class 3 members looking more like Class 1 members at follow-up. These increases in tobacco-related harm perceptions over time are consistent with other studies in the U.S. (Elton-Marshall et al., 2020; Huang et al., 2019b; Strong et al., 2019) and England (Perski et al, 2020; Tattan-Birch et al., 2020).

Similar to Class 3, Class 4 was defined by beliefs about nicotine having a small role in health risks, with one distinction: Class 4 held a strong belief that none or a small part of cancer was caused by nicotine. Class 4 had the highest prevalence of past 30-day e-cigarette use at Wave 9 and the pattern that emerged from cross-sectional and longitudinal analyses of study outcomes were consistent for this product: compared to Class 1, Class 4 had higher odds of susceptibility and curiosity to use e-cigarettes at Wave 9, past 30-day use of e-

cigarettes at Wave 9, and increased use of e-cigarettes at Wave 10. As seen with Class 3, Class 4 also had higher odds of past 30-day cigar and smokeless use at Wave 9 compared to Class 1.

Strengths of the study include a large, national sample of young adults and a novel approach to examining the influence of nicotine beliefs on key tobacco-related outcomes cross-sectionally and longitudinally. There are however, several limitations to this study. First, the generalizability of the sample is limited by a low cumulative response rate. While this is similar to other health studies that have relied on KnowledgePanel (Fowler et al., 2013; Grande et al., 2013; Kumar et al., 2012; Rhodes et al., 2015) and the prevalence of response to the “nicotine is a cause of cancer” item in this sample is consistent with another national sample, (O’Brien et al., 2017) we acknowledge that this may limit the external validity of our findings. Second, data for this study were collected prior to changes in the e-cigarette market (Allem et al., 2018; Chu et al., 2018; Huang et al., 2019a) and before national public education campaigns were launched to address e-cigarettes (Truth Initiative; U.S. Department of Health and Human Services), which may affect more contemporary responses to the items on nicotine beliefs.

Our previous work highlighted great variability in nicotine and tobacco-related harm perceptions across nicotine beliefs latent classes (Villanti et al., 2019a), though our current study suggests that nicotine beliefs themselves are strongly correlated with susceptibility, curiosity, and use of some tobacco products. Importantly, Classes 3 and 4, who espoused the lowest risk perceptions about nicotine, had the highest prevalence of past 30-day tobacco use and never users in these classes reported the greatest susceptibility to try cigarettes, hookah, and e-cigarettes at Wave 9. These relationships were largely absent at Wave 10. The lack of significant prospective associations between nicotine beliefs and tobacco-related outcomes may be a function of the age of our sample, given other studies showing stronger relationships between harm perceptions and tobacco use in older (age 55+) than young adults (Elton-Marshall et al., 2020). This study provides early evidence in a large U.S. sample, that nicotine beliefs are associated with tobacco-related outcomes. Future work is needed to understand whether or how measures of nicotine beliefs track with measures of nicotine and tobacco product harm perceptions, which one of these is a stronger predictor of tobacco use over time, and whether these relationships differ in countries with different regulatory regimes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGEMENTS

Research reported in this publication was supported by the National Cancer Institute of the National Institutes of Health under Award Number R03CA212694. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

RSN receives funding from the FDA Center for Tobacco Products via contractual mechanisms with Westat and the NIH. Within the past three years, he has served as a paid consultant to the Government of Canada and has received an honorarium for a virtual meeting from Pfizer.

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HIGHLIGHTS

- This study examined the relationship between nicotine beliefs and susceptibility, curiosity, and use of tobacco products.
- Four latent classes of nicotine beliefs characterized the role of nicotine in the health risks of smoking.
- Latent classes were correlated with susceptibility, curiosity, and use of tobacco products in cross-sectional analyses.
- There were few prospective associations with these outcomes, though there were also shifts in nicotine beliefs over time.
- Like tobacco harm perceptions, nicotine beliefs should be assessed to guide tobacco prevention and intervention efforts.

Sociodemographic characteristics of adults aged 18–40 by nicotine beliefs latent class, 2016 ($n = 3122$).

Table 1

Characteristic	Class 1			Class 2			Class 3			Class 4			Total	p-value	
	Large role of nicotine in health risks			Don't know/large role of nicotine in health risks			Small role of nicotine in health risks			None/small role of nicotine in cancer					
	n	Weighted %		n	Weighted %		n	Weighted %		n	Weighted %				(n = 3122; 100%)
(n = 1593; 51.0%)															
Age group															
18–24	407	23.8%		79	23.6%		241	24.0%		62	27.1%		789	24.0%	
25–34	860	56.1%		163	59.3%		585	59.1%		133	56.3%		1741	57.4%	
35–40	326	20.1%		51	17.1%		176	16.9%		39	16.6%		592	18.6%	
Race/ethnicity															
White, non-Hispanic	978	52.4%		167	46.0%		751	69.0%		161	60.0%		2057	57.2%	
Black, non-Hispanic	165	13.1%		39	18.8%		59	9.0%		16	13.4%		279	12.6%	
Other, non-Hispanic	117	8.8%		29	10.5%		74	7.6%		17	6.9%		237	8.5%	
Hispanic	333	25.7%		58	24.8%		118	14.4%		40	19.6%		549	21.8%	
Sex															
Male	555	45.7%		118	48.4%		431	52.4%		129	63.2%		1233	49.2%	
Female	1038	54.3%		175	51.6%		571	47.6%		105	36.8%		1889	50.8%	
Education completed															
Less than high school	69	10.3%		19	11.7%		26	5.7%		7	7.2%		121	8.9%	
High school	294	26.4%		77	34.1%		141	20.4%		39	22.9%		551	25.3%	
Some college or greater	1230	63.3%		197	54.1%		835	73.9%		188	69.8%		2450	65.9%	
Annual household income															
Less than \$10,000	144	12.3%		38	16.9%		57	7.3%		25	15.5%		264	11.6%	
\$10,000–\$24,999	196	15.1%		43	17.4%		125	15.8%		28	14.0%		392	15.5%	
\$25,000–\$49,999	398	26.9%		78	28.0%		214	23.1%		53	23.0%		743	25.6%	
\$50,000–\$99,999	571	31.5%		94	27.4%		393	35.7%		82	32.6%		1140	32.3%	
More than \$100,000	284	14.3%		40	10.3%		213	18.0%		46	14.9%		583	14.9%	

Table 2

Correlations between nicotine beliefs latent class and susceptibility, curiosity, and past 30-day use of tobacco products at Wave 9, 2016.

	Class 1		Class 2		Class 3		Class 4	
	Large role of nicotine in health risks		Don't know/large role of nicotine in health risks		Small role of nicotine in health risks		None/small role of nicotine in cancer	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Susceptibility among never users								
Cigarettes (<i>n</i> = 1657)								
Crude Ref.	0.55	(0.26–1.18)			1.60	(0.98–2.63)	0.77	(0.32–1.86)
Adjusted Ref.	0.51	(0.22–1.17)			2.03	(1.21–3.41)	0.80	(0.29–2.22)
Hookah (<i>n</i> = 2401)								
Crude Ref.	0.58	(0.36–0.94)			1.34	(1.02–1.75)	1.24	(0.78–1.97)
Adjusted Ref.	0.55	(0.33–0.89)			1.43	(1.08–1.89)	1.23	(0.75–2.01)
<i>E</i> -cigarettes (<i>n</i> = 2511)								
Crude Ref.	0.83	(0.51–1.33)			1.40	(1.06–1.84)	1.72	(1.04–2.83)
Adjusted Ref.	0.80	(0.50–1.30)			1.56	(1.18–2.07)	1.71	(1.02–2.86)
Curiosity among never users								
Cigarettes (<i>n</i> = 1653)								
Crude Ref.	1.32	(0.77–2.25)			1.26	(0.88–1.81)	0.98	(0.55–1.74)
Adjusted Ref.	1.26	(0.73–2.19)			1.42	(0.98–2.06)	1.02	(0.54–1.95)
Hookah (<i>n</i> = 2394)								
Crude Ref.	0.64	(0.40–1.03)			1.61	(1.25–2.08)	1.11	(0.69–1.77)
Adjusted Ref.	0.62	(0.38–0.99)			1.69	(1.30–2.20)	1.09	(0.66–1.79)
<i>E</i> -cigarettes (<i>n</i> = 2428)								
Crude Ref.	0.68	(0.39–1.18)			1.56	(1.19–2.06)	1.83	(1.13–2.96)
Adjusted Ref.	0.65	(0.37–1.12)			1.60	(1.20–2.12)	1.73	(1.04–2.86)
Past 30-day use In full sample								
Cigarettes (<i>n</i> = 3111)								
Crude Ref.	0.72	(0.44–1.18)			1.22	(0.92–1.63)	1.50	(0.97–2.30)
Adjusted Ref.	0.61	(0.36–1.03)			1.33	(0.99–1.78)	1.48	(0.91–2.39)
Hookah (<i>n</i> = 3114)								
Crude Ref.	1.04	(0.32–3.36)			1.55	(0.72–3.30)	2.27	(0.79–6.49)

Class 1		Class 2		Class 3		Class 4	
Large role of nicotine in health risks		Don't know/large role of nicotine in health risks		Small role of nicotine in health risks		None/small role of nicotine in cancer	
		OR	95% CI	OR	95% CI	OR	95% CI
Adjusted	Ref.	1.00	(0.29–3.38)	2.20	(1.01–4.83)	2.38	(0.88–6.44)
<i>E</i> -cigarettes (<i>n</i> = 3055)							
Crude	Ref.	0.93	(0.30–2.85)	2.71	(1.58–4.65)	8.50	(4.70–15.4)
Adjusted	Ref.	0.88	(0.27–2.83)	3.37	(1.90–5.99)	9.69	(5.27–17.8)
Cigars (<i>n</i> = 3115)							
Crude	Ref.	1.85	(0.58–3.96)	2.83	(1.35–5.96)	4.65	(1.71–12.7)
Adjusted	Ref.	1.80	(0.57–3.75)	3.13	(1.37–7.18)	4.33	(1.52–12.3)
Little cigars/cigarillos/bidis (<i>n</i> = 3117)							
Crude	Ref.	0.84	(0.33–2.12)	1.44	(0.83–2.50)	1.30	(0.55–3.05)
Adjusted	Ref.	0.67	(0.25–1.75)	1.99	(1.11–3.55)	1.21	(0.45–3.31)
Smokeless tobacco (<i>n</i> = 3116)							
Crude	Ref.	0.077	(0.010–0.59)	1.98	(0.98–4.00)	3.84	(1.30–9.80)
Adjusted	Ref.	0.077	(0.0099–0.61)	2.20	(1.05–4.61)	3.85	(1.49–9.97)

Table 3

Association of nicotine beliefs latent class with susceptibility and curiosity to use tobacco products among never users at Wave 10, 2016.

	Class 1		Class 2		Class 3		Class 4	
	Large role of nicotine in health risks	OR	Don't know/large role of nicotine in health risks	95% CI	Small role of nicotine in health risks	OR	None/small role of nicotine in cancer	95% CI
Cigarettes (<i>n</i> = 3103)								
Crude	Ref.		2.80	(1.50–5.24)	0.90		1.72	(0.60–4.90)
Adjusted	Ref.		2.77	(1.51–5.09)	0.88		1.86	(0.70–4.95)
Hookah (<i>n</i> = 3104)								
Crude	Ref.		1.18	(0.71–1.96)	0.89		1.01	(0.52–1.97)
Adjusted	Ref.		1.10	(0.66–1.84)	0.93		1.00	(0.52–1.95)
E-cigarettes (<i>n</i> = 3104)								
Crude	Ref.		0.81	(0.46–1.43)	0.88		0.96	(0.49–1.90)
Adjusted	Ref.		0.77	(0.43–1.35)	0.96		0.97	(0.47–2.02)
Cigarettes (<i>n</i> = 3094)								
Crude	Ref.		1.13	(0.64–2.02)	1.35		1.02	(0.59–1.75)
Adjusted	Ref.		1.16	(0.66–2.03)	1.37		1.10	(0.63–1.90)
Hookah (<i>n</i> = 3089)								
Crude	Ref.		1.00	(0.62–1.63)	1.05		0.79	(0.44–1.43)
Adjusted	Ref.		0.98	(0.60–1.60)	1.04		0.77	(0.42–1.41)
E-cigarettes (<i>n</i> = 3032)								
Crude	Ref.		0.54	(0.30–0.96)	1.15		0.67	(0.34–1.32)
Adjusted	Ref.		0.49	(0.27–0.90)	1.21		0.68	(0.34–1.36)

Table 4

Association of nicotine beliefs latent class with increased use of tobacco products at Wave 10, 2016 (n = 3122).

	Class 1		Class 2		Class 3		Class 4	
	Large role of nicotine in health risks	Don't know/large role of nicotine in health risks	Small role of nicotine in health risks	None/small role of nicotine in cancer	Small role of nicotine in health risks	None/small role of nicotine in cancer	Small role of nicotine in health risks	None/small role of nicotine in cancer
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Cigarettes								
Crude	Ref.		1.09	(0.70–1.69)	0.97	(0.71–1.33)	1.23	(0.77–1.96)
Adjusted	Ref.		1.02	(0.65–1.61)	1.14	(0.83–1.57)	1.29	(0.79–2.10)
E-cigarettes								
Crude	Ref.		1.36	(0.85–2.19)	1.15	(0.82–1.61)	1.87	(1.14–3.05)
Adjusted	Ref.		1.29	(0.79–2.09)	1.23	(0.87–1.75)	1.86	(1.12–3.07)
Cigars								
Crude	Ref.		0.52	(0.29–0.97)	0.91	(0.64–1.31)	1.45	(0.85–2.49)
Adjusted	Ref.		0.53	(0.28–0.99)	0.85	(0.58–1.23)	1.25	(0.72–2.16)
Little cigars/cigarillos/bidis								
Crude	Ref.		0.95	(0.52–1.75)	1.38	(0.95–2.01)	1.87	(1.05–3.34)
Adjusted	Ref.		0.84	(0.44–1.58)	1.44	(0.98–2.10)	1.69	(0.92–3.08)
Hookah								
Crude	Ref.		0.64	(0.31–1.32)	0.94	(0.63–1.41)	1.03	(0.50–2.12)
Adjusted	Ref.		0.62	(0.30–1.30)	0.99	(0.64–1.51)	0.99	(0.48–2.05)
Smokeless tobacco								
Crude	Ref.		1.52	(0.76–3.04)	1.22	(0.76–1.93)	1.42	(0.61–3.31)
Adjusted	Ref.		1.55	(0.78–3.10)	1.25	(0.77–2.04)	1.34	(0.58–3.10)