Latent Classes of Young Adults Based on Use of Multiple Types of Tobacco and Nicotine Products

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ABSTRACT

Introduction: New tobacco and nicotine products such as snus, hookah, and electronic cigarettes have risen in popularity in recent years. Use of these products among young adults is of particular interest given that experimentation with new products is common in young adulthood.

Methods: We conducted latent class analysis among a population-based sample of young adults to identify separate classes based on use of 6 types of tobacco or nicotine products: snus, hookah, electronic cigarettes, cigarillos, snuff, and cigarettes. We then examined how identified classes differed on demographic characteristics and marijuana and alcohol use.

Results: We identified 5 classes: the largest group (60%) was characterized as reporting no or limited use of any of the products, while the smallest group (7%) was characterized by use of many types of products (poly-users). Of the 3 middle classes, 2 were the same size (10%) and were characterized by primarily using 2 of the products: one class used snus and snuff, and the other used cigarillos and hookah; the third class (13%) was characterized by primarily cigarette smoking. Numerous differences were seen across classes, including the poly-users being less likely to be college students/graduates and more likely to be male and use marijuana and alcohol.

Conclusions: We found that young adults can be grouped into 5 subgroups based on types of tobacco/nicotine products they do and do not use. A poly-use group that uses all types of tobacco products is concerning, particularly given high levels of marijuana and alcohol use reported in this group.

INTRODUCTION

Until recent years, tobacco and nicotine use in the United States was largely limited to use of cigarettes, chewing tobacco, pipes, and cigars. However, other tobacco and nicotine products such as snus, hookah, electronic cigarettes, and cigarillos have risen in popularity in recent years, with these additional products adding to the potential for abuse and addiction. Relatively little is known about the prevalence of use of these new products, and how their use correlates to one another and to use of more traditional tobacco products. Use of these products among young adults is of particular interest given that experimentation with new products is common in young adulthood (Kandel & Logan, 1984) and more available options may increase experimentation and subsequent addiction.

Snus is a porous packet that contains moist tobacco; it is designed to be placed between the gum and cheek similar to traditional chewing tobacco. Snus was introduced into test markets in the United States between 2006 and 2009 by Camel and Marlboro and then launched nationwide in 2009–2010 (Choi & Forster, 2013a). Limited research has examined the prevalence of use of snus among young adults in the United States; most recent estimates for ever use range from 6% to 14.5% and from 3% to 5% for past 30-day use (Choi & Forster, 2013a; Rath, Villanti, Abrams, & Vallone, 2012).

Hookah (also known as waterpipe, shisha, and narghile) is a pipe with a long flexible tube connected to a container of water. It has long been used for tobacco consumption in the Middle East and parts of Asia and more recently has been introduced into western nations. One study showed that daily use of hookah produces a nicotine absorption rate equivalent to smoking 10 cigarettes/day, and a single session of hookah use is equivalent to smoking two cigarettes (Neergaard, Singh, Job, & Montgomery, 2007). Several studies have examined use of hookah among U.S. college students, showing that about one in five students report current hookah use (Grekin & Ayna, 2012). A recent study of young adults (ages 18–34) in the United States found that 8% reported past 30-day hookah use (Rath et al., 2012).

Electronic cigarettes (also known as e-cigarettes or electronic nicotine delivery systems) are battery-operated devices

that look similar to traditional cigarettes but deliver nicotine through a vaporizing process rather than through smoke. The product has been marketed to users of traditional cigarettes as an alternative in settings where smoking is banned, such as indoors or in parks (Cobb, Byron, Abrams, & Shields, 2010; Henningfield & Zaatari, 2010). Little is known about use of e-cigarettes among young adults in the United States. A few recent studies have found estimates of ever use of e-cigarettes at 6%–7% (Choi & Forster, 2013b; Rath et al., 2012).

Cigarillos (Spanish for "little cigar"; also known as blunts or cheroots) represent a middle ground between cigarettes and traditional cigars. While they share a number of similarities to cigarettes (similar size, machine made, filled with shredded tobacco), they use a tobacco or tobacco-based wrapper like a cigar. Historically they were marketed to cigar smokers as a product that could be smoked in a short period of time; more recently, they have been considered a lower price alternative for cigarette smokers as, before federal legislation in 2009, they were taxed as cigars, with a much lower rate than cigarettes (U.S. Government Accountability Office, 2012). Rath et al. (2012) found that 26% of U.S. 18- to 34-year olds had used cigarillos in their lifetime.

While a number of studies have been conducted that seek to classify tobacco users based primarily on their amount and frequency of tobacco use (e.g., Furberg et al., 2005; Storr, Zhou, Liang, & Anthony, 2004; Sutfin, Reboussin, McCoy, & Wolfson, 2009), only a few studies have attempted to create groups of tobacco users based on the types of tobacco products they use. Timberlake (2008) examined nicotine dependence, smoking levels, and alternative types of tobacco (smokeless tobacco, cigars, bidis [thin, hand-rolled cigarettes primarily imported from India and Southeast Asia]) in a sample of regular cigarette smokers using the Ad Health dataset. Descriptive results showed that 43% of men and 23% of women who were regular cigarette smokers had used smokeless tobacco, cigars, or bidis in that past month. Latent class analyses identified one class (among five total classes) that was characterized as light to medium smokers and who also were fairly high users of all three of these alternative tobacco products. This class was the least prevalent of the five classes (with only 4% of the sample), and use of these alternative tobacco products did not appear to vary across the other four classes.

Rigotti, Lee, and Wechsler (2000) examined use of cigarettes, cigars, pipes, smokeless tobacco, and all tobacco products among college students. Overall, cigarettes were far and away the most popular tobacco product used by college students. With 33% of college students reporting current use of any tobacco product, 29% reported current use of cigarettes, 9% for cigars, 4% for smokeless tobacco, and 1% for pipes. Over three quarters used only one product currently, although cigarette users reported using multiple types in the past year, with cigars accounting for the vast majority of other tobacco use.

The goal of the current study is to examine the prevalence and clustering of different tobacco and nicotine products among a population-based sample of young adults. The products include more recently popular items such as snus, hookah, and e-cigarettes and uses latent class analysis to identify subtypes of tobacco users based on types of tobacco or nicotine product used. Finally, associations with a number of demographic characteristics and alcohol and marijuana use are examined. It is hypothesized that cigarettes will be the most prevalent tobacco product used, a number of subtypes of tobacco product users will be identified (including some who do not use traditional cigarettes), and classes will differ in terms of demographic characteristics and other drug use.

METHODS

Data are from the Minnesota Adolescent Community Cohort, a community-based prospective cohort study of youth and young adults in the upper Midwestern United States.

Participants

Participants for this study were selected in 2000–2001 and 2001–2002 through cluster random sampling from geopolitical units (GPUs) in Minnesota and four comparison states (North and South Dakota, Michigan, and Kansas). A combination of probability and quota sampling methods (to assure equal age distribution) was used to recruit participants. Recruitment was conducted by telephone by Clearwater Research, Inc., using modified random digit dial sampling. Households were called to identify those with at least one teenager between the ages of 12 and 16. Of the eligible households, 3,636 participants in Minnesota and 605 participants in comparison states were recruited (recruitment rates of 58.5% and 58.3%, respectively). An additional cohort of 585 twelve-year olds in Minnesota was recruited during 2001–2002 (recruitment rate = 63.6%), resulting in an overall sample of 4,826. Participants were surveyed every 6 months through 2007–2008 (except in 2003–2004 due to a gap in funding) and then annually between 2008 and 2011 (full details of the study design are included in Forster, Chen, Perry, Oswald, & Willmorth, 2011). Participants who completed round 21 (data collected between October 2010 and March 2011; $n = 2,624$; response rate = 68.9% of the original cohort) were included in the analysis. Participants at this round were between the ages of 20 and 27 ($M = 23.6$).

Comparison at baseline of study participants with those who dropped out of the study shows that those who dropped out are more likely to be male ($\chi^2 = 10.7$; $p = .001$), non-White ($\chi^2 = 87.2$; $p < .0001$), and past 30-day smokers ($\chi^2 = 35.5$; $p < .0001$), but no differences were seen in use of chewing tobacco. Logistic regression analyses show that difference in past 30-day smoking remained after controlling for age, gender, and ethnicity. We were unable to compare the dropouts with our participants for other tobacco and nicotine products (snus, electronic cigarettes, cigarillos, and hookah) because these substances were not included on the baseline survey.

The University of Minnesota Institutional Review Board approved this study. Participants provided active consent before completing the interview and were provided $25 for completing the survey.

Measures

The survey included a large number of tobacco-related items as well as demographic and individual characteristics and other drug use items. Below, we describe the subset of tobacco-related items included to define the latent classes, as well as other demographic and drug use variables tested as potential correlates of class.

Tobacco-Related Items
We used six measures from the survey to characterize various types of tobacco (or nicotine) use among young adults.

Latent classes of young adults

Cigarette use was measured with the item "Thinking about the last 30 days, on how many of those did you smoke a cigarette, even one or two puffs?" with an open-ended response ranging from 0 to 30. We recoded this response into a dichotomized item where 0 was no days with reported cigarette use in the past 30 days and 1 was at least 1 day with reported cigarette use in the past 30 days. The other five types of products were measured as "ever use" with *yes* = 1 and *no* = 0 (don't know and missing responses, which were rare, were treated as missing). Chewing tobacco was measured with the item "Have you ever used any of the following loose tobacco products, such as chewing tobacco, snuff, or dip?". Snus use was measured based on two survey items—a lead-in question: "Have you heard of snus, a tobacco product that is chewing tobacco in a little white pouch to be put between your gum and cheek (such as Camel Snus)?" If respondents answered "yes," they received a follow-up question: "Have you ever used snus?" Similarly, electronic cigarette use was measured based on two survey questions—"Have you heard of an E-cigarette or electronic cigarette, a cigarette-looking device that delivers nicotine vapor when you puff it?". If respondents answered "yes," they received the follow-up question: "Have you ever used electronic cigarettes?". Hookah use was measured by one survey item "Have you ever smoked tobacco in a hookah or waterpipe?", as was cigarillo use, "Have you ever used cigarillos or little cigars?".

Demographics

We used four demographic variables from the survey. Sex was determined during recruitment for the first baseline survey (male vs. female). Race and ethnicity were measured with the survey item "Which of the following do you consider yourself to be?" (response options: African American or Black, American Indian or Alaskan Native, Asian, Hispanic or Latino, White, "Something else"). Because of distributional limitations of the sample, these variables were recoded into a dichotomous variable where 1 = *White* and 0 = *all others*. Education was measured using several survey items pertaining to current student status and highest education level completed. Responses from these items were recoded into a dichotomous variable where 1 = *4-year college graduates or current 4-year college students* and 0 = *all others*. Age (measured in years) was dichotomized using the median (<24, ≥24) as the cut point.

Other Drug Use

Marijuana use was measured based on two survey items— a lead-in question: "Have you ever used marijuana?" with respondents who answered "yes" getting a follow-up question, "In the past 30 days, how many times did you use marijuana?". This second question had an open-ended response that we recoded into a dichotomized item where 0 was *no past 30-day use* and 1 was *some use in the past 30 days* ("no" responses from the lead-in question were recoded as 0 ["no use"]; all don't know responses were coded as missing).

We measured binge alcohol use from the survey item "How many times over the last 2 weeks have you had five or more drinks in a row?" This was an open-ended response that was considerably skewed so we recoded it as a dichotomized item where 0 was *no binge drinking* and 1 was *at least one incident of binge drinking in the 2 weeks*.

Analytic Strategy

Following descriptive analyses, a series of independently estimated latent class analyses were used to characterize groups of young adults based on patterns of use of traditional and new tobacco/nicotine products. Six dichotomous items were used to define the latent classes. A series of models were estimated with number of classes ranging from 2 to 6. We used a number of recommended criteria (Collins & Lanza, 2010) to facilitate model choice, including the information criteria (Akaike's information criterion, Bayesian information criteria [BIC]), homogeneity, separation, average posterior probabilities, class size, and interpretability/consistency with theory.

Following estimation of an optimal number of classes, a set of analyses was conducted to examine potential correlates of class. Each individual was assigned to a specific class based on the largest probability from the retained latent class model. We first conducted bivariate analyses to assess independent effects between class membership and correlates (demographic and other drug use variables). Variables significantly associated with class ($p < .05$) were then examined simultaneously in a multivariable multinomial logistic regression. All analyses were conducted using SAS v9.2 (SAS Institute, 2009).

RESULTS

Among our sample, about half were males, 89% were White, and 63% were 4-year college students or graduates (Table 1). Over half (59%) of our participants reported ever smoking cigarettes and 19% reported ever using chew/snuff. Among the newer tobacco/nicotine products, 34% reported ever using hookah, 30% ever used cigarillos, 15% ever used snus, and 7% ever used electronic cigarettes (Table 1).

In our latent class analyses of the six measures of tobacco/nicotine products, we took into consideration all criteria and chose the five-class model as the best model. The BIC of the four-class solution was slightly lower than five-class; however, considering separation, homogeneity, and theory and interpretability, the five-class model was deemed more suitable. Among the five classes (Table 2), the largest group (60%) was characterized as reporting no or little use of any of the products, while the smallest group (7%) was characterized by use of many types of products ("poly-users"). Of the three other classes, two were the same size (10%) and were characterized by use of primarily two of the products: one class used snus and snuff, and the other used cigarillos and hookah. Finally, 13% were in a class characterized by primarily smoking cigarettes only. The overall media posterior probabilities for the five-class model was 92% and the median posterior probabilities by class were Class 1 = 99%, Class 2 = 74%, Class 3 = 88%, Class 4 = 71%, and Class 5 = 75%.

In bivariate analyses, we found that all four demographic variables were significantly associated with tobacco/nicotine class (Table 3). The poly-user group was more likely to be male and younger, and those in the no/limited use and cigarette smoker groups were more likely to be female. Members of the cigarette smoker group were least likely to be college students/ graduates. Members of the poly-user group were more likely than other groups to report past-month marijuana use and binge drinking in past 2 weeks (Table 3). In multivariable logistic regression using Class 1 as the reference group (Table 4), we

found that members in Class 2 (snuff/snus), Class 3 (cigarillos/hookah), and Class 5 (poly-users) were more likely to be male (vs. female). Members in Class 3 (cigarillos and hookah) and Class 5 (poly-users) were more likely to be under 24 (vs. ≥24) compared to Class 1. In terms of other drug use, members in Classes 2–5 were more likely than those in Class 1 to be marijuana users and alcohol users.

CONCLUSIONS

The current analyses confirm previous findings and provide a number of new and intriguing results. Consistent with previous research, a majority of the young people in the sample report no/limited current tobacco use, and our latent class model combined these into the largest class (60%). The remaining 40%

report at least some lifetime tobacco/nicotine use and were roughly equally spread across four latent classes. The largest of these four other classes is primarily a traditional cigarette smoker class, with virtually everyone in this class reporting past 30-day use of cigarettes. Other tobacco products were not heavily used, particularly the smokeless snuff and snus. Snus and snuff users were grouped together into a class, as were hookah and cigarillos users, and each of these classes included about 10% of young adults. The snus and snuff class reported a modest amount of current cigarette use and lifetime hookah and cigarillos use, whereas the hookah and cigarillos class reported very little use of other tobacco/nicotine products. Finally, the smallest class, labeled poly-users, included approximately 7% of young adults and was clearly characterized by the use of almost all tobacco/nicotine products, with the highest response probabilities of any of the classes for snus, e-cigarettes, and hookah and high levels of use of all other products.

There were a number of notable demographic and substance use differences between the classes. Sex differences were striking across a number of the classes. Not surprisingly, the no/limited user class and the traditional cigarette smoker class were more likely to include women and the snus and snuff class and the poly-user class had higher proportions of men. This finding is consistent with a large body of research that has shown that men are more likely than women use snuff and snus (Choi & Forster, 2013a; Substance Abuse and Mental Health Services Administration, 2012) and the combination of cigarettes and smokeless products (Rath et al., 2012). Ethnic minorities, although of limited sample size in the current study, were more likely to be in the no/limited user and cigarette smoker classes. College attendees and graduates were more likely to be in the nonuser and hookah and cigarillos classes. Although the age range in our sample was limited (ages 21–27), the poly-user and cigarillos/hookah classes were more likely to have younger members, perhaps reflecting that younger adults may be more willing and interested in trying a variety of new products such as hookah and e-cigarettes.

A number of other substance use differences are seen between classes of tobacco/nicotine use. Past 30-day marijuana use is significantly associated with class, with the highest rates of marijuana use seen among the poly-users (49%), the hookah and cigarillo users (25%), and cigarette smokers (22%). After adjusting for other covariates and predictors in the multivariate model, marijuana use is significantly higher in all four tobacco use classes compared to the no/limited use class. Other studies have found tobacco and marijuana use to be positively associated among youth (Centers for Disease Control and Prevention [CDC], 2008; Leatherdale, Hammond, Kaiserman,

Table 1. Descriptive Statistics (*n* = 2,624)

	Percentage of sample	
Demographics		
Sex (male)	47	
Age		
20	0.3	
21	13	
22	18	
23	18	
24	17	
25	17	
26	17	
27	0.4	
Ethnicity (White)	89	
4-Year college (student or graduate)	63	
	Past 30 days	Ever
Tobacco use		
Cigarettes	24	59
Snuff/chew	6	19
Snus	3	15
E-cigs	1	7
Hookah	4	34
Cigarillos/little cigars	5	30
Other substance use		
Marijuana	13	40
Alcohol		
Any use	83	
Binge use (5+ drinks)	38[a]	

[a]Past 2 weeks.

Table 2. Five-Class Model: Parameter Estimates (Item-Response Probabilities)

	Class 1: 60% (*n* = 1,574)	Class 2: 10% (*n* = 265)	Class 3: 10% (*n* = 269)	Class 4: 13% (*n* = 331)	Class 5: 7% (*n* = 185)
	No/limited use	Snuff/snus	Cigarillos and hookah	Cigarette smokers	Poly-users
Cigarettes: past 30 days	.050	.331	.150	.967	.819
Snuff/chew: ever	.030	.885	.105	.008	.801
Snus: ever	.011	.660	.036	.056	.775
E-cigs: ever	.009	.035	.041	.281	.379
Hookah: ever	.179	.407	.771	.419	.810
Cigarillos/little cigars: ever	.064	.587	.884	.322	.808

Table 3. Bivariate Associations Between Class Membership and Demographics/Other Substances (*n* = 2,624)

	Class 1: no/limited use	Class 2: snuff/snus	Class 3: cigarillos/ hookah	Class 4: cigarette smokers	Class 5: poly-users	χ^2 (*p*), *df* = 4
	60% (*n* = 1,574)	10% (*n* = 265)	10% (*n* = 269)	13% (*n* = 331)	7% (*n* = 185)	
Demographics						
Sex (% male)	37%	86%	57%	34%	89%	384 (<.0001)
Age (≥24)	53%	58%	43%	50%	38%	27.4 (<.0001)
Ethnicity (% White)	89%	95%	91%	86%	95%	21.5 (.0002)
4-year college (graduate/student)	69%	58%	71%	34%	49%	153 (<.0001)
Other substances						
Marijuana: past 30 days	5%	16%	25%	22%	49%	366 (<.0001)
Binge: past 2 weeks	26%	64%	48%	46%	74%	303 (<.0001)

Table 4. Multivariate Model: Class Membership and Demographics/Other Substances (*n* = 2,624)

	Class 1: no/ limited use	Class 2: snuff/snus	Class 3: cigarillos and hookah	Class 4: cigarette smokers	Class 5: poly-users
		OR (95% CI)			
Demographics					
Sex (% male)	Reference	7.8 (5.4–12)*	1.9 (1.5–2.6)*	0.67 (0.50–0.90)*	8.1 (4.9–13)*
Age (≥24)	Reference	1.3 (0.96–1.7)	0.67 (0.50–0.88)*	0.97 (0.75–1.3)	0.57 (0.39–0.82)*
Ethnicity (% White)	Reference	2.8 (1.4–5.6)*	1.3 (0.79–2.0)	0.91 (0.61–1.4)	2.4 (1.1–5.1)*
4-year college (graduate/student)	Reference	0.57 (0.42–0.77)*	1.0 (0.76–1.4)	0.20 (0.15–0.26)*	0.37 (0.26–0.54)*
Other substances					
Marijuana: past 30 days	Reference	2.6 (1.7–4.1)*	5.4 (3.7–7.9)*	5.8 (4.0–8.5)*	14 (8.9–21)*
Binge: past 2 weeks	Reference	3.8 (2.8–5.1)*	2.0 (1.5–2.7)*	2.8 (2.1–3.8)*	5.0 (3.4–7.5)*

*p < .05.

& Ahmed, 2007). One explanation is that these substances share common risk factors. It could also be the case that there is a causal link although the exact nature of the link (e.g., gateway hypothesis, stage theory, and reciprocal relation) and the causal mechanism (e.g., shared genetics, peer influences, and availability) is still unclear (Agrawal & Lynskey, 2009; Timberlake et al., 2007; Vega & Gil, 2005). These results are consistent with two additional hypotheses. One, the highest rates of marijuana use are seen in the two classes that include elevated rates of hookah and cigarillo use. These tobacco products share certain aspects with marijuana. Hookah gets its name from the waterpipe used to smoke the tobacco or shisha, and water pipes (often referred to as bongs in marijuana culture) are commonly used for smoking marijuana. Also, cigarillos are becoming more popular as smoking vessels for marijuana; the shredded tobacco is removed from the cigarillos and replaced with marijuana to create what is commonly referred to as a blunt. This has become so popular in certain demographics that cigarillos manufacturers are now packaging and selling just the wrappers. These results are also consistent with findings showing a stronger link between use of inhaled tobacco and cannabis than between smokeless tobacco use and cannabis (Agrawal & Lynskey, 2009).

Although binge drinking is also associated with the tobacco/nicotine use classes, a slightly different pattern exists than that seen with marijuana. Poly-users are still the most likely to report binge drinking, but the next most likely class to report

binge drinking is the snus and snuff class. Even after adjusting for a large sex effect, this association remains significant. Those in the hookah and cigarillo use class, although more likely to report binge drinking than the nonusers, are the least likely of the tobacco/nicotine use classes to report binge drinking.

One of the major implications of these findings is for tobacco use prevention. Models that measure unobserved heterogeneity are particularly useful for identifying subgroups for message tailoring or market segmentation. A clear outcome of these results is that prevention efforts targeting young adults cannot just focus on cigarettes. A large number of young adult tobacco/nicotine users are using products other than and in addition to cigarettes, and traditional prevention efforts may not work as well for these individuals. There are a fair number of young men, for example, who are either predominantly smokeless users or poly-users. By using only cigarette smoking to identify those at risk, we may lose the opportunity to influence smokeless users. Similarly, focusing only on cigarette smoking in prevention and intervention programs may underutilize these efforts. The poly-users are also a particularly concerning subgroup as they show such elevated levels of use for all types of tobacco/nicotine products, which may indicate severe nicotine addiction, as well as marijuana use and binge use of alcohol.

This study has a number of limitations. First, the sample is a Midwestern sample predominantly from a single state and thus may not be generalizable to the entire U.S. young adult

population. Second, these data came from round 21 (approximately 10 years from the beginning) of a longitudinal cohort study. At this point, there was 31% attrition, and this may limit the generalizability of the findings. Analyses comparing those still in the study at round 21 to those who had dropped out of the study do show differences, with males, non-Whites, and smokers more likely to drop out. It is unknown if these differences affect the composition of the classes but almost certainly lead to an underestimate of the prevalences of tobacco/nicotine use classes. It is unknown if attrition is differentially associated with specific classes. Third, other than cigarettes, the tobacco/nicotine use measures were limited, with only lifetime use available for these other products. Although these data were collected quite recently (2010–2011), it is possible that some of the newer substances, particularly e-cigarettes, may have become more popular in last 2 years, as seen in the recent quick uptick in e-cigarette use among youth in 2011–2012 (CDC, 2013). Fourth, although these data come from a longitudinal cohort study, the current analyses used data from one round and were therefore cross-sectional. Finally, participants were assigned to their most likely class and these class assignments were used in the conditional regression models. This treats all individuals as having the same probability of being in the class, when in actuality the posterior probabilities vary a bit across individuals. Although this approach could bias estimates, examination of the posterior probabilities shows relatively high posteriors and this approach simplifies interpretation.

Despite these limitations, the current study provides important data on the prevalence among young adults of newer tobacco and nicotine products and specific use patterns of these products. Young adults can be grouped into five subgroups based on the types of tobacco/nicotine products they do and do not use. Smokeless types of tobacco cluster together, as do hookah and cigarillos. The prevalence of e-cigarettes, a nontobacco nicotine product, has overall low prevalence and does not appear to cluster with the other products. A poly-use group that uses all types of tobacco/nicotine products is concerning, particularly given the high levels of marijuana and binge drinking reported in this group.

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REFERENCES

Agrawal, A., & Lynskey, M. T. (2009). Tobacco and cannabis co-occurrence: Does route of administration matter? *Drug and Alcohol Dependence*, *99*, 240–247. doi:10.1016/j.drugalcdep.2008.08.007

Centers for Disease Control and Prevention (CDC). (2008). Youth risk behavior surveillance—United States, 2007. *Morbidity and Mortality Weekly Report*, *57*, 1–131.

CDC. (2013). Notes from the field: Electronic cigarette use among middle and high school students—United States, 2011–2012. *Morbidity and Mortality Weekly Report*, *62*, 729–730.

Choi, K., & Forster, J. L. (2013a). Awareness, perceptions and use of snus among young adults from the upper Midwest region of the USA. *Tobacco Control*, *22*, 412–417. Retrieved from http://tobaccocontrol.bmj.com/content/early/2012/07/19/tobaccocontrol-2011-050383.full. doi:tobaccocontrol-2011-050383

Choi, K., & Forster, J. L. (2013b). Characteristics associated with awareness, perceptions, and use of electronic nicotine delivery systems among young US Midwestern adults. *American Journal of Public Health*, *103*, 556–561. doi:10.2105/ajph.2012.300947

Cobb, N. K., Byron, M. J., Abrams, D. B., & Shields, P. G. (2010). Novel nicotine delivery systems and public health: The rise of the "e-cigarette". *American Journal of Public Health*, *100*, 2340–2342. doi:10.2105/ajph.2010.199281

Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences*. New York, NY: John Wiley & Sons, Inc.

Forster, J., Chen, V., Perry, C., Oswald, J., & Willmorth, M. (2011). The Minnesota Adolescent Community Cohort Study: Design and baseline results. *Prevention Science*, *12*, 201–210. doi:10.1007/s11121-011-0205-x

Furberg, H., Sullivan, P. F., Maes, H., Prescott, C. A., Lerman, C., Bulik, C., & Kendler, K. S. (2005). The types of regular cigarette smokers: A latent class analysis. *Nicotine & Tobacco Research*, *7*, 351–360. doi:10.1080/14622200500124917

Grekin, E. R., & Ayna, D. (2012). Waterpipe smoking among college students in the United States: A review of the literature. *Journal of American College Health*, *60*, 244–249. doi:10.1080/07448481.2011.589419

Henningfield, J. E., & Zaatari, G. S. (2010). Electronic nicotine delivery systems: Emerging science foundation for policy. *Tobacco Control*, *19*, 89–90. doi:10.1136/tc.2009.035279

Kandel, D. B., & Logan, J. A. (1984). Patterns of drug use from adolescence to young adulthood: I. Periods of risk for initiation, continued use, and discontinuation. *American Journal of Public Health*, *74*, 660–666. doi:10.2105/ajph.74.7.660

Leatherdale, S. T., Hammond, D. G., Kaiserman, M., & Ahmed, R. (2007). Marijuana and tobacco use among young adults in Canada: Are they smoking what we think they are smoking? *Cancer Causes & Control*, *18*, 391–397. doi:10.1007/s10552-006-0103-x

Neergaard, J., Singh, P., Job, J., & Montgomery, S. (2007). Waterpipe smoking and nicotine exposure: A review of the current evidence. *Nicotine & Tobacco Research*, *9*, 987–994. doi:10.1080/14622200701591591

Rath, J. M., Villanti, A. C., Abrams, D. B., & Vallone, D. M. (2012). Patterns of tobacco use and dual use in US young adults: The missing link between youth prevention and adult cessation. *Journal of Environmental and Public Health*, Article ID 679134. doi:10.1155/2012/679134

Rigotti, N. A., Lee, J. E., & Wechsler, H. (2000). US college students' use of tobacco products—Results of a national survey. *Journal of the American Medical Association*, *284*, 699–705. doi:10.1001/jama.284.6.699

SAS Institute. (2009). *SAS/STAT 9.2 user's guide* (2nd ed.). Cary, NC: SAS Institute, Inc.

Storr, C. L., Zhou, H. L., Liang, K. Y., & Anthony, J. C. (2004). Empirically derived latent classes of tobacco dependence syndromes observed in recent-onset tobacco smokers:

Epidemiological evidence from a national probability sample survey. *Nicotine & Tobacco Research*, *6*, 533–545. doi:10.1080/14622200410001696493

Substance Abuse and Mental Health Services Administration. (2012). *Results from the 2011 National Survey on Drug Use and Health: Summary of National Findings*. NSDUH Series H-44, HHS Publication No. (SMA) 12-4713. Rockville, MD: Author.

Sutfin, E. L., Reboussin, B. A., McCoy, T. P., & Wolfson, M. (2009). Are college student smokers really a homogeneous group? A latent class analysis of college student smokers. *Nicotine & Tobacco Research*, *11*, 444–454. doi:10.1093/ntr/ntp006

Timberlake, D. S. (2008). A latent class analysis of nicotine-dependence criteria and use of alternate tobacco. *Journal of Studies on Alcohol and Drugs*, *69*, 709–717.

Timberlake, D. S., Haberstick, B. C., Hopfer, C. J., Bricker, J., Sakai, J. T., Lessem, J. M., & Hewitt, J. K. (2007). Progression from marijuana use to daily smoking and nicotine dependence in a national sample of US adolescents. *Drug and Alcohol Dependence*, *88*, 272–281. doi:10.1016/j.drugalcdep.2006.11.005

U.S. Government Accountability Office. (2012). *Large disparities in rates for smoking products trigger significant market shifts to avoid higher taxes*. GAO-12-475. Washington, DC: Author.

Vega, W. A., & Gil, A. G. (2005). Revisiting drug progression: Long-range effects of early tobacco use. *Addiction (Abingdon, England)*, *100*, 1358–1369. doi:10.1111/j.1360-0443.2005.01141.x