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Prevalence and correlates of hookah use: a nationally representative sample of United States adults ages 18 to 40 years old

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Abstract

Background—Hookah use may be increasing among adults in the United States. Information on the prevalence and correlates of hookah use in the adult population is relatively limited.

Objectives—To determine the prevalence of current (past 30-day) and lifetime use of hookah among adults ages 18–40 in the United States, and to investigate the socio-demographic characteristics associated with lifetime use.

Methods—Data were drawn from the Tobacco Use Supplement of the Current Population Survey data from May 2010, August 2010, and January 2011 (n=85,545). Logistic regression was used to examine various demographic correlates of lifetime hookah use.

Results—Among 18–40 year olds, the past-month prevalence rate of hookah use was 0.6% and the lifetime prevalence rate of hookah use was 3.9%. Being male, non-Hispanic White, having higher levels of educational attainment, having never been married, not having any children, earning less than \$20,000 annually, residing in the Midwest or Western United States, being a student, and being a cigarette smoker were associated with increased likelihood of lifetime hookah use. The prevalence of hookah use among current, non-daily cigarette smokers was 10.7%, more than double that of the general adult population.

Conclusions—Hookah use is significantly more common among cigarette smokers and among various demographic sub-groups of the general adult population. Given the risks associated with hookah and poly-tobacco use, targeted public health efforts are recommended. Additionally, healthcare providers may consider expanding screening tests to include hookah use.

Keywords

Hookah use; water pipe tobacco smoking; prevalence rate; epidemiology

1. Introduction

Hookah use is growing in popularity in United States (US), particularly among young persons (Centers for Disease Control and Prevention, 2014; Maziak, 2011). The past-year prevalence of hookah use among twelfth grade students in the US has increased from 17.1% in 2010 to 21.4% in 2013, with a 3.1% increase from 2012–2013 alone (Johnston, O'Malley, Bachman, & Schulenberg, 2013). Similar results were found in a representative sample of US high school students (Palamar, Zhou, Sherman, & Weitzman, 2014) as well as in samples of undergraduate students (Erika Dugas, O'Loughlin, Low, Wellman, & O'Loughlin, 2013; Eissenberg, Ward, Smith-Simone, & Maziak, 2008; Primack et al., 2008). Some suggest that the rise in hookah use is due to the lower cost and greater accessibility of hookah products (Primack et al., 2012; Smith et al., 2011), compared with cigarettes, as well as the false perception that hookah use is less harmful than cigarette smoking (Daniels & Roman, 2013; Jacob et al., 2013; Nuzzo et al., 2013).

However, hookah use, like cigarette use, has been linked with several physical health problems (Maziak, 2011). Hookah use has been associated with increased risk of leukemia (Jacob et al., 2013), gastric cancer (Gunaide et al., 1995; Shakeri et al., 2013), esophageal cancer (Nasrollahzadeh et al., 2008) and pulmonary (Boskabady, Farhang, Mahmodinia, Boskabady, & Heydari, 2012) and cardiovascular dysfunction (Hakim et al., 2011). The ancillary risks of hookah use are also notable. The risk of secondhand smoke is considerable given that hookah is traditionally smoked in tight and enclosed spaces, such as hookah cafés and private homes (WHO study group on tobacco product regulation, 2005). Further, because users share a single mouthpiece, there is an increased chance of contracting an orally transmitted disease, such as tuberculosis, herpes, and hepatitis (Munckhof, Konstantinos, Wamsley, Mortlock, & Gilpin, 2003; Salem & Sami, 1974). In addition to the physical health risks, hookah use has been linked with other substance use, including cigarettes (Goodwin et al., 2014), alcohol (E. Dugas, Tremblay, Low, Cournoyer, & O'Loughlin, 2010), and marijuana (Fielder, Carey, & Carey, 2012).

Despite the rise in hookah use and its known risks, there is scant research on the correlates of hookah use in the general adult population. What is known about the correlates of hookah use come mainly from convenience samples (Daniels & Roman, 2013; Jarrett, Blosnich, Tworek, & Horn, 2012; Linde et al., 2015; Smith et al., 2011) or representative samples of adolescents (Amrock, Gordon, Zelikoff, & Weitzman, 2014), high school students (Palamar et al., 2014), and college students (Chen & Loukas, 2015; Montgomery et al., 2015). However, findings from these studies cannot be generalized to the overall adult population – additionally because a large minority of US high school students fail to complete high school, and of those who receive a high school degree, a smaller percentage enroll in university and earn a college degree (Chapman, Laird, Ifill, & KewalRamani, 2011). Among the studies that have used adult samples, most have not included a number of potentially relevant covariates, such as labor force participation, student status, and specific race-ethnicity categories (McMillen, Maduka, & Winickoff, 2012), or were limited in sample size and therefore could not provide reliable estimates (Lariscy et al., 2013). The advantage of the current dataset, relative to those in previous studies (B. A. King, Dube, & Tynan, 2012; Lariscy et al., 2013; McMillen et al., 2012), is the large size at 85,545 observations, thereby

allowing for a more precise, fine-grained analysis of hookah use across several sub-groups in the population.

The current study used a nationally representative sample of adults in the US to address three goals. First, we investigated the past-month and lifetime prevalence of hookah use among adults aged 18–85 years old in the US; then, we specifically examined the prevalence of these practices among 18–40 year olds, a subgroup with the highest prevalence of hookah use. Second, we examined the socio-demographic characteristics associated with lifetime and past-month hookah use among 18–40 year olds. Third, we examined the relationship between cigarette smoking and hookah use, controlling for demographic variables. Examining this relationship is valuable given that previous studies have found that the pattern of use for cigarette smoking is different from that of hookah use.

2. Materials and Methods

2.1. Sample

The Current Population Survey (CPS) is a monthly telephone survey of approximately 50,000 randomly selected households in the US conducted by the Bureau of Census for the Bureau of Labor Statistics. The goal of the survey is to collect up-to-date information on the employment rate, labor force activities, and demographic characteristics of persons in the US (M. King et al., 2010). The CPS is a rotating panel design; households are interviewed once a month for four consecutive months (panels #1 – #4). After the fourth interview, there is an 8-month dormant period in which households are not contacted. After the 8-month dormant period, households are re-interviewed for an additional 4 months (panels #5 – #8). There are eight interviews, or panels, in total.

In the years in which it is administered, the Tobacco Use Supplement (TUS-CPS) is administered three times a year to different randomly selected subsamples of the CPS. The TUS-CPS, sponsored by the National Cancer Institute, was developed to track trends in tobacco use over time including types and amount of tobacco used, intentions and attempts to quit, cost of tobacco products by state, and to obtain data on people's attitudes about smoke-free policies in the US (US Department of Commerce, 2011). This study used TUS-CPS data from May 2010, August 2010, and January 2011. The total number of observations with valid tobacco use data in these three TUS-CPS samples is 224,837. The response rate for the 2011 TUS was 81.6% (since eligibility to participate in the TUS is dependent on the completion of the CPS, the response rate was calculated as the percentage of persons who completed the TUS over those who completed the CPS) (US Department of Commerce, 2011). The study focused on individuals between the ages of 18–40 years old, thereby reducing the final sample to 85,545.

The current dataset comprises a series of cross-sectional surveys of the Tobacco Use Supplement to the Current Population Survey. While the CPS has a panel design, the TUS was administered only once to each respondent in the Supplements we use. This design eliminates the possibility of duplicate survey data entries from the same individual or household (United States Department of Commerce, 2014).

2.2. Measures

2.2.1. Hookah Use—Hookah use was measured with two items on the TUS-CPS (US Department of Commerce, 2011). (1) “*Have you ever tried smoking tobacco in a water pipe in your entire life, even one or two puffs?*” Responses were either *yes* or *no*. (2) “*During the past 30 days, on how many days did you smoke tobacco in a water pipe?*” Responses ranged from “none” to 30. The past 30 days variable was created into a dichotomous variable, 0=no and 1=one or more days in the past month.

2.2.2. Cigarette Smoking—Two questions from the TUS-CPS were used to determine whether a respondent was a current cigarette smoker: (1) “*Have you smoked at least 100 cigarettes in your entire life?*” and (2) “*Do you now smoke cigarettes every day, some days, or not at all?*” If the respondent answered in the affirmative to the first question, then he/she was asked the second question. Respondents who reported smoking cigarettes *every day* or *some days* were identified as “daily” and “non-daily” cigarette smokers, respectively (Based on the survey documentation, individuals who endorsed smoking cigarettes “some days” were asked, “*On how many of the past 30 days did you smoke cigarettes?*” Thus, “*do you now smoke cigarettes?*” was operationalized as smoking cigarettes in the past 30 days). “Some day” or “non-daily smokers” was defined as having smoked at least one cigarette in the past 30 days. Collectively, “daily” and “non-daily” cigarette smokers were identified as “*current cigarette smokers.*” Respondents who reported to have never smoked or reported smoking 0 cigarettes were identified as “never” cigarette smokers.

2.2.3. Geographic region—Respondents were given the following options when providing their current geographic information in the US: *Northeast, Midwest, South, or West.*

2.2.4. Number of own children in household under 18 years of age—The variable was recorded as: 0 children, 1 to 2 children, and 3 or more children.

2.2.5. Current student status—Current student status was measured with, “*Are you enrolled in school as a full-time or part-time student?*” This question was valid whether the respondent was enrolled in high school, college, or university. Respondents who responded in the affirmative were classified as students.

2.2.6. Current employment status—Employment status was measured with the following question: “*last week, did you have a job either full or part-time?*” The options included 1=*yes*, 2=*no*, 3=*retired*, 4=*disabled*, and 5=*unable to work*. The variable was recoded as 1=*employed* (full or part-time), 2=*unemployed but in the labor force*, and 3=*not in labor force due to disability, retirement, or not being able to work*.

2.2.7. Family income—Family income refers to the “*combined income of all family members during the last 12 months, [including] money from jobs, net income from business, far or rent, pensions, dividends, interest, social security payments, and any other money income received by family members who are 15 years of age or older.*” The variable was

recoded as *family income less than \$19,999, \$20,000-\$39,999, \$40,000-\$74,999, and \$75,000 or more.*

2.2.8. Demographics—Respondents reported on demographic information including sex, age, race, highest educational level attained, and marital status.

2.3. Analytic Strategy

We first analyze the proportion of different groups between lifetime and current hookah users. The groups are defined by age in table A.1 and by socio-demographic characteristics in table A.3. We also calculate the proportion of different socio-demographic groups among lifetime and current hookah users in table A.2. Also in table A.2, we calculate Wald tests of whether the differences in socio-demographic characteristics between lifetime hookah users and lifetime non-users are statistically significant. Tests were two-tailed and significance was set at <0.05 . In table A.5, multiple logistic regression analyses were used to determine the relationship between each socio-demographic characteristic (sex, race-ethnicity, marital status, highest level of education, geographic location, number of children in the household, student status, employment status, family income, and cigarette smoking status) and hookah use, first without adjustment and then adjusting for all other socio-demographic characteristics. Data were weighted using the sampling weights provided by the TUS. Standard errors were calculated that were robust to heteroscedasticity, using the survey commands in Stata 13 (StataCorp, 2013).

3. Results

3.1. Prevalence of lifetime and past-month hookah use by different age groups

The prevalence of lifetime and past-month hookah use were greatest among 18–25 year olds and 26–40 year olds. The lifetime prevalence among 18–25 year olds and 26–40 year olds were 5.59% and 2.98%, respectively. The past-month prevalence among 18–25 year olds and 26–40 year olds were 1.10% and 0.28%, respectively. The prevalence dropped significantly after the age of 40; thus, the sample was restricted to 18–40 year olds.

3.2. Prevalence of lifetime and past-month hookah use among 18–40 and 18–85 year olds

The overall lifetime prevalence of hookah use among adults aged 18–85 was 2.1%. For adults 18–40 years old, the lifetime prevalence of hookah use was 3.9%. The past-month prevalence of hookah use was 0.25% among all adults aged 18–85 years and 0.6% among those 18–40 years old.

Due to the very low prevalence of current hookah among adults, only the correlates of lifetime hookah use were examined, as detailed below.

3.3. Socio-demographic characteristics associated with lifetime hookah use

We found a higher proportion of males (63.1%), non-Hispanic Whites (76.3%), persons who have never been married (70.0%), persons with at least a college education (38.8%), persons who reside in the western US (37.9%), persons without children (81.7%), and persons who are currently employed (75.3%) among lifetime hookah users than among lifetime non-

hookah users. Further, 22.1% of lifetime hookah users are also daily cigarette smokers compared 11.9% of lifetime non-hookah users. Lifetime hookah use was not significantly associated with family income or student status (See Table A.2).

3.4. Frequency of hookah use among lifetime users in the past 30 days

Among lifetime users, 80.93% used hookah one to five days in the month. The prevalence drops significantly after 5 days. However, there is a relative increase in frequency of use for 26–30 days; 6.37% of lifetime users smoked hookah 26 to 30 days in the past month.

3.5. Prevalence of lifetime and current hookah use among 18–40 year olds in the US

Among 18–40 year olds, the prevalence of lifetime hookah use was higher among males (5.0%), non-Hispanic Whites (4.9%) and non-Hispanic other (6.8%), persons who have never been married (5.4%), persons with at least a college degree (5.5%), persons living in the western US (6.1%), persons without children (5.6%), and past-month non-daily or daily cigarette smokers (10.7% & 7.0%, respectively) (See Table A.4).

Differences in the prevalence of past-month hookah use paralleled difference in the prevalence of lifetime hookah use, with the exception of educational attainment and the number of children in the household (See Table A.4). Interestingly, non-daily cigarettes smokers were twice as likely to have used hookah in the past-30 days as daily cigarette smokers.

3.5. Correlates of lifetime hookah use among 18–40 year olds in the US

Table A.5 presents the associations between socio-demographic characteristics and the odds of lifetime hookah use versus no lifetime use. We found that controlling for these characteristics did not meaningfully change the correlates of hookah use among most sub-groups but there were several exceptions. First, the unadjusted odds of lifetime use among non-Hispanic Other were significantly higher than among non-Hispanic Whites but the difference became insignificant after adjustment. Second, after adjustment, differences among income groups became statistically significant. Third, both daily and non-daily cigarette smoking remained significant predictors of hookah use.

4. Discussion

This study investigated the correlates of hookah use among adults aged 18–40 years old in the US using a nationally representative sample. Hookah use was twice as common among cigarette smokers compared with non-smokers; in particular, non-daily cigarette smokers had the highest levels of hookah use. Hookah use was also significantly more common among various demographic sub-groups of the general adult population. Below we discuss the potential implications of these findings on the future of research into the growing phenomenon of hookah use in this country, and in the context of existing knowledge in this area.

We found that hookah use was significantly more common among cigarette smokers compared with non-smokers. The prevalence of hookah use among current, non-daily

cigarette smokers was 10.7%, more than double that of the general adult population at 3.9%. This is particularly concerning because poly-tobacco use has been found to increase the risk of illicit drug use, nicotine addiction, and adverse health outcomes more than cigarettes alone. (Bombard, Pederson, Koval, & O'Hegarty, 2009). Two possible explanations for the high rates of hookah use among non-daily cigarette smokers are provided, both of which call for targeted, public health efforts that are comparable to the regulation of cigarettes. First, research suggests that non-daily cigarette smokers are less addicted to nicotine than daily cigarette smokers (Levinson et al., 2007). Thus, whereas daily cigarette smokers may be using hookah as a cheaper supplement for their nicotine intake, non-daily cigarette smokers may be using hookah for other reasons, such as a means of socializing with others. Second, hookah use may predict cigarette use, and what is captured in the data is the gradual transition from hookah use to regular cigarette use. Given the risks associated with hookah, it is also recommended that healthcare providers consider expanding their screening tests to include hookah use.

We found that hookah use is more common among students, among those earning less than \$20,000 annually, and among individuals with higher levels of formal education. There are a number of possible explanations for the seeming contradiction of these predictors. First, our analysis focused on the correlates of lifetime hookah use among 18–40 year olds, which is a young age group overall. Hookah use in this group appears to be most concentrated among the youngest segment of this group, and lower income and being a student are more common among youth as well, which may explain this result. It is not clear why those with higher levels of education, compared with lower, are more likely to have used hookah. Since we examined lifetime use, it is conceivable that individuals with higher levels of education tried hookah while an undergraduate student, where substances, such as hookah, are more accessible and experimentation is common. It should be noted, however, that the association between these seemingly disparate factors with hookah use does not suggest that these factors are overlapping, but may simply reflect separate groups at increased vulnerability to hookah use. Further research, potentially with longitudinal data may be useful in disentangling and clarifying the relationship of each of these factors to hookah use.

There is support in the literature that students have high levels of drug use (Cho et al., 2015; Clemow, 2015) and to experiment with newer or different types of substances (Botvin & Griffin, 2007). Students may have high levels of exposure to hookah smoking since a large portion of hookah lounges or bars and hookah advertisements can be found near college campuses (Office of Local Public Health, 2011). The number of hookah establishments have risen since the mid-1990s, particularly in college towns and large cities in the US, from two to twenty-five in Denver and from zero to seven in Sacramento alone (Edds, 2003; Maurer, 2006; The BACCHUS Network). Many hookah establishments have concentrated their marketing efforts to local college newspapers and radio stations (Edds, 2003; Maurer, 2006; The BACCHUS Network). Physical proximity and access to substances has been strongly associated with use of cigarettes and alcohol in previous studies (Hawkins, Catalano, & Miller, 1992; Leatherdale & Strath, 2007; Powell, Tauras, & Ross, 2005) and as such, the same effect may occur in the case of hookah. Hookah is often smoked in groups (Braun, Glassman, Wohlwend, Whewell, & Reindl, 2012; Maziak, Ward, & Eissenberg, 2007). Jamil, Elsouhag, Hiller, Arnetz, and Arnetz (2010) administered a survey on hookah

smoking behavior to a sample of US adults and found that 95% of respondents reported smoking hookah as a means of “socialize with family/friends,” and with therefore may be common among college students, as prior studies have found (e.g., Goodwin et al 2014). Prior studies have found high levels of hookah use among students pursuing advanced degrees, such as medical degrees (Almerie et al., 2008; Jawad et al., 2013), and among college students (Chen & Loukas, 2015; Montgomery et al., 2015). Therefore, it is not surprising being a student is associated with increased levels of use among this young sample.

Another striking correlate of hookah use is geographic region. Consistent with the literature (Jarrett et al., 2012; Primack et al., 2013), hookah use is most prevalent in the western part of the US. This is particularly interesting given that several states in the western part of the US are known to have one of the most stringent anti-cigarette (but not hookah) smoking laws and the lowest cigarette smoking rate in the country (e.g., Utah and California) (Centers for Disease Control and Prevention, 2014). The concurrent legalization of marijuana use in the western US may be serving as a possible contributing factor. Given that the mode of administration between marijuana and hookah use is similar, but disparate with cigarette smoking, it is possible that hookah use predicts or is predicted by marijuana use. While research on the directionality of use is scant, there is primarily support that marijuana use predicts initiation of hookah use one year later (Fielder et al., 2012).

Several limitations of this study should be considered when interpreting results, which can be addressed in future research. First, given the cross-sectional nature of the data, a temporal relationship could not be established between hookah use and cigarette use. Future research using a longitudinal sample to determine the sequence and progression of hookah, cigarette, and potentially marijuana use would be useful. It is currently unclear whether hookah use precedes cigarette use, cigarette use precedes hookah use, or whether it occurs concurrently, and additionally how marijuana use fits within the relationship (and there are likely multiple pathways). There is preliminary evidence to suggest that hookah use predicts progression from experimentation to regular cigarette use (Doran, Godfrey, & Myers, 2015; Jensen, Cortes, Engholm, Kremers, & Gislum, 2010). This may explain our finding that the odds of lifetime hookah use were significantly greater among current non-daily cigarette smokers. Alternatively, non-daily cigarette smokers may be supplementing their nicotine intake with hookah, which is currently less expensive (Nakkash, Khalil, & Afifi, 2011) and less regulated (Primack et al., 2012) than cigarettes. Second, lifetime hookah use was measured with the question, “*Have you ever tried smoking tobacco in a water pipe in your entire life, even one or two puffs?*” While tobacco is commonly smoked in a hookah, marijuana and other substances can also be smoked. Thus, individuals who have smoked marijuana with a hookah –not tobacco, for example – would not be captured in the data. Future research may benefit from determining whether other substances, in addition to shisha, are being inhaled with a water pipe. Third, given the exploratory nature of the study, it is possible that we did not include other relevant socio-demographic variables that are predictive of hookah use. Thus, we recommend future research to investigate the predictive utility of these socio-demographic variables, as well as others, on hookah use.

5. Conclusions

Hookah use is significantly more common among cigarette smokers, compared with non-smokers, and among various demographic sub-groups of the general adult population. Compared with non-cigarette smokers, cigarette smokers are more than twice as likely to have smoked hookah. Given the risks associated with hookah and poly-tobacco use, we propose at least two recommendations. First, we recommend that that lawmakers enforce targeted public health efforts on hookah. Second, healthcare providers may consider expanding screening tests to include hookah use.

Abbreviations

CPS	Current Population Survey
TUS-CPS	Tobacco Use Supplement of Current Population Survey
US	United States

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A.1

Rate of lifetime and current hookah use by age group, ages 18–85 (n=224,837)

Age	Lifetime hookah use	Past month hookah use
Total	2.11% (0.035)	0.25% (0.012)
18 to 25	5.59% (0.153)	1.10% (0.068)
26 to 40	2.98% (0.080)	0.28% (0.025)
41 to 50	1.12% (0.057)	0.07% (0.014)
51 to 60	1.11% (0.059)	0.03% (0.011)
61 to 70	0.78% (0.058)	0.01% (0.008)
71 to 85	0.39% (0.042)	0.01% (0.005)

A.2

Socio-demographic characteristics associated with lifetime hookah users versus lifetime non-hookah users
(n=85,545), ages 18–40

	Full Sample (n=85,545) %(SE)	Lifetime non- hookah (n=82,086) %(SE)	Lifetime hookah (n= 3,459) %(SE)	<i>p</i>
Gender				0.000
Male	49.3% (0.19)	48.5% (0.20)	63.1% (0.94)	
Female	50.7% (0.19)	51.5% (0.20)	36.9% (0.94)	
Race/Ethnicity				0.000
Hispanic	19.5% (0.16)	19.9% (0.16)	11.4% (0.64)	
Non-Hispanic White	60.1% (0.19)	59.4% (0.20)	76.3% (0.86)	
Non-Hispanic Black	12.6% (0.14)	12.9% (0.14)	4.1% (0.43)	
Non-Hispanic Asian	5.3% (0.09)	5.4% (0.09)	4.2% (0.40)	
Non-Hispanic Native American	0.7% (0.03)	0.7% (0.03)	0.8% (0.17)	
Non-Hispanic Other	1.8% (0.05)	1.7% (0.05)	3.2% (0.35)	
Marital Status				0.000
Married	41.7% (0.19)	42.5% (0.20)	24.9% (0.84)	
Widowed	0.3% (0.02)	0.3% (0.02)	0.0% (0.02)	
Divorced	5.2% (0.08)	5.3% (0.09)	3.4% (0.34)	
Separated	2.4% (0.06)	2.4% (0.06)	1.7% (0.25)	
Never Married	50.4% (0.19)	49.5% (0.20)	70.0% (0.89)	
Highest Educational Attainment				0.000
Less than HS	12.9% (0.13)	13.2% (0.14)	4.5% (0.41)	
HS degree or GED	27.6% (0.17)	27.8% (0.18)	19.2% (0.77)	
Some college including Associates degree	32.3% (0.18)	32.1% (0.18)	37.6% (0.95)	
College and above	27.3% (0.17)	27.0% (0.17)	38.8% (0.96)	
Geographic Region				0.000
Northeast	17.0% (0.15)	17.2% (0.15)	13.8% (0.69)	
Midwest	21.4% (0.15)	21.4% (0.16)	20.9% (0.77)	

	Full Sample (n=85,545) %(SE)	Lifetime non- hookah (n=82,086) %(SE)	Lifetime hookah (n= 3,459) %(SE)	<i>p</i>
South	37.3% (0.19)	37.7% (0.20)	27.4% (0.90)	
West	24.3% (0.16)	23.7% (0.16)	37.9% (0.95)	
Number of own children in household (< 18 years)				0.000
No children	56.9% (0.19)	55.7% (0.20)	81.7% (0.74)	
1–2 children	33.0% (0.18)	33.8% (0.19)	16.3% (0.71)	
3 children	10.1% (0.11)	10.5% (0.12)	2.0% (0.26)	
Student status				0.131
Not enrolled	87.0% (0.13)	87.2% (0.13)	82.1% (0.76)	
Part-time	1.6% (0.05)	1.6% (0.05)	2.7% (0.32)	
Full-time	11.4% (0.12)	11.2% (0.13)	15.1% (0.71)	
Employment status				0.000
Employed	69.6% (0.18)	69.4% (0.18)	75.3% (0.85)	
Unemployed (layoff or looking)	9.0% (0.11)	8.9% (0.11)	10.3% (0.60)	
Not in Labor Force (retired or disabled)	21.4% (0.16)	21.7% (0.16)	14.4% (0.69)	
Family income				0.092
\$19,999	17.9% (0.15)	17.8% (0.15)	19.6% (0.77)	
\$20,000–39,999	24.0% (0.17)	24.0% (0.17)	22.8% (0.83)	
\$40,000–74,999	28.9% (0.17)	28.9% (0.18)	28.7% (0.89)	
\$75,000	29.2% (0.17)	29.3% (0.18)	28.8% (0.89)	
Cigarette smoking				0.000
Daily	12.6% (0.13)	11.9% (0.13)	22.1% (0.81)	
Non-daily	4.1% (0.08)	3.7% (0.08)	11.1% (0.61)	
Never	83.3% (0.14)	84.3% (0.14)	66.8% (0.92)	

Table A.3

Frequency of hookah use the past 30 days among lifetime users, ages 18–40

Frequency of monthly use	% (SE)
1 to 5 days	80.93 (0.287)
6 to 10 days	8.51 (0.207)
11 to 15 days	1.91 (0.087)
16 to 20 days	2.12 (0.094)
21 to 25 days	0.16 (0.016)
26 to 30 days	6.37 (0.185)

Heteroskedasticity-robust standard errors are in parentheses.

Table A.4

Prevalence of lifetime and current hookah use, ages 18–40 (n=85,545)

	Lifetime hookah % (SE)	Current hookah % (SE)
Gender		
Male	5.0% (0.12)	0.8% (0.05)
Female	2.8% (0.09)	0.4% (0.03)
Race/Ethnicity		
Hispanic	2.3% (0.13)	0.4% (0.05)
Non-Hispanic White	4.9% (0.11)	0.7% (0.04)
Non-Hispanic Black	1.3% (0.14)	0.2% (0.04)
Non-Hispanic Asian	3.1% (0.29)	0.4% (0.10)
Non-Hispanic Native American	4.3% (0.93)	0.5% (0.36)
Non-Hispanic Other	6.8% (0.74)	1.4% (0.34)
Marital Status		
Married	2.3% (0.09)	0.2% (0.03)
Widowed	0.5% (0.34)	0.0% (N/A)
Divorced	2.5% (0.25)	0.2% (0.07)
Separated	2.8% (0.41)	0.3% (0.11)
Never Married	5.4% (0.12)	0.9% (0.05)
Highest Educational Attainment		
Less than HS	1.4% (0.13)	0.3% (0.06)
HS degree or GED	2.7% (0.12)	0.5% (0.05)
Some college including Associates degree	4.5% (0.14)	0.8% (0.06)
College and above	5.5% (0.17)	0.5% (0.05)
Geographic Region		
Northeast	3.2% (0.17)	0.4% (0.06)
Midwest	3.8% (0.15)	0.5% (0.06)
South	2.8% (0.11)	0.4% (0.04)
West	6.1% (0.18)	1.1% (0.08)
Number of own children in household (< 18 years)		
No children	5.6% (0.12)	0.9% (0.05)
1–2 children	1.9% (0.09)	0.1% (0.03)
3 children	0.8% (0.10)	0.1% (0.04)
Student status		
Not enrolled	5.6% (0.22)	1.0% (0.10)
Part-time	6.5% (0.75)	1.4% (0.33)
Full-time	5.2% (0.26)	1.2% (0.12)
Employment status		
Employed	4.2% (0.09)	0.6% (0.03)

	Lifetime hookah % (SE)	Current hookah % (SE)
Unemployed (layoff or looking)	4.5% (0.27)	0.8% (0.11)
Not in labor force (retired or disabled)	2.6% (0.13)	0.4% (0.06)
Family income		
\$19,999	4.3% (0.18)	0.7% (0.08)
\$20,000–39,999	3.7% (0.15)	0.6% (0.06)
\$40,000–74,999	3.9% (0.14)	0.5% (0.05)
\$75,000	3.8% (0.14)	0.5% (0.05)
Cigarette smoking		
Daily	7.0% (0.28)	1.3% (0.13)
Non-daily	10.7% (0.59)	2.1% (0.28)
Never	3.1% (0.07)	0.4% (0.03)

Table A.5

Correlates of lifetime hookah use among 18–40 year olds in the US, crude and adjusted

	Model 1		Model 2	
	OR	95% CI	AOR	95% CI
Female (ref: male)	0.55	(0.51, 0.60)	0.62	(0.57, 0.68)
Race/Ethnicity (ref: non-Hispanic white)				
Non-Hispanic Black	0.29	(0.23, 0.36)	0.32	(0.25, 0.40)
Hispanic	0.52	(0.46, 0.59)	0.59	(0.52, 0.68)
Non-Hispanic Native American	1.11	(0.71, 1.73)	0.84	(0.53, 1.33)
Non-Hispanic Asian	0.77	(0.63, 0.94)	0.48	(0.39, 0.60)
Non-Hispanic Other	1.85	(1.47, 2.33)	1.21	(0.95, 1.54)
Marital Status (ref: married)				
Widowed	0.12	(0.03, 0.47)	0.18	(0.04, 0.73)
Divorced	0.62	(0.51, 0.76)	0.69	(0.55, 0.87)
Separated	0.71	(0.53, 0.96)	0.98	(0.71, 1.35)
Never married	2.38	(2.19, 2.59)	1.45	(1.29, 1.63)
Highest Educational Attainment (ref: Less than high school)				
High school degree or GED	0.62	(0.56, 0.68)	1.92	(1.55, 2.36)
Some college	1.27	(1.17, 1.38)	3.32	(2.71, 4.06)
College or above	1.72	(1.58, 1.86)	5.73	(4.64, 7.09)
Geographic region (ref: Northeast)				
Midwest	0.97	(0.88, 1.06)	1.16	(1.01, 1.33)
South	0.62	(0.57, 0.68)	1.07	(0.94, 1.23)
West	1.97	(1.82, 2.13)	2.35	(2.06, 2.67)
Number of own children in household (< 18 years) (ref: None)				
1–2 children	0.38	(0.34, 0.42)	0.47	(0.42, 0.54)
3 children	0.17	(0.13, 0.22)	0.22	(0.17, 0.30)
Student status (ref: not enrolled)				
Full-time	1.41	(1.26, 1.58)	1.48	(1.29, 1.69)
Part-time	1.74	(1.36, 2.22)	1.48	(1.14, 1.90)
Employment status (ref: employed)				
Unemployed (layoff/looking)	1.18	(1.03, 1.34)	1.02	(0.88, 1.17)
Not in labor force (retired/disability)	0.61	(0.54, 0.68)	0.72	(0.63, 0.82)

	Model 1		Model 2	
	OR	95% CI	AOR	95% CI
Family income (ref: \$19,999)				
\$20,000 – 39,999	0.93	(0.85, 1.03)	0.77	(0.68, 0.87)
\$40,000 – 74,999	0.99	(0.91, 1.08)	0.71	(0.63, 0.80)
\$75,000	0.98	(0.90, 1.07)	0.62	(0.55, 0.71)
Cigarette smoking (ref: Never)				
Daily	2.10	(1.91, 2.31)	3.05	(2.73, 3.40)
Non-daily	3.22	(2.83, 3.67)	3.72	(3.24, 4.29)

Model 1: Unadjusted

Model 2: Adjusting for all other socio-demographic characteristics