



Published in final edited form as:

Addict Behav. 2018 October ; 85: 21–25. doi:10.1016/j.addbeh.2018.05.007.

Prevalence and factors associated with use of hookah tobacco among young adults in the U.S.

Julia N. Soulakova^{a,*}, Thanh Pham^a, Victoria L. Owens^a, Lisa J. Crockett^b

^aBurnett School of Biomedical Sciences, College of Medicine, University of Central Florida, Orlando, FL, 6900 Lake Nona Blvd., Orlando, FL 32827, United States

^bDepartment of Psychology, University of Nebraska-Lincoln, 315 Burnett Hall, Lincoln, NE 68588-0308, United States

Abstract

Introduction: Among young adults, use of hookah tobacco (HT) is an emerging health-risk behavior. The goals were to demonstrate that (1) the prevalence of ever-use and current use of HT increased among U.S. young adults (18–30 years old) in the period from 2010 to 2015 and (2) the patterns of HT use differed across diverse demographic subpopulations of young adults.

Methods: We merged and analyzed data from the 2010–2011 and 2014–2015 Tobacco Use Supplement to the Current Population Survey. The sample ($n = 55,352$) was representative of the young adult population in the U.S. Two binary measures were the ever and current use of HT. The significance level was 5%.

Results: The rate of current use of HT increased from 1% in 2010–11 to 2% in 2014–15 (CI = 0.6%:1.1%). The rate of ever-use increased from 7% to 12% (CI = 4.2%:5.6%). The over-time increase was not uniform: the increase was most rapid among 26–30 year-old adults, non-Hispanic Black and African American adults, and in Northeastern and Midwestern U.S. regions. HT ever-use, overall, was associated (all p 's < 0.001) with many sociodemographic factors and current tobacco-use behaviors. The rate of HT ever-use was 16% for daily and 23% for occasional cigarette smokers, 23% for users of smokeless tobacco products, 37% for cigar smokers, and 55% for smokers of regular pipe (filled with tobacco).

Discussion/conclusion: HT use is becoming increasingly more popular among young adults in the U.S. Methods should target not only cessation of cigarette smoking but use of all tobacco products.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

*Corresponding author. Julia.Soulakova@ucf.edu (J.N. Soulakova), ecrockett1@unl.edu (L.J. Crockett).

Contributors

Author Soulakova designed the study and supervised all aspects of the research, including the paper preparation. Authors Pham and Owens performed tests, prepared the literature review and the first draft of the paper. Author Pham performed modeling. Author Crockett provided her guidelines throughout the study and helped prepare the final draft. All authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

Keywords

Response bias; Survey administration mode; Waterpipe

1. Introduction

The prevalence of use of hookah tobacco (HT) is relatively low among adults in the U.S.; for instance, the rate of ever using a HT was 3.9% among 18–40 year-old adults in 2010–11 (Grinberg & Goodwin, 2016). However, the prevalence is relatively high among U.S. youth and young adults; e.g., the rate of ever-use was 30.5% among college students in 2008–09 (Primack et al., 2013).

Use of HT is also associated with use of other tobacco products, such as cigarette or e-cigarette smoking (Barnett, Soule, Forrest, Porter, & Tomar, 2015; Cobb, Ward, Maziak, Shihadeh, & Eissenberg, 2010; Leventhal et al., 2015; Rice et al., 2006; Ward, Vander Weg, Relyea, DeBon, & Klesges, 2006). Moreover, among Arab American adolescents, HT use was linked to cigarette smoking initiation: the odds of cigarette smoking initiating were 8 times higher among those who had ever used HT than among those who had not used HT (Rice et al., 2006). A study of young adult US military recruits also indicated that intentions to start smoking cigarettes in the next year were higher among current HT users relative to HT non-users (Ward et al., 2006).

Young adult HT users generally perceive HT use safe and socially acceptable. In particular, HT users tend to believe that using a HT is less harmful than smoking cigarettes, that the government has evaluated HT for safety and that use of HT is not addictive (Aljarrah, Ababneh, & Al-Delaimy, 2009; Chen & Loukas, 2015; Primack et al., 2008; Sidani, Shensa, Barnett, Cook, & Primack, 2014). Additionally, the majority of college students have close friends who have used a HT (Heinz et al., 2013). Misconceptions about safety of use of HT have been linked to HT use initiation, as well as increased prevalence of HT use among college students (Villanti, Cobb, Cohn, Williams, & Rath, 2015). Nonetheless, HT use could be as dangerous as cigarette smoking, could cause nicotine addiction, and was linked to heart disease and cancer (Cobb et al., 2010; Jabbour, El-Roueiheb, & Sibai, 2003; Maziak, 2011).

In addition to perceptions, there are established demographic correlates of HT use. Studies of ever-use of HT in diverse populations in the U.S. indicated that the prevalence of HT ever-use was higher among younger than older subjects; non-Hispanic Whites than the other racial/ethnic groups including Hispanics, non-Hispanic Blacks/African Americans, non-Hispanic Asians, and non-Hispanic American Indians/Native Americans; more educated than less educated individuals; never-married than married individuals; childless individuals compared to those with children and those living in the West or Midwest compared to those living in the South or Northeast (Grinberg & Goodwin, 2016; Salloum, Thrasher, Kates, & Maziak, 2015; Villanti et al., 2015).

Several systematic reviews of worldwide publications addressing HT use indicated a lack of studies with nationally representative samples, disproportional rates of HT use across

different countries, as well as adverse effect of HT use on health (Akl et al., 2013, 2011; Jawad et al., 2018; Waziry, Jawad, Bailout, Al Akel, & Akl, 2016). While these and several other studies have estimated the prevalence of HT use and identified related factors, there is limited literature on trends in HT use in the U.S. (Robinson, Wang, Jackson, Donaldson, & Ryant, 2017). Our study aimed to examine the trends in prevalence of ever-use of HT over the period from 2010 to 2015 and to identify the key characteristics associated with HT ever-use by means of a large data set representative of the U.S. young-adult population. The goals were to demonstrate that the prevalence of ever-use and current use of HT increased among young adults in recent years and the patterns of HT use differed across diverse demographic subpopulations of young adults.

2. Methods

We used pooled data from the 2010–2011 (30,135 adults surveyed) and 2014–2015 (25,217 adults surveyed) Tobacco Use Supplement to the Current Population Survey (US Department of Commerce Census Bureau, 2016). The 2010–2011 and 2014–2015 data sets are representative of civilian non-institutional adults (18+ years old) in the U.S. in the periods 2010–2011 and 2014–2015, respectively. Each survey period (2010–11 and 2014–15) consisted of three monthly surveys, where the non-response rates among self-respondents varied from 37.7% to 40.2% in 2010–11 and from 46.3% to 55.7% in 2014–15 (US Department of Commerce Census Bureau, 2012, 2016).

In the study we used information on self-reported tobacco use among 55,352 young adults (i.e., 18–30 years old); the sample was weighted so it was representative of 54,140,106 U.S. young adults. The interviews were conducted either in-person (46%) or by phone (54%). The majority of young adults resided in a metropolitan area (86.6%).

Our key measure of interest was HT ever-use which was defined using responses of “Yes” and “No” to the survey item, “Have you ever used any of the following even one time: A water pipe or hookah pipe filled with tobacco?” Responses to the follow-up question, “Do you now smoke a water pipe or hookah pipe filled with tobacco every day, some days or not at all?” were used to measure current HT use. Current HT users were respondents who indicated every day or someday use; current HT non-users were respondents who were ever-users and answered “not at all” to the follow-up question. Current cigarette smoking status and other tobacco use measures were defined using similar questions. These and additional measures such as sociodemographic characteristics are listed in Table 1.

We used Rao-Scott chi-square tests to identify factors associated with HT ever-use. Adjustments for the complex design of the TUS-CPS were incorporated in all analyses; specifically, we used balanced repeated replications for variance estimation and main survey weights for point estimation (“US Department of Commerce, US Census Bureau. Current Population Survey. Methodology”, 2017; Ha & Soulakova, 2017). The significance level for each test of association was 5%. If the test indicated a significant association between ever-use and a categorical measure with three or more categories, we performed post-hoc comparisons using Bonferroni-adjusted *p*-values. When comparing the over-time differences in the prevalence of HT use, we also constructed the 95% confidence intervals (CI) for

the differences: 2014–15 prevalence minus 2010–11 prevalence. Therefore, positive limits indicate increased prevalence from 2010 to 11 to 2014–15.

We also used a logistic regression (Likelihood Ratio = 4,320,602, $df = 34$, $p < 0.0001$) to model the relationship between the logit of probability of HT ever-use and the other factors, i.e., time period (2011–2012, 2014–2015), characteristics depicted in Table 1, metropolitan status of residency (metropolitan area, non-metropolitan area) and survey mode (phone interview, in-person interview). While building the model we explored significance of all possible two-way interaction effects between time period and the other covariates, starting with the full model containing all these interactions. Then we used an analog of backward elimination: in each step, we detected all interactions with p -values exceeding 0.050, among these detected interactions we deleted the interaction with the highest p -value, and refitted the model. The final model contained three two-way interactions between time period and age (p -value < 0.0001), race/ethnicity (p -value < 0.0001) and region of residency (p -value = 0.0007), as well as main effects ($p = 0.0041$ for survey mode and p 's < 0.0001 for all other factors). Analyses were performed using SAS®9.4 software (SAS Institute Inc., 2016) and methods described previously (Ha & Soulakova, 2017).

3. Results

The overall prevalence of current use of HT was 1.5%. The prevalence significantly increased from 1.1% in 2010–2011 to 1.9% in 2014–2015 ($p < 0.0001$; 95% CI = 0.6%: 1.1%). Similarly, the prevalence of ever-use of HT significantly increased from 7.1% in 2010–2011 to 12.0% in 2014–2015 ($p < 0.0001$; CI = 4.2%:5.6%). Overall (across both time periods), the prevalence of HT ever-use differed significantly among populations with diverse sociodemographic characteristics and current tobacco use behaviors (all p 's < 0.0001). Specifically, the prevalence of ever-use was significantly higher among 18–25 year-olds (10.1%) than 26–30 year-olds (8.8%), among males (12.0%) than females (7.2%), among those residing in a metropolitan area (10.2%) compared to those residing in a non-metropolitan area (6.5%), and among additional subpopulations depicted in Table 2. Phone interviews were associated ($p < 0.0001$) with higher prevalence (10.2%) of HT ever-use than in-person interviews (8.8%). In addition, the 2014–15 prevalence of ever-use was significantly higher among young adults who were current users of e-cigarettes (38.3%) relative to non-users (11.1%, i.e., former or never users of e-cigarettes). We note that use of e-cigarettes was not surveyed in 2010–2011. Overall, in 2010–2015 the prevalence of ever-use was significantly higher among young adults who were current users of smokeless tobacco products (22.8%) relative to non-users (9.3%); cigars, cigarillos or little filtered cigars (37.2%) relative to non-users (8.7%); and regular tobacco pipes (54.8%) relative to non-users (9.4%).

The estimates based on the fitted multiple logistic regression for over-time comparisons of diverse populations as well as comparisons for main effects are depicted in Table 3. In addition to the results depicted in Table 3, residing in a metropolitan area was associated with higher odds of HT ever-use relative to residing in a non-metropolitan area (OR = 1.706, CI = 1.485:1.960) and interviewing in-person was associated with lower odds of ever-use

relative to interviewing by phone (OR = 0.897, CI = 0.832:0.966). All results for factors not included in the interactions were consistent with the results based on unadjusted analyses.

4. Discussion

4.1. Increased overall rates of current and ever-use of HT

The prevalence of current use of HT remains relatively low among young adults in the U.S.; however, despite small rates of < 2%, there was a significant increase in the rate of current use from 2010 to 2015. In addition, there was a significant 5% increase in the prevalence of ever-use of HT in this period. The rate of HT ever-use is much more pronounced: the rate was about 7% in 2010–2011 and 12% in 2014–2015. This significant escalation in the rates of HT use indicates that HT becomes increasingly more popular among young adults in the U.S. Considering HT use is similar to cigarette smoking in that it leads to nicotine dependence and increased risks for cardiovascular disease and cancer (Cobb et al., 2010; Jabbour et al., 2003; Maziak, 2011; Maziak, Eissenberg, & Ward, 2005), the topics of initiation of HT use and current HT use deserve much more attention in the public health research and media than are given currently. The study results are consistent with prior research indicating that HT use is a rising health concern across the nation (Cobb et al., 2010).

4.2. Over-time differences in the rates of ever-use for diverse populations

The over-time differences in the prevalence of HT ever-use (after controlling for sociodemographic characteristics and current cigarette smoking status) were not uniform across the age groups, races/ethnicities or U.S. regions. Specifically, the increase in the rates of HT use was more noticeable among 26–30 year-old than 18–25 year-old adults, and for the Non-Hispanic Black/African American population, followed in turn by the Non-Hispanic Multiracial, Hispanic, Non-Hispanic White and Non-Hispanic Asian populations. The odds ratios for Non-Hispanic Hawaiian/Pacific Islander and Non-Hispanic American Indian/Alaskan Native populations were not significant, potentially indicating no over-time difference in the rates of HT ever-use in these populations. Among the U.S. regions, the most pronounced increase in the rates of HT ever-use was observed for the Northeast, followed by the Midwest, the South and then the West.

4.3. Sociodemographic factors and tobacco use behaviors associated with HT ever-use

The overall prevalence of HT ever-use was higher among younger (18–25 year old) than older (26–30 year old) adults, among men than women, among non-Hispanic Multiracials and non-Hispanic Whites compared to the other racial/ethnic groups, among more educated than less educated adults, among employed individuals compared to those who are not in labor force, among those who have never been married and among those residing in the U.S. Western or Midwestern regions. These results are consistent with prior literature (Grinberg & Goodwin, 2016; Salloum et al., 2015; Villanti et al., 2015). In addition, the overall prevalence of HT ever-use was highest for occasional cigarette smokers (23%), former smokers (21%) and daily smokers (16%) than never smokers (7%). The ever-use of HT was positively associated with current cigarette smoking, use of smokeless tobacco products,

cigar smoking (including cigarillo and little filtered cigars) and smoking a pipe filled with tobacco.

4.4. Study limitations

The study has several limitations. First, the study indicated that phone interviews resulted in a higher prevalence estimate of HT ever-use than did in-person interviews. This points to a response bias associated with the survey mode (Bowling, 2005; Bright & Soulakova, 2014; Ha & Soulakova, 2018; Kolenikov & Kennedy, 2014; Soulakova, Davis, Hartman, & Gibson, 2009; St-Pierre & Beland, 2004). However, we believe that adjusting for the survey mode in the model (used in this study) resulted in decreased discrepancy associated with the mixed modes used in the survey. We note that the TUS-CPS data could be potentially subject to other types of response bias, e.g., recall bias (Bright & Soulakova, 2014; Soulakova, Bright, & Crockett, 2013; Soulakova, Bright, & Crockett, 2015; Soulakova, Huang, & Crockett, 2015). Second, while results based on Rao-Scott tests and regression model were generally consistent, the model is potentially under-fitted (all effects in the model were highly significant). Therefore, future studies could consider a larger set of covariates in the hopes of improving model fit and accuracy of estimation. Third, there was a relatively small sample size for Non-Hispanic Hawaiian/Pacific Islander population ($n = 249$, < 1% of the sample). Thus, all inferences for this population should be drawn with caution, e.g., while there was a relatively large odds ratio (exceeding 4) potentially pointing to a drastic increase in the rate of ever-use from 2010 to 11 to 2014–15 in this population, the ratio was not statistically significant. In addition, analyses targeted ever-use of HT rather than current use of HT; the small proportion of current HT users prohibited testing for associations between current HT use and the other characteristics.

4.5. Implications

A significant increase in the rates of current and lifetime HT use from 2010 to 2015 suggests growing popularity of HT among young adults in the U.S. in recent years. The high rate of HT use among former smokers indicates that quitting cigarette smoking does not necessarily imply discontinued use of other tobacco products. Thus, smoking cessation methods should target discontinuation of tobacco use in general, not just cessation of cigarette use. Otherwise there is a risk that cigarettes will be replaced with other tobacco products or ways of smoking tobacco. The overall rate of HT ever-use was the lowest among non-Hispanic Blacks and African Americans. However, HT use became much more prevalent within this population (relative to the other racial/ethnic groups) in the period from 2010 to 2015. Therefore, the racial/ethnic differences in the rates of HT use could become smaller in the near future because HT use is a rapidly emerging behavior among non-Hispanic Black and African American young adults. The study confirms the importance of a new tobacco use policy covering all tobacco products, including HT, and use of HT at commercial premises, such as water-pipe bars, e.g., mandatory health warning labels to the hookah apparatus have been previously suggested (Jawad et al., 2018).

Acknowledgements

We would like to thank Richard Pack and Dr. Yujiao Mai for their help with paper editing.

Funding

Research reported in this publication was supported by the National Institute On Minority Health And Health Disparities of the National Institutes of Health under Award Number R01MD009718. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

References

- Akl EA, Gunukula SK, Aleem S, Obeid R, Jaoude PA, Honeine R, & Irani J (2011). The prevalence of waterpipe tobacco smoking among the general and specific populations: A systematic review. *BMC Public Health*, 11, 244. 10.1186/1471-2458-11-244. [PubMed: 21504559]
- Akl EA, Jawad M, Lam WY, Co CN, Obeid R, & Irani J (2013). Motives, beliefs and attitudes towards waterpipe tobacco smoking: A systematic review. *Harm Reduction Journal*, 10, 12. 10.1186/1477-7517-10-12. [PubMed: 23816366]
- Aljarah K, Ababneh ZQ, & Al-Delaimy WK (2009). Perceptions of hookah smoking harmfulness: Predictors and characteristics among current hookah users. *Tobacco Induced Diseases*, 5, 16. 10.1186/1617-9625-5-16. [PubMed: 20021672]
- Barnett TE, Soule EK, Forrest JR, Porter L, & Tomar SL (2015). Adolescent Electronic Cigarette Use. *American Journal of Preventive Medicine*, 49, 199–206. <http://dx.doi.org/10.1016/j.amepre.2015.02.013>. [PubMed: 25840880]
- Bowling A (2005). Mode of questionnaire administration can have serious effects on data quality. *Journal of Public Health*, 27, 281–291. 10.1093/pubmed/fdi031. [PubMed: 15870099]
- Bright BC, & Soulakova JN (2014). Evidence of telescoping in regular smoking onset age. *Nicotine & Tobacco Research*, 16. 10.1093/ntr/ntt220.
- Chen YT, & Loukas A (2015). Examining hookah use among US College students. *Health Behavior and Policy Review*, 2, 343–351. <http://dx.doi.org/10.14485/HBPR.2.5.2>.
- Cobb C, Ward KD, Maziak W, Shihadeh AL, & Eissenberg T (2010). Waterpipe tobacco smoking: An emerging health crisis in the United States. *American Journal of Health Behavior*, 34, 275–285. [PubMed: 20001185]
- Grinberg A, & Goodwin RD (2016). Prevalence and correlates of hookah use: A nationally representative sample of US adults ages 18–40 years old. *The American Journal of Drug and Alcohol Abuse*, 42, 567–576. 10.3109/00952990.2016.1167214. [PubMed: 27184516]
- Ha T, & Soulakova JN (2017). Statistical analyses of public health surveys using SAS® survey package Trung Ha and Julia Soulakova, in: SESUG paper 189.
- Ha T, & Soulakova JN (2018). Survey mode and rates of smoke-free homes and support for smoking bans among single parents in the United States in 2010–11 and 2014–15. *Survey Practice*, 11. 10.29115/SP-2018-0014.
- Heinz AJ, Giedgowd GE, Crane NA, Veilleux JC, Conrad M, Braun AR, ... Kassel JD (2013). A comprehensive examination of hookah smoking in college students: Use patterns and contexts, social norms and attitudes, harm perception, psychological correlates and co-occurring substance use. *Addictive Behaviors*, 38, 2751–2760. <http://dx.doi.org/10.1016/J.ADDBEH.2013.07.009>. [PubMed: 23934006]
- Jabbour S, El-Roueiheb Z, & Sibai AM (2003). Nargileh (water-pipe) smoking and incident coronary heart disease: A case-control study. *Annals of Epidemiology*, 13, 570. 10.1016/S1047-2797(03)00165-0.
- Jawad M, Charide R, Waziry R, Darzi A, Bailout RA, & Akl EA (2018). The prevalence and trends of waterpipe tobacco smoking: A systematic review. *PLoS One*, 13, e0192191. 10.1371/journal.pone.0192191. [PubMed: 29425207]
- Kolenikov S, & Kennedy C (2014). Evaluating three approaches to statistically adjust for mode effects. *Journal of Survey Statistics and Methodology*, 2, 126–158. 10.1093/jssam/smu004.
- Leventhal AM, Strong DR, Kirkpatrick MG, Unger JB, Sussman S, Riggs NR, ... Audrain-McGovern J (2015). Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. *JAMA*, 314, 700. 10.1001/jama.2015.8950. [PubMed: 26284721]

- Maziak W (2011). The global epidemic of waterpipe smoking. *Addictive Behaviors*, 36, 1–5. <http://dx.doi.org/10.1016/j.ADDBEH.2010.08.030>. [PubMed: 20888700]
- Maziak W, Eissenberg T, & Ward K (2005). Patterns of waterpipe use and dependence: Implications for intervention development. *Pharmacology, Biochemistry, and Behavior*, 80, 173–179. <http://dx.doi.org/10.1016/j.pbb.2004.10.026>.
- Primack BA, Shensa A, Kim KH, Carroll MV, Hoban MT, Leino EV, ... Fine MJ (2013). Waterpipe smoking among U.S. university students. *Nicotine & Tobacco Research*, 15, 29–35. 10.1093/ntr/nts076. [PubMed: 22641433]
- Primack BA, Sidani J, Agarwal AA, Shadel WG, Donny EC, & Eissenberg TE (2008). Prevalence of and associations with waterpipe tobacco smoking among U.S. university students. *Annals of Behavioral Medicine*, 36, 81–86. 10.1007/S12160-008-9047-6. [PubMed: 18719977]
- Rice VH, Weglicki LS, Templin T, Hammad A, Jamil H, & Kulwicki A (2006). Predictors of Arab American adolescent tobacco use. *Merrill-Palmer Quarterly*, 52, 327–342.
- Robinson J, Wang B, Jackson K, Donaldson E, & Ryant C (2017). Characteristics of hookah tobacco smoking sessions and correlates of use frequency among US adults: Findings from wave 1 of the population assessment of tobacco and health (PATH) study. *Nicotine & Tobacco Research*, 13, 565–572. 10.1093/ntr/ntx060.
- Salloum RG, Thrasher JF, Kates FR, & Maziak W (2015). Water pipe tobacco smoking in the United States: Findings from the National Adult Tobacco Survey. *Preventive Medicine*, 71, 88–93. <http://dx.doi.org/10.1016/j.YPMED.2014.12.012>. [PubMed: 25535678]
- SAS Institute Inc (2016). SAS/STAT © 14.2 User's guide. Cary, NC: SAS Institute Inc.
- Sidani JE, Shensa A, Barnett TE, Cook RL, & Primack BA (2014). Knowledge, attitudes, and normative beliefs as predictors of hookah smoking initiation: A longitudinal study of university students. *Nicotine & Tobacco Research*, 16(6), 647–654. 10.1093/ntr/ntt201. [PubMed: 24323574]
- Soulakova J, Davis WW, Hartman A, & Gibson J (2009). The impact of survey and response modes on current smoking prevalence estimates using TUS-CPS: 1992–2003. *Survey Research Methods*, 3.
- Soulakova JN, Bright BC, & Crockett LJ (2013). On consistency of self-and proxy-reported regular smoking initiation age. *Journal of Substance Abuse and Alcoholism*, 1, 1001–1017. [PubMed: 25408943]
- Soulakova JN, Bright BC, & Crockett LJ (2015). Perception of time since smoking cessation: Time in memory can elapse faster. *Journal of Addictive Behaviors, Therapy & Rehabilitation*, 4, 10.4172/2324-9005.1000145.
- Soulakova JN, Huang H, & Crockett LJ (2015). Racial/ethnic disparities in consistent reporting of smoking-related behaviors. *Journal of Addictive Behaviors, Therapy & Rehabilitation*, 4, 10.4172/2324-9005.1000147.
- St-Pierre M, & Béland Y (2004). Mode effects in the Canadian community health survey: A comparison of CAP I and CATI. In: Proc. Am. Stat Association Meet Sur vey Res. Methods. Toronto, Canada: Am. Stat. Assoc.
- US Department of Commerce, & Census Bureau (2012). National Cancer Institute-sponsored tobacco use supplement to the current population survey (2010–11). Technical documentation. (WWW Document) 2012. URL <https://www.census.gov/programs-surveys/cps/technical-documentation/complete.html>.
- US Department of Commerce Census Bureau (2016). Complete technical documentation: The 2014–2015 series. (WWW Document). Natl. Cancer Inst. Food Drug Adm. Co-Sponsored Tob. Use Suppl. to Curr. Popul. Surv.
- US Department of Commerce, & US Census Bureau (2017). Current population survey. Methodology (WWW Document). URL <https://www.census.gov/programs-surveys/cps/technical-documentation/methodology.html>, Accessed date: 16 June 2017.
- Villanti AC, Cobb CO, Cohn AM, Williams VF, & Rath JM (2015). Correlates of hookah use and predictors of hookah trial in U.S. young adults. *American Journal of Preventive Medicine*, 48, 742–746. <http://dx.doi.org/10.1016/j.amepre.2015.01.010>. [PubMed: 25890683]
- Ward KD, Vander Weg MW, Relyea G, DeBon M, & Klesges RC (2006). Waterpipe smoking among American military recruits. *Preventive Medicine*, 43, 92–97. <http://dx.doi.org/10.1016/j.yjpm.2006.03.010>. [PubMed: 16675003]

Waziry R, Jawad M, Bailout RA, Al Akel M, & Akl EA (2016). The effects of waterpipe tobacco smoking on health outcomes: An updated systematic review and meta-analysis: Table 1. *International Journal of Epidemiology*, 46, dyw021. 10.1093/ije/dyw021.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

HIGHLIGHTS

- Current use of hookah tobacco (HT) was defined as current daily or occasional use
- The 2014–15 rate of current HT use among young adults in the U.S. was about 2%
- The rate of HT ever-use increased significantly from 7% in 2010–11 to 12% in 2014–15
- Among diverse races/ethnicities, the rates of HT use increased most for Non-Hispanic Blacks/African Americans
- The high rate of HT use among former cigarette smokers (21%) indicates continued use of tobacco among former smokers

Table 1

Sample summary statistics for sociodemographic characteristics and current tobacco use in young adults.

Characteristics	Sample count	Percent based on the population count
Sociodemographic characteristics		
Age		
18–25	28,733	61.4%
26–30	26,619	38.6%
Sex		
Male	25,064	49.8%
Female	30,288	50.2%
Race/ethnicity		
Non-Hispanic White	35,357	57.2%
Non-Hispanic Black/African American	6110	13.7%
Non-Hispanic American Indian/Alaskan Native	639	0.8%
Non-Hispanic Asian	2680	5.4%
Non-Hispanic Hawaiian/Pacific Islander	249	0.4%
Non-Hispanic Multiracial	1003	1.9%
Hispanic	9314	20.7%
Highest level of education		
Less than high school	5942	12.6%
High school or equivalent	15,052	28.5%
Some college or Bachelor's degree	30,963	54.1%
Graduate degree	3395	4.9%
Employment status		
Employed	38,828	66.8%
Unemployed	4745	9.6%
Not in labor force	11,779	23.6%
Marital status		
Married (live with a spouse)	16,230	24.7%
Widowed, divorced, separated	2686	4.2%
Never married	36,436	71.1%
Region		
Northeast	8927	15.5%
Midwest	13,243	21.4%
South	18,952	37.6%
West	14,230	24.0%
Current tobacco use Cigarette smoking status		
Never smoker	40,905	76.5%
Former smoker	4857	7.5%
Occasional smoker	2547	4.5%
Daily smoker	7043	11.5%
E-cigarette (2014–2015 data only)		

Characteristics	Sample count	Percent based on the population count
Non-user (former user or never user)	24,336	96.6%
Current user (daily user or occasional user)	877	3.4%
Smokeless tobacco		
Non-user	54,024	97.9%
Current user	1328	2.1%
Cigar, cigarillo, or little filtered cigars		
Non-user	53,739	96.9%
Current user	1613	3.1%
Regular pipe filled with tobacco		
Non-user	55,131	99.6%
Current user	221	0.4%

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2

Pair-wise comparisons for characteristics significantly associated with HT ever-use.

Characteristics	Prevalence of HT ever-use	Adjusted p-value
Race/ethnicity		
Non-Hispanic White	11.8%	Reference level
Non-Hispanic Black/African American	4.6%	< 0.0006
Non-Hispanic American Indian/Alaskan Native	5.6%	< 0.0006
Non-Hispanic Asian	7.4%	< 0.0006
Non-Hispanic Hawaiian/Pacific Islander	9.9%	Not significant
Non-Hispanic Multiracial	15.0%	Not significant
Hispanic	7.0%	< 0.0006
Highest level of education		
Less than high school	4.4%	Reference level
High school or equivalent	7.2%	< 0.0003
Some college or Bachelor's degree	11.7%	< 0.0003
Graduate degree	13.0%	< 0.0003
Employment status		
Employed	10.7%	Reference level
Unemployed	9.6%	Not significant
Not in labor force	6.3%	< 0.0002
Marital status		
Married (live with a spouse)	6.4%	Reference level
Widowed, divorced, separated	7.2%	Not significant
Never married	10.9%	< 0.0002
Region		
Northeast	8.8%	Reference level
Midwest	10.5%	0.0081
South	7.6%	0.0153
West	12.4%	< 0.0003
Current smoking status		
Never smoker	6.7%	Reference level
Former smoker	21.2%	< 0.0003
Occasional smoker	23.0%	< 0.0003
Daily smoker	16.2%	< 0.0003

Table 3

Logistic regression model results: odds ratios of HT ever-use.

Comparison	Odds ratio	Simultaneous 95% confidence interval for odds ratio	Adjusted p-value
Over-time comparison: 2014–15 versus 2010–11			
Age			
18–25	1.774	1.346: 2.339	< 0.0001
26–30	2.810	2.122: 3.720	< 0.0001
Race/ethnicity			
Non-Hispanic White	2.016	1.773: 2.292	< 0.0001
Non-Hispanic Black/African American	4.226	2.649: 6.742	< 0.0001
Non-Hispanic American Indian/Alaskan Native	0.577	0.169: 1.967	NS ^a
Non-Hispanic Asian	1.866	1.152: 3.022	0.0035
Non-Hispanic Hawaiian/Pacific Islander	4.649	0.889: 24.316	NS*
Non-Hispanic Multiracial	2.569	1.322: 4.993	0.0007
Hispanic	2.523	1.849: 3.444	< 0.0001
Region			
Northeast	2.655	1.788: 3.942	< 0.0001
Midwest	2.574	1.825: 3.630	< 0.0001
South	2.089	1.522: 2.866	< 0.0001
West	1.740	1.250: 2.424	< 0.0001
Overall comparison			
Sex: Female versus male	0.614	0.572: 0.659	< 0.0001
Marital status			
Married (live with a spouse) versus never married	0.580	0.524: 0.642	< 0.0001
Widowed, separated or divorced versus never married	0.612	0.485: 0.772	< 0.0001
Employment status			
Employed versus not in labor force	1.334	1.195: 1.490	< 0.0001
Unemployed versus not in labor force	1.377	1.143: 1.658	0.0002
Current smoking status			
Daily smoker versus never smoker	3.690	3.255: 4.184	< 0.0001
Occasional smoker versus never smoker	4.561	3.857: 5.393	< 0.0001

Comparison	Odds ratio	Simultaneous 95% confidence interval for odds ratio	Adjusted p-value
Former smoker versus never smoker	4.118	3.613: 4.695	< 0.0001
Highest level of education			
Less than high school versus graduate degree	0.200	0.155: 0.259	< 0.0001
High school or equivalent versus graduate degree	0.295	0.245: 0.355	< 0.0001
Some college or Bachelor's degree versus graduate degree	0.602	0.508: 0.712	< 0.0001

^aNS stands for not significant at 5% level.