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Waterpipe Tobacco Smoking in the United States: Findings from the National Adult Tobacco Survey

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Abstract

Objective—To report prevalence and correlates of waterpipe tobacco smoking (WTS) use among U.S. adults.

Methods—Data were from the 2009–2010 National Adult Tobacco Survey, a nationally representative sample of U.S. adults. Estimates of WTS ever and current use were reported overall, and by sex, age, race/ethnicity, educational attainment, annual household income, sexual orientation, and cigarette smoking status. State-level prevalence rates of WTS ever were reported using choropleth thematic maps for the overall population and by sex.

Results—The national prevalence of WTS ever was 9.8% and 1.5% for current use. WTS ever was more prevalent among those who are male (13.4%), 18–24 years old (28.4%) compared to older adults, non-Hispanic White (9.8%) compared to non-Hispanic Black, with some college education (12.4%) compared to no high school diploma, and reporting sexual minority status (21.1%) compared to heterosexuals. States with highest prevalence included DC(17.3%), NV(15.8%), and CA(15.5%).

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Conflict of interest statement

The authors declare that there are no conflicts of interest.

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Conclusion—WTS is now common among young adults in the US and high in regions where cigarette smoking prevalence is lowest and smoke-free policies have a longer history. To reduce its use, WTS should be included in smoke-free regulations and state and federal regulators should consider policy development in other areas, including taxes, labeling, and distribution.

INTRODUCTION

Waterpipe tobacco smoking (WTS) is a centuries-old form of tobacco use endemic to the Middle East (Maziak et al., 2014b) that has been rising in popularity across the world and within the United States (Maziak, 2013; Salloum et al., 2014). This type of smoking (also known as *hookah*, *shisha*, and *narghileh*) uses a flavored tobacco mixture that is sweetened with molasses that, when smoked, is heated with charcoal (Martinasek et al., 2011; Rastam et al., 2004). A typical WTS session lasts longer than smoking a cigarette and involves larger volumes of inhaled smoke that contain many of the same carcinogens and toxic heavy metals found in cigarette smoke (Akl et al., 2010). Smokers and nonsmokers in the vicinity are exposed to significant toxic emissions arising from the tobacco mixture as well as the burning charcoal (Maziak et al., 2008; Monzer et al., 2008). Despite the evidence that WTS potentially carries similar health risks as cigarettes and is associated with nicotine dependence (Akl et al., 2010; Cobb et al., 2011; Eissenberg and Shihadeh, 2009; Maziak et al., 2008; Maziak et al., 2009; Monzer et al., 2008; Neergaard et al., 2007), the general perception among waterpipe smokers is that it is less harmful than cigarettes (Maziak et al., 2004a; Roskin and Aveyard, 2009).

The limited data on the spread of WTS in the US point to college students as the population at greatest risk for use, mostly due to targeting by near-campus hookah establishments and intensive marketing through the Internet and social media (Brockman et al., 2012; Heinz et al., 2013; Maziak et al., 2004b; Noonan, 2013; Primack et al., 2013; Sutfin et al., 2011). Among this population, WTS is the second most popular method of tobacco use after cigarettes (Primack et al., 2013). Up to half of current WTS users have never smoked cigarettes, suggesting that WTS delivers nicotine to many who otherwise would have been nicotine-naïve (Primack et al., 2013). Therefore, WTS can serve as a gateway to cigarettes and other tobacco use methods among youth, as well as thwart tobacco control efforts among this sensitive population (Maziak, 2014a). Despite the alarming trends of WTS among US adolescents and young adults, evidence about WTS use in older adults has been primarily from non-representative samples (Braun et al., 2012; Heinz et al., 2013; Primack et al., 2013; Sutfin et al., 2011). Recent nationally representative surveys of tobacco use in the US have included WTS (King et al., 2012; Lee et al., 2014; Rath et al., 2012), but to date, no published reports have focused on the epidemiology of WTS. Furthermore, preliminary evidence suggests that WTS has been growing in states with the longest histories of smoke-free policies (Noonan, 2010). This also warrants examination with population-based data both nationally and across jurisdictions.

The National Adult Tobacco Survey (NATS) is the first survey in the US to establish a comprehensive standard for assessing the prevalence of tobacco use and its correlates among adults at the national and state levels. Indeed, it is the first nationally representative survey to capture the use of non-cigarette tobacco products, such as WTS (King et al., 2012), at a

time when the Food and Drug Administration is only beginning to develop regulations for these products (Department of Health and Human Services: Food and Drug Administration, 2014). These data therefore provide a unique opportunity to examine the epidemiology and correlates of WTS among US adults.

METHODS

Sample

The 2009–2010 NATS is a stratified, national telephone survey of non-institutionalized adults aged 18 years who reside in the 50 US states and the District of Columbia (King et al., 2012). The sample was developed from two separate overlapping sampling frames (landlines and cell phones) to generate representative data at both national and state levels. One adult respondent was randomly selected from each eligible household for the landline sample, while adults were included in the cell phone sample if that was the only method to reach them by telephone at home. Each state was allocated a target sample of 1,863 for landline phones to ensure adequate precision for state-level estimates; cell phone allocation size was in proportion to population size (range= 255–24,100). The final sample included 118,581 respondents, consisting of 110,634 landline and 7,947 cell phone interviews conducted between October 2009 and February 2010. The response rate (number of completed interviews divided by the number of eligible respondents in the sample) was 37.6% (40.4% for landline and 24.9% for cell phone respondents). The cooperation rate (number of completed interviews divided by the number of eligible respondents who were successfully reached by the interviewer) was 62.3% (61.9% for landline and 68.7% for cell phone respondents). Additional detail about the survey methodology can be found elsewhere (King et al., 2012).

Waterpipe Tobacco Smoking

Two questions were used to define use of waterpipe tobacco: “The next question asks you about smoking tobacco in a water pipe. A water pipe is also called a hookah. Have you ever tried smoking tobacco in a waterpipe in your entire life, even one or two puffs?” and “During the past 30 days, on how many days did you smoke tobacco in a waterpipe?” We classified respondents who reported smoking tobacco in a waterpipe in their lifetime as *ever* waterpipe smokers and those who reported smoking tobacco in a waterpipe on at least 1 day within the past 30 days as *current* waterpipe smokers.

Respondent Characteristics

The following characteristics of survey respondents were assessed: sex, age in years (18–24, 25–44, 45–64, or 65), race/ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, non-Hispanic Other, or Hispanic), education (0–12 years [no diploma], high school graduate [or GED recipient], some college [no degree], associate degree, undergraduate degree, or graduate degree), annual household income (<\$20,000, \$20,000–\$49,999, \$50,000–\$99,999, \$100,000, or unspecified), and sexual minority status (heterosexual/straight or lesbian/gay/bisexual/transgender [LGBT]). For race/ethnicity, “non-Hispanic Other” included respondents who were American Indian or Alaska Native, Native Hawaiian or Pacific Islander, multiracial, or some other race. We also classified

respondents based on cigarette use (current smokers [everyday or some days], former smokers [at least 100 cigarettes in their lifetime, but not current], or never smokers [<100 cigarettes in their lifetime]).

Analysis

Data were analyzed during May 2014 using Stata 12 (StataCorp, College Station, TX) and weighted to adjust for the differential probability of selection and response. Landline data were weighted according to the selection probability of the telephone number, the number of adults in each household, and the number of telephone numbers per household. Cell phones were assumed to be used exclusively by the respondent and were weighted only according to the selection probability of the phone number. Final weights were adjusted for under-coverage by sex, age, race/ethnicity, marital status, educational attainment, and telephone type (i.e., landline vs. cell). The national-level weights were used when all respondents were analyzed. The state-specific weights assign a non-zero weight for states with 200 or more cell phone respondents and zero in states with less than 200. State-level prevalence rates of ever waterpipe tobacco smokers (overall and gender-specific) were mapped in ArcGIS 10.2 (ESRI, Redlands, WA), using choropleth thematic maps. Prevalence rates for WTS *ever* and *current* users were calculated. Demographics and smoking characteristics were summarized using weighted percentages and confidence intervals. We used multivariate logistic regression to examine the relationship between WTS *ever* and *current* use and respondent characteristics. This study was deemed exempt from institutional review board approval because it uses publicly available data.

RESULTS

National Rates of Waterpipe Tobacco Smoking

The overall prevalence of *ever* WTS was 9.8% (Table 1). Prevalence was significantly higher among males (13.4%) compared with females (6.3%). Among all age groups, young adults (18–24 years) had the highest prevalence rates (28.6%). By race/ethnicity, prevalence was lowest among non-Hispanic Blacks (3.6%) and highest among non-Hispanic Others (17.6%). By education, those with some college education (but no degree) had the highest rate of *ever* use (12.4%). Adults with annual household income ≥\$100,000 had the highest rates of *ever* use (12.0%) among all income groups. By sexual minority status, prevalence was higher among LGBT respondents (21.1%) compared with heterosexual-straight respondents (9.8%). Finally, current smokers of cigarettes had higher prevalence rates of *ever* WTS (17.7%) relative to never smokers of cigarettes (7.0%).

The overall prevalence for *current* WTS was 1.5%. Current prevalence was significantly higher among males (2.3%) compared with females (0.9%). Young adults (between 18–24 years) had the highest rates of *current* WTS (7.8%). Non-Hispanic Blacks had the lowest prevalence of *current* WTS (0.7%) by race/ethnicity, and non-Hispanic Others had the highest (4.0%). High school graduates (no college) had the highest rate of *current* use (2.1%) by education. Prevalence did not vary across income groups (1.6%) with the exception of those with an annual household income between \$20,000 and \$49,999 (1.3%). Prevalence of *current* WTS was higher among LGBT respondents (6.1%) compared with

heterosexual respondents (1.5%), and current cigarette smokers had higher prevalence (4.0%) compared with never smokers (1.0%).

Prevalence Rates by State

The weighted percentage of adults who have ever tried WTS are presented in Figure 1. Overall, the District of Columbia (DC) had the highest rate of ever WTS use (17.3%), followed by Nevada (NV; 15.8%), California (CA; 15.5%), Colorado (CO; 14.0%), and New Mexico (NM; 13.4%). The lowest rates were found in West Virginia (3.8%), Alabama (3.8%), North Dakota (3.5%), Mississippi (3.1%), South Carolina (3.1%), and Nebraska (3.0%). Among males, the highest prevalence rates of ever WTS were encountered in CA (21.4%), followed by DC (19.9%), NV (19.4%), CO (19.1%), and NM (18.0%). The highest rates among females were in DC (15.0%), NV (12.1%), NM (10.2%), CA (9.8%), and Oregon (9.6%).

Correlates of Waterpipe Tobacco Smoking

In the adjusted logistic regression model for *ever* WTS, adult males were more likely than females to smoke waterpipe tobacco (Odds Ratio [OR] = 2.0). Compared with respondents aged between 35 and 44 years, young adults (between 18–24 years) were significantly more likely to use WTS (OR = 8.8). Non-Hispanic Blacks were significantly less likely to have used waterpipe tobacco (OR = 0.3), whereas non-Hispanics of other races (OR = 1.7) were significantly more likely compared to non-Hispanic Whites. Those with a high school degree (OR = 1.4) and those who attended at least some college (OR = 2.3) were significantly more likely to have ever tried WTS compared to those without a high school diploma. Finally, LGBT respondents were significantly more likely to have tried WTS (OR = 1.5) compared to heterosexual respondents, and current cigarette smokers were significantly more likely to have tried WTS relative to never smokers of cigarettes (OR = 3.6).

In the model for *current* WTS, adult males were more likely than females to smoke waterpipe tobacco (OR = 1.9). Compared with respondents aged between 35 and 44 years, young adults (between 18–24 years) were significantly more likely to use WTS (OR = 18.1). Asians (OR = 1.9) and non-Hispanics of other races (OR = 2.3) were more likely to be current WTS users compared to non-Hispanic Whites. Finally, LGBT respondents were more likely to smoke waterpipe tobacco (OR = 2.2) compared with non-LGBT respondents, and current cigarette smokers (OR = 4.1) and former smokers (OR = 1.7) were significantly more likely to use WTS relative to never smokers of cigarettes. Finally, we further examined regression models stratified by gender but found no major differences (results not shown).

DISCUSSION

This study provides an opportunity to assess the national status of WTS, including its concentration in particular geographic areas and sociodemographic groups. In terms of geographical distribution, the prevalence of ever WTS was highest in DC and Western states, and lowest in the Southern and Midwestern states. This study confirms that some states with the longest history of smoke-free policies (American Nonsmokers' Rights

Foundation, 2014) and the lowest cigarette smoking prevalence (King et al., 2012) – e.g., CA, NY, and DC – are among the highest in WTS prevalence. An investigation of the largest US jurisdictions that ban cigarette smoking in bars had found that the vast majority of them permit WTS via exemption (Primack et al., 2012). This issue deserves further investigation to determine whether high prevalence rates were driven by substitution from cigarette smoking in places with comprehensive smoking bans, or other drivers such as larger populations with Arab-American ancestry, known to have high rates of WTS (Akl et al., 2011). The fact that adults who identified themselves as non-Hispanic Other had the highest WTS prevalence among all racial/ethnic groups may be at least partially due to Arab American respondents, and calls for further investigation into this group.

Other primary determinants of WTS in the US according to our study were age, gender and educational status. The results indicated that almost 1 in 3 adults between the ages of 18 and 24 years have tried WTS in their lifetime, and approximately 8% of them used WTS in the 30 days preceding their interview. The findings from the analysis suggest 18–24 year olds, particularly males with at least some college education, were the largest group to have tried WTS or were currently WTS users. As in other parts of the world, WTS seems to be most prevalent among educated youth, especially males (Akl et al., 2011; Primack et al., 2013; Sutfin et al., 2011). Unlike cigarette smoking and other forms of tobacco (King et al., 2012), WTS prevalence is not higher among less educated and lower income groups. Typically, these trends have been facilitated by WTS establishments locating near college campuses and the role of the Internet in the promotion, marketing, and sales of WTS-related products (Salloum et al., 2014). Also unlike cigarette smoking, there are no major differences in correlates of *ever* vs. *current* WTS. This difference between cigarette and WTS is likely observed because cigarette smoking is a primarily daily habit, whereas WTS is a primarily intermittent habit (Maziak et al., 2014b).

Another vulnerable population that was revealed in this study in terms of WTS is the LGBT community, where 21% have used WTS in their lifetime and 6% were current users. Though it is well established that smoking rates are higher among sexual minorities (Blosnich et al., 2011), the finding that LGBT adults are twice as likely than heterosexuals to be current waterpipe users deserves further investigation. More specific information is needed on the contexts and frequency of WTS use among this group, its relationship to regular cigarette smoking, and its distribution across different sexual minority communities to guide efforts that target those at most risk with prevention and tailored intervention strategies.

While only the first wave of NATS is currently available for analysis, comparison of our results with national trends from Internet searches for WTS (Salloum et al., 2014) suggests that prevalence in the US is rising. As WTS prevalence increases, the fact that many young users are concurrent cigarette smokers should be a cause for concern to policymakers. This is especially worrisome because WTS both could bridge to cigarette smoking among youth who would have otherwise not become cigarette smokers and it could thwart cessation attempts among adult cigarette smokers (Maziak, 2014a). Subsequent efforts should be made to increase awareness of the harmful effects of WTS among young adults, and to ensure the tobacco control community is informed about the potential of WTS to hinder long-fought successes in tobacco control.

As policy implications of WTS are considered, these data along with others suggest that college towns and cities with commercial WTS establishments in states with the largest percentage of WTS users should be a priority. The 2009 Family Smoking Prevention and Tobacco Control Act provides a useful framework to guide and prioritize policy options to curb WTS in light of epidemiological data about its spread and correlates. Recently, the FDA issued ‘deeming’ regulations that made possible the inclusion of WTS under its regulating authority (Department of Health and Human Services: Food and Drug Administration, 2014). This presents a chance for policymakers to tighten and enforce smoke-free and under-age smoking provisions nationwide. For example, despite bans on indoor smoking in the US, a combination of loopholes and exemptions have allowed WTS establishments to thrive, especially around college campuses. Other policy tools that are within the scope of FDA regulation (Department of Health and Human Services: Food and Drug Administration, 2014) include: requirement for a minimum age of purchase; banning of flavors, which are especially attractive to youth (Maziak et al., 2004a); inclusion of prominent pictorial health warning labels on tobacco products and smoking devices; proper disclosure of product ingredients; and regulation of Internet sales.

Despite the value of this study as the first to utilize a national sample to describe in detail the spread and correlates of WTS among US adults, we note several limitations. First, tobacco use was self-reported. While studies have found under-reporting in self-reported cigarette use compared with biochemical tests, it is unclear whether self-reports of WTS use carry the same bias. Second, cell-phone responses were excluded from state-specific estimates for states with fewer than 200 cell phone respondents (King et al., 2012). This limits generalizability of results within this subpopulation. Third, we did not present state-level WTS current use rates because of small sample sizes for some states. Fourth, the data were only representative at the national and state levels. We did not have the appropriate scale to analyze cultural and ethnic correlates of WTS at the level of counties or metropolitan statistical areas. Finally, the study results are cross-sectional and cannot be used to assess recent trends or tobacco control policy impact. Nonetheless, this is the first such national surveillance of waterpipe use in the US and it establishes a baseline for later assessment of WTS trends.

Given the potential of WTS to harm users and those surrounding them, hook young people on nicotine, and thwart tobacco control efforts more generally, these findings regarding its spread among US adults should sound the alarm about WTS becoming an important public health problem in the US. Continuing surveillance of WTS is critical, as is its inclusion in the development of the next generation of tobacco control policies, regulations, and programs.

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Highlights

- National prevalence of waterpipe ever smoking was 9.8% and current smoking is 1.5%
- Highest prevalence by state/district: DC (17.3%), NV (15.8%), and CA (15.5%)
- Prevalence was highest among 18–24 year olds (28.4%) and LGBT (21.1%)

Figure 1a

Figure 1b

Figure 1c

Figure 1.

Percent of US adults who have ever smoked tobacco from a waterpipe, by state, in the United States: National Adult Tobacco Survey, 2009–2010

(A) Overall

(B) Among males only

(C) Among females only

Table 1

Estimates and adjusted logistic model of factors associated with waterpipe tobacco *ever* and *current*^a smoking, among U.S. adults aged 18 years:
National Adult Tobacco Survey, 2009–2010

Characteristics	N	%, WTS ever (95% CI)	OR, WTS ever (95% CI)	%, WTS current (95% CI)	OR, WTS current (95% CI)
Gender					
Female	71,959	6.3 (5.9, 6.7)	-	0.9 (0.7, 1.0)	-
Male	46,449	13.4 (12.7, 14.1)	2.0 (1.8, 2.2)	2.3 (1.9, 2.6)	1.9 (1.5, 2.4)
Age, years					
65	32,321	1.8 (1.5, 2.1)	0.3 (0.2, 0.3)	0.1 (0.0, 0.1)	0.2 (0.1, 0.5)
45–64	49,347	4.8 (4.4, 5.2)	0.7 (0.6, 0.8)	0.3 (0.2, 0.4)	0.5 (0.3, 1.0)
35–44	17,005	6.8 (6.0, 7.6)	-	0.5 (0.3, 0.7)	-
25–34	11,951	16.3 (15.0, 17.6)	2.9 (2.4, 3.4)	1.9 (1.4, 2.4)	3.7 (2.2, 6.3)
18–24	5,117	28.6 (26.7, 30.5)	8.8 (7.4, 10.4)	7.8 (6.7, 9.0)	18.1 (11.0, 30.0)
Race/ethnicity					
White, non-Hispanic	97,255	9.8 (9.4, 10.2)	-	1.3 (1.1, 1.5)	-
Black, non-Hispanic	8,664	3.6 (2.9, 4.3)	0.3 (0.3, 0.4)	0.7 (0.4, 1.2)	0.5 (0.3, 0.9)
Asian, non-Hispanic	2,135	12.9 (10.1, 15.7)	1.0 (0.8, 1.4)	2.7 (1.5, 4.8)	1.9 (1.0, 3.5)
Other, non-Hispanic	4,320	17.6 (14.9, 20.3)	1.7 (1.4, 2.1)	4.0 (2.8, 5.8)	2.3 (1.5, 3.6)
Hispanic	4,543	12.4 (10.6, 14.3)	1.1 (0.9, 1.3)	2.7 (2.0, 3.7)	1.4 (1.0, 2.1)
Education					
0–12 years (no diploma)	8,234	7.1 (5.6, 8.5)	-	1.6 (1.1, 2.3)	-
High school graduate	26,768	9.4 (8.7, 10.2)	1.4 (1.1, 1.8)	2.1 (1.7, 2.5)	1.4 (0.9, 2.3)
Some college (no degree)	18,483	12.4 (11.4, 13.5)	2.3 (1.8, 3.0)	1.7 (1.4, 2.2)	1.4 (0.9, 2.3)
Associate degree	16,511	8.9 (7.9, 9.8)	1.8 (1.4, 2.4)	1.2 (0.9, 1.8)	1.4 (0.8, 2.5)
Undergraduate degree	26,611	11.8 (11.0, 12.6)	3.0 (2.3, 3.9)	1.1 (0.8, 1.5)	1.6 (1.0, 2.7)
Graduate degree	21,177	9.4 (8.6, 10.2)	3.3 (2.5, 4.3)	0.5 (0.3, 0.9)	1.3 (0.6, 2.6)
Annual household income, \$					
<20,000	12,282	9.8 (8.4, 11.1)	-	1.6 (1.2, 2.1)	-
20,000–49,999	34,001	9.5 (8.8, 10.2)	1.0 (0.9, 1.2)	1.3 (1.1, 1.6)	0.7 (0.5, 1.0)
50,000–99,999	36,037	10.3 (9.5, 11.0)	1.1 (1.0, 1.3)	1.6 (1.3, 2.0)	1.2 (0.8, 1.7)
100,000	20,934	12.0 (11.0, 13.0)	1.4 (1.2, 1.6)	1.6 (1.2, 2.2)	1.4 (0.9, 2.2)

Characteristics	N	%, WTS ever (95% CI)	OR, WTS ever (95% CI)	%, WTS current (95% CI)	OR, WTS current (95% CI)
Sexual orientation					
Heterosexual/straight	108,410	9.8 (9.4, 10.3)	-	1.5 (1.3, 1.7)	-
LGBT	2,431	21.1 (17.5, 24.7)	1.5 (1.2, 2.0)	6.1 (4.1, 8.9)	2.2 (1.3, 3.6)
Concurrent cigarette use					
Never smoker	67,680	7.0 (6.5, 7.4)	-	1.0 (0.8, 1.2)	-
Current smoker	16,542	17.7 (16.5, 18.9)	3.6 (3.2, 4.1)	4.0 (3.3, 4.7)	4.1 (3.1, 5.4)
Former smoker	34,359	9.9 (9.1, 10.8)	2.9 (2.6, 3.3)	0.7 (0.5, 0.9)	1.7 (1.1, 2.5)
Total	118,581	9.8 (9.4, 10.2)		1.5 (1.4, 1.7)	

Note: Estimates included both landline and cell phone respondents;

WTS: waterpipe tobacco smoking; OR: odds ratio; CI: confidence interval; LGBT: lesbian, gay, bisexual, or transgender;

^aReported ever smoking tobacco in a waterpipe in their lifetime, and at the time of the survey, reported smoking tobacco in a waterpipe on at least 1 day within the past 30 days.