Tobacco and nicotine delivery product use in a U.S. national sample of women of reproductive age

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ARTICLE INFO

ABSTRACT

This study examined prevalence and correlates of using cigarettes, e-cigarettes, and other tobacco/nicotine delivery products in a U.S. national sample of women of reproductive age. Weighted data were obtained from women aged 15–44 years who were not currently pregnant in the first wave of the Population Assessment of Health and Tobacco (PATH, 2013–2014) study ($N = 12,848$). 20.1% of women were current cigarette smokers, 5.9% current e-cigarette users, 4.9% current cigar smokers, and 6.5% current hookah users. Prevalence of current use of other tobacco products was < 1.0%. Current cigarette smoking was the strongest correlate of current e-cigarette use ($OR = 65.7$, 95% CI = 44.8–96.5), cigar smoking ($OR = 19.2$, 95% CI = 14.1–26.1), and hookah use ($OR = 6.6$, 95% CI = 5.1–8.5). Among former cigarette smokers, 3.8%, 6.9%, and 3.2% were also currently using e-cigarettes, hookah, and cigars, respectively. Use of other tobacco and nicotine delivery products was low among those who never smoked tobacco cigarettes: 2.5% used hookah and < 1.0% used other products. Cigarette smoking prevalence remains relatively high among women of reproductive age and strongly correlated with use of other tobacco products. Monitoring tobacco and nicotine use in this population is important due to the additional risk of adverse health impacts should they become pregnant. Clinicians working with cigarette smokers should assess for use of other tobacco products. Among women of reproductive age, use of emerging tobacco and nicotine products appears to be largely, although not exclusively, restricted to current cigarette smokers.

1. Introduction

Despite marked reductions in cigarette smoking prevalence in the general U.S. adult population over the past approximately 50 years, smoking rates among women have decreased at a slower rate than among men and have even increased among socioeconomically disadvantaged women (Chilcoat, 2009; Higgins and Chilcoat, 2009; Higgins et al., 2009, 2016; Kandel et al., 2009; Schroeder and Koh, 2014). For example, while current smoking rates for men and women in 1955 were 54% versus 24%, respectively, these rates were 24% and 18% for men and women in 2006, demonstrating an unequal decline by gender (Chilcoat, 2009). Cigarette smoking and non-cigarette tobacco use among women of reproductive age is of particular interest due to the potential for serious adverse effects of use on mother and fetus should she become pregnant, including catastrophic pregnancy complications, fetal growth restriction, and premature delivery (Bonnie et al., 2007; Cnattingius, 2004; Dietz et al., 2010; Pauly and Slotkin, 2008). Concerns about the potential for such adverse consequences of cigarette smoking before, during, and after pregnancy have led researchers to investigate risk for tobacco use among women of reproductive age (e.g., Chivers et al., 2016; Hand et al., 2015; Vurbic et al., 2015). Variables associated with cigarette smoking are well

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known (e.g., sociodemographic characteristics, drug and alcohol use/dependence, mental illness, impulsivity; Friedel et al., 2014; White et al., 2016; Higgins et al., 2016, 2015; O'Loughlin et al., 2014). Less is known about these risk factors among women of reproductive age, especially use of new and emerging tobacco product use.

Use of e-cigarettes (Breland et al., 2016; Lopez and Eissenberg, 2015; Greenhill et al., 2016; Schoenborn and Gindi, 2015; Singh et al., 2016) and other tobacco products including cigars (collapsed across large cigars, little cigars, and cigarillos; CDC, 2014; SAMHSA, 2015) and hookah (Cobb et al., 2010; Lopez et al., 2017) has increased considerably in recent years, but there is little known about the use of these products in vulnerable populations such as women of reproductive age (Baeza-Loya et al., 2014; Benowitz, 2014; Chivers et al., 2016; Lopez and Eissenberg, 2015). Women of reproductive age (15–44) represent an important and unique segment of the population where health decisions about tobacco/nicotine use have the potential for substantial and multi-generational impact. Because half of all pregnancies are unplanned the CDC recommends healthy preconception behavior to all women of reproductive age, not just those planning to become pregnant (CDC, 2017). The purpose of the present study was to estimate the prevalence and correlates of tobacco/nicotine use across a broad list of commercially available products in a national sample of women of reproductive age. This study focuses on women who were not pregnant at the time of survey completion. Our group is conducting parallel studies of use of these same tobacco/nicotine products during pregnancy using the Population Assessment of Tobacco and Health (PATH) survey (Kurti et al., 2017; Kurti et al., under review).

2. Method

2.1. Data source

Data were obtained from the PATH survey, a longitudinal, nationally representative study of the U.S. non-institutionalized population aged ≥12 years that is designed to measure prevalence and correlates of tobacco use. A detailed description of survey procedures has been provided previously (Hyland et al., 2017; Kasza et al., 2017; USDHHS, 2014). Weighted data from Wave 1, collected September 2013 through December 2014, were used. Analyses focus on non-pregnant females aged 15–44 years ($N = 12,848$). PATH recruitment across each of the survey years was completed using a four-stage, stratified probability sample design in which a predetermined number of participants were randomly recruited by home address ($N = 45,971$, Adult $N = 32,320$). The sample included current, former, and never tobacco users, and was weighted and adjusted to reflect the U.S. population. Respondents completed computer- and audio-assisted structured interviews. Youth and adult respondents were compensated $25 and $35 for completing the interview, respectively. The time required to complete the survey was approximately 45 min. The weighted interview response rate from Wave 1 was 78.4% for youth and 74.0% for adults.

2.2. Measures

2.2.1. Sociodemographics

Data on respondents' age, race/ethnicity, education, U.S. census and region were obtained. Educational attainment was coded as Adolescent for those in the youth sample, because they were largely not old enough to have completed their education.

2.2.2. Tobacco cigarette smoking

Respondents were identified as current smokers, former smokers, or never-smokers. Current smokers among those 18 years of age and older were defined as those smoking every day or some days at the time of survey completion, regardless of whether they (a) reported smoking ≥100 lifetime cigarettes, or (b) did not report smoking ≥100 lifetime cigarettes. Former smokers were defined as respondents who did not

report smoking at all at the time of survey completion and either (a) reported smoking ≥100 lifetime cigarettes previously, or (b) reported previously smoking but not ≥100 lifetime cigarettes. Never-smokers were respondents who did not fall into the other two categories. Adolescent current smokers were defined as respondents who reported smoking at least one cigarette in the previous 30 days. Former smokers reported having ever tried smoking, even one or two puffs, but not having smoked in the previous 30 days. Never smokers reported never having tried cigarettes.

2.2.3. Other non-cigarette tobacco product use

Prevalence of current, former, or never-use was also obtained for the following products: e-cigarettes, hookah, any cigar (i.e., an aggregate category of traditional cigars, filtered cigars, cigarillos), smokeless tobacco (i.e., an aggregate category of moist snuff, dip, spit, or chewing tobacco and snus), pipe, and dissolvable tobacco. For all products, adult current users were defined as respondents who were now using some days or every day, regardless of whether they previously used the product regularly. Former users were defined as respondents who were not using at all now, but had previously used the product. Never-users were respondents who did not fall into the other two categories. Adolescent users of other tobacco products were defined as respondents who reported having used the specific tobacco product at least once in the previous 30 days. Former users reported having ever tried a particular product, but not having used it in the previous 30 days. Never users reported never having tried the specific tobacco product.

2.2.4. Psychiatric status

The GAIN-SS (Dennis et al., 2006) is designed to measure possible internalizing and externalizing psychiatric disorders, substance use disorders, and crime/violence problems. A total score can be obtained, as well as four subscale scores. We report on two subscales that measure constructs associated with smoking: the Internalizing (anxiety, depression) and Externalizing (attention deficits, hyperactivity, impulsivity) subscales. Scores on those subscales range from 0–4 to 0–5, respectively, indicating the number of symptoms experienced in the past year.

2.2.5. Other substance use

Alcohol use was defined as any alcohol consumption within the past year. Illicit drug use was defined as using at least one of the following substances in the past year: marijuana, cocaine or crack, prescription drugs like painkillers or sedatives used without a prescription, stimulants like methamphetamine or speed, or any other drugs such as heroin, inhalants, solvents, or hallucinogens.

2.3. Statistical methods

Frequencies and weighted percentages were calculated across all females aged 15–44 years of age who endorsed not being pregnant at the time they completed the survey. Frequencies and weighted percentages of current, former, and never-use of all tobacco products examined in this report were evaluated overall and separately within groups defined by tobacco cigarette smoking status (i.e., current, former, and never-smokers).

Logistic regression was used to identify variables associated with current use of those products for which overall prevalence was > 1%. These products included (a) conventional tobacco cigarettes, (b) e-cigarettes, (c) hookah, and (d) cigars. The regression for each outcome involved two steps. First, we used simple logistic regression to examine associations between the variables described above (e.g., sociodemographics, psychiatric status, alcohol or illicit drug use) with the outcome. Second, independent variables were included in a multiple logistic regression model to determine which variables remained significantly associated with the outcome after controlling for the presence of others. All independent variables examined were retained in the

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Table 1

Sociodemographics, substance use, and psychiatric status among non-pregnant women of reproductive age ($N = 12,848$) – Population Assessment of Health and Tobacco (PATH) Study, United States, 2013–2014.

	Weighted % prevalence (95% CI)
Age	
15–24	33.9 (33.7, 34.1)
25–44	66.1 (65.9, 66.3)
Race/ethnicity[a]	
White	57.7 (56.6, 58.8)
Black	12.4 (11.7, 13.1)
Other	9.1 (8.3, 9.8)
Hispanic	20.8 (19.9, 21.8)
Education	
Adolescents	9.9 (9.8, 10.0)
Less than high school/GED	11.9 (11.5, 12.2)
High school	17.9 (17.6, 18.2)
Some college	32.6 (32.2, 33.0)
Bachelor's degree/advanced	27.8 (27.4, 28.1)
U.S. census region	
Northeast	17.0 (16.1, 17.9)
Midwest	21.1 (19.9, 22.4)
South	37.4 (36.0, 38.8)
West	24.4 (23.2, 25.7)
Alcohol use[b]	
Past year alcohol use	68.1 (66.2, 69.9)
Illicit drug use[c]	
Past year illicit drug use	20.0 (18.8, 21.1)
	M (SE)
Psychiatric status[d]	
Internalizing scale	1.5 (0.02)
Externalizing scale	0.9 (0.01)

Notes.

[a] The four racial/ethnicity categories (White, Black, Other, Hispanic) are mutually exclusive; persons identifying as Hispanic are categorized as such, regardless of race, "Other" includes non-Hispanic persons of two or more races and persons belonging to racial groups other than non-Hispanic White or non-Hispanic Black.

[b] Self-reported alcohol use within the past year.

[c] Self-reported use of at least one of the following illicit drugs with in the past year: marijuana, cocaine or crack, prescription drugs such as painkillers or sedatives used without a prescription, stimulants like methamphetamine or speed, or any other drugs such as heroin, inhalants, solvents, or hallucinogens.

[d] Represents the average number of symptoms experienced in the past year reflecting a possible internalizing or externalizing psychiatric disorder (score ranges 0 to 4 and 0 to 5, respectively), as measured by the Gain Short Screener (GAIN-SS).

multiple logistic regression analyses in order to ensure comparability of results across models. Odds ratios in those models represent the odds of using the product in question adjusting for all other variables remaining in the final model.

All analyses were conducted using SAS 9.4 software (SAS Institute, Cary, NC) and statistical significance was defined as $p < .05$ (2-tailed). All prevalence and OR estimates were weighted to account for the complex sampling scheme, using weighting variables included with the restricted use dataset. Variance estimation was conducted as a variant of balanced repeated replication known as Fay's methods, using a predetermined value ε set to 0.3, recommended as the preferred procedure for the PATH study (Judkins, 1990; McCarthy, 1969). Missing data on any variable resulted in case-wise deletion of that respondent.

3. Results

3.1. Characteristics

Participant characteristics are reported in Table 1. Slightly more than a third (33.9%) were between the ages of 15 and 24, with the remaining almost two-thirds 25–44 years of age. Almost 40% attained a high school education or less or were 15–17 years of age so their highest educational attainment could not be assessed, and similar proportions of participants were represented across three of the four Census regions,

with a slightly higher proportion from the South (37.4%). 68.1% endorsed past year alcohol use and 20% past year illicit drug use. Prior pregnancy status could only be obtained for women over the age of 18 and thus is not shown in Table 1. Among those ≥ 18, 62.3% (95% CI: 60.9%, 63.8%) reported having ever been pregnant.

3.2. Prevalence of use of tobacco products

Overall weighted prevalence of current, former, and never use of all six tobacco/nicotine delivery products is displayed in Table 2, including prevalence of use of each product within groups defined by tobacco cigarette smoking status. The most commonly used product was conventional tobacco cigarettes (20.1%), followed by hookah (6.5%), e-cigarettes (5.9%), and any cigar (4.9%). Prevalence of current use was < 1.0% for the remaining nicotine/tobacco products: smokeless or snus, pipe, and dissolvables.

Prevalence of current use of other tobacco products was graded corresponding to current, former, and never cigarette smoker status. For example, prevalence of current e-cigarette use was 22.5%, 3.8%, and 0.4% among current, former, and never smokers, respectively. Similar patterns were seen for current cigar use, 17.5%, 3.2%, and 0.8% among current, former, and never smokers, respectively, and hookah use, 15.3%, 6.9%, and 2.5% among current, former, and never smokers, respectively.

3.3. Logistic regression modeling

3.3.1. Conventional tobacco cigarettes

Table 3 shows results from the multiple logistic regression model predicting current cigarette smoking. All of the sociodemographic, substance use, and psychiatric variables examined were significantly associated with cigarette smoking in simple logistic regression models. Among those variables, all but Externalizing scale scores remained associated with cigarette smoking in the multiple logistic models. More specifically, those who were older, less educated, and non-Hispanic White were more likely to smoke cigarettes. Living outside the Western region of the U.S., past year alcohol and drug use, and higher scores on the GAIN-SS Internalizing Scale also independently predicted cigarette smoking. Educational attainment was the strongest predictor of cigarette smoking, with odds of current smoking increasing as an inverse function of educational attainment among women in the adult sample.

3.3.2. E-cigarettes

Table 3 shows results from the multiple logistic regression model predicting current e-cigarette use. All sociodemographic, substance use, and psychiatric variables examined except age were significantly associated with e-cigarette use in the simple regression models. In the multiple logistic regression model, current cigarette smokers were more likely than former and never smokers to be classified as e-cigarette users, with current cigarette smokers having 66 times greater odds of using e-cigarettes than never smokers, while former cigarette smokers had 11 times greater odds. Those who had less than a Bachelor's Degree, were White, endorsed illicit drug use in the past year, or had higher scores on the GAIN-SS Internalizing Scale were also more likely to use e-cigarettes.

3.3.3. Cigars

Table 4 shows results from the multiple logistic regression model predicting any current cigar smoking. Again all sociodemographic, substance use, and psychiatric variables examined were significantly associated with any cigar use in the simple models. In the multiple logistic regression model, cigarette smoking was the strongest predictor of cigar smoking. The effect of cigarette smoking on cigar smoking was graded, being strongest among current users, followed by former users. Current and former cigarette smokers had 19.2 and 3.8 times greater odds of smoking cigars relative to never smokers, respectively. Those

Table 2

Weighted prevalence of use of conventional tobacco cigarettes[a] and other tobacco/nicotine delivery products[b] overall and across three categories of tobacco cigarette smoking status: current, former, and never smoker – Population Assessment of Tobacco and Health (PATH) Study, United States, 2013–2014.

	Overall	Current smokers	Former smokers	Never smokers
	(N = 12,848)	(n = 3933)	(n = 3488)	(n = 5427)
	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)
Tobacco cigarettes				
Current smoker	20.1 (19.1, 21.0)	100.0 (100.0, 100.0)	–	–
Former smoker	32.7 (31.4, 34.0)	–	100.0 (100.0, 100.0)	–
Never smoker	47.2 (45.7, 48.8)	–	–	100.0 (100.0, 100.0)
E-cigarettes				
Current user	5.9 (5.5, 6.4)	22.5 (20.9, 24.0)	3.8 (3.2, 4.4)	0.4 (0.3, 0.5)
Former user	14.8 (14.0, 15.6)	42.9 (41.0, 44.8)	16.1 (14.7, 17.5)	2.0 (1.7, 2.3)
Never user	79.3 (78.3, 80.2)	34.6 (32.8, 36.5)	80.1 (78.5, 81.7)	97.6 (97.3, 98.0)
Any cigar[c]				
Current user	4.9 (4.6, 5.3)	17.5 (16.3, 18.7)	3.2 (2.6, 3.7)	0.8 (0.6, 1.0)
Former user	24.6 (23.4, 25.8)	42.3 (40.4, 44.1)	42.9 (40.2, 45.6)	4.5 (3.7, 5.2)
Never user	70.4 (69.1, 71.7)	40.2 (38.3, 42.2)	53.9 (51.2, 56.6)	94.7 (93.9, 95.5)
Hookah				
Current user	6.5 (6.0, 7.0)	15.3 (13.9, 16.7)	6.9 (6.2, 7.7)	2.5 (2.1, 2.9)
Former user	17.2 (16.2, 18.1)	24.1 (22.2, 25.9)	26.2 (24.0, 28.3)	7.9 (7.2, 8.7)
Never user	76.3 (75.1, 77.6)	60.6 (58.3, 63.0)	66.9 (64.5, 69.3)	89.6 (88.6, 90.5)
Smokeless and snus				
Current user	0.5 (0.4, 0.6)	1.7 (1.3, 2.2)	0.4 (0.2, 0.6)	0.1 (0.0, 0.2)
Former user	6.0 (5.4, 6.5)	13.8 (12.6, 15.0)	9.4 (8.0, 10.8)	0.3 (0.1, 0.5)
Never user	93.5 (93.0, 94.1)	84.5 (83.1, 85.8)	90.2 (88.8, 91.6)	99.6 (99.4, 99.8)
Pipe				
Current user	0.3 (0.2, 0.4)	1.2 (0.8, 1.6)	0.2 (0.0, 0.3)	0.0 (0.0, 0.1)
Former user	4.4 (4.0, 4.9)	12.2 (11.0, 13.5)	5.5 (4.4, 6.6)	0.3 (0.1, 0.5)
Never user	95.3 (94.8, 95.8)	86.6 (85.3, 87.9)	94.3 (93.2, 95.4)	99.6 (99.4, 99.9)
Dissolvable[d]				
Current user	0.1 (0.0, 0.1)			
Former user	0.3 (0.2, 0.4)			
Never user	99.6 (99.56, 99.7)			

Notes.

[a] For tobacco cigarette smoking, categories of use were (a) current smoker = self-reported smoking ≥100 lifetime cigarettes and smoking every day or some days now, OR self-reported smoking < 100 lifetime cigarettes and smoking every day or some days now, (b) former smoker = self-reported smoking ≥100 lifetime cigarettes and not smoking at all now, OR self-reported smoking < 100 lifetime cigarettes and not smoking at all now, and (c) never smoker = self-reported no lifetime or current cigarette smoking. Smoking status could not be determined for one woman.

[b] For all other non-cigarette tobacco/nicotine-delivery products, categories of use were (a) current user = has ever used the product fairly regularly and using every day some days now, OR has used the product but not regularly and using every day or some days now, (b) former user = has ever used the product fairly regularly but is not using at all now, OR has used the product but not regularly and is not using at all now, and (c) never user = has never used the product fairly regularly and is not using at all now.

[c] Any cigar includes traditional cigars, filtered cigars, and/or cigarillo. All prevalence estimates weighted to reflect the sampling design and, thus, are estimates of the non-institutionalized United States population.

[d] Use of dissolvable tobacco is not broken down by cigarette smoking status due to small cell sizes.

who were younger, non-White, had less than high school or some college education, or had used alcohol or illicit drugs in the past year were more likely to report any current cigar use.

3.3.4. Hookah

Table 4 shows the multiple logistic regression model predicting current hookah use. Consistent with each of the models described above, all sociodemographic, substance use and psychiatric variables examined were significantly associated with use in the simple models. In the multiple logistic regression model, being 15–24 years and a current cigarette smoker were the strongest predictor of hookah use. In addition, being a former smoker, more educated, White, living in the West, and using alcohol or illicit drugs in the past year also predicted current use of hookah.

3.3.5. Other products

Logistic regression modeling was not conducted for smokeless and snus, pipe, or dissolvable tobacco because overall prevalence of current use of these products was < 1%.

4. Discussion

The present results offer a unique opportunity to identify and compare predictors of cigarette smoking, the most prevalent and conventional form of tobacco/nicotine use among women of reproductive age, with those associated with use of newer or less conventional products. The predictors of cigarette smoking are consistent with those identified previously in women of reproductive age and other smokers: younger age, lower educational attainment, non-Hispanic White race/ethnicity, poverty, residing in a U.S. region other than the West, alcohol and drug use, and elevated internalizing (i.e., anxiety & depressive) symptoms (Higgins et al., 2009, 2016; Kandel et al., 2009). Regarding use of other products, being a current smoker is by far the strongest predictor of current use of e-cigarettes, cigars, and hookah consistent with what has been reported previously for e-cigarettes in this population (Chivers et al., 2016). There is great interest in monitoring the extent to which the rapidly changing tobacco/nicotine marketplace may be reaching and impacting those who have never smoked cigarettes. The current results raise no alarms in that regard although the 2.7% prevalence of hookah use among never smokers should not go unnoticed, which we discuss more below. Interestingly, each of the predictors of tobacco cigarette smoking in the present study also predicted e-cigarette use even after controlling for the influence of cigarette smoking, which underscores the considerable overlap in the processes underpinning risk for using these products (Hampson et al., 2015). As might be expected, current cigar use shares correlates with

Table 3
Multiple logistic regression analyses predicting current tobacco cigarette smoking and e-cigarette use among non-pregnant females age 15–44 years ($n = 12,848$) – Population Assessment of Health and Tobacco (PATH) Study, United States, 2013–2014.

	Cigarette smoking				E-cigarette use			
	AOR	95% CI		p	AOR	95% CI		p
Cigarette smoking								< .001
Never smoker					Reference			
Former smoker					10.74	(7.10,	16.25)	
Current smoker					65.74	(44.76,	96.54)	
Age				< .001				.56
15 to 24 years old	0.54	(0.47,	0.61)		1.05	(0.90,	1.21)	
25 to 44 years old	Reference				Reference			
Education				< .001				< .001
Adolescent	1.47	(1.16,	1.85)		2.28	(1.61,	3.21)	
Less than high school/GED	11.15	(8.87,	14.01)		1.53	(1.14,	2.04)	
High school graduate	6.06	(4.92,	7.46)		1.51	(1.14,	1.98)	
Some college/associates degree	3.91	(3.31,	4.62)		1.59	(1.25,	2.03)	
Bachelor's degree or higher	Reference				Reference			
Race[a]				< .001				.02
Non-Hispanic White	Reference				Reference			
Non-Hispanic Black	0.60	(0.49,	0.73)		0.65	(0.49,	0.85)	
Other	0.69	(0.54,	0.89)		0.89	(0.64,	1.23)	
Hispanic	0.38	(0.32,	0.46)		0.87	(0.71,	1.07)	
Region				< .001				.01
West	Reference				Reference			
Northeast	1.52	(1.26,	1.83)		0.63	(0.44,	0.88)	
Midwest	1.67	(1.43,	1.96)		0.85	(0.65,	1.10)	
South	1.43	(1.22,	1.69)		1.02	(0.79,	1.31)	
Other substance use								
Past year alcohol use[b]	1.65	(1.39,	1.95)	< .001	0.92	(0.76,	1.12)	.42
Past year illicit drug use[c]	3.27	(2.87,	3.73)	< .001	1.42	(1.19,	1.68)	< .001
GAIN-SS[d]								
Externalizing	1.05	(0.99,	1.12)	.13	0.99	(0.93,	1.06)	.81
Internalizing	1.21	(1.15,	1.27)	< .001	1.08	(1.01,	1.14)	.02

Notes.

[a] The four racial/ethnicity categories (White, Black, Other, Hispanic) are mutually exclusive; persons identifying as Hispanic are categorized as such, regardless of race, "Other" includes non-Hispanic persons of two or more races and persons belonging to racial groups other than non-Hispanic White or non-Hispanic Black.

[b] Self-reported alcohol use within the past year.

[c] Self-reported use of at least one of the following illicit drugs with in the past year: marijuana, cocaine or crack, stimulants like methamphetamine or speed, or any other drugs such as heroin, inhalants, solvents, or hallucinogens.

[d] Represents the average number of symptoms experienced in the past year reflecting a possible internalizing or externalizing psychiatric disorder (max score = 4 and 5, respectively), as measured by the Gain Short Screener (GAIN-SS).

predictors of tobacco cigarette smoking but also some notable differences. Like cigarettes, cigar use among women of reproductive age is related to race/ethnicity, but in the opposite direction, with use being higher in all race/ethnicity categories compared to non-Hispanic Whites, and is not associated with educational attainment or internalizing scores after controlling for the influence of cigarette smoking, similar to recently published evidence with an adult population (Nollen et al., 2016). Hookah use, while also strongly associated with tobacco cigarette smoking and sharing several correlates including younger age and use of alcohol/drugs, is predicted by higher rather than lower education, by minority rather than non-Hispanic White race/ethnicity, is highest in the West compared to the three other U.S. regions, and is not associated with poverty or psychiatric symptoms. These results on hookah are consistent with those reported previously using the 2014 National Adult Tobacco Survey (NATS) (Agaku et al., 2014) and other nationally representative samples (e.g., Cavazos-Rehg et al., 2015).

Characterizing prevalence and correlates of using a broad array of commercially available tobacco products in a U.S. national sample of reproductive-aged women is unique, thus there are few optimal comparison studies particularly with respect to non-cigarette tobacco products. Regarding prevalence of cigarette smoking, one reasonable comparison is Alshaarawy and Anthony's (2015) report where smoking prevalence among non-pregnant women aged 12–44 years in the 2002–2009 National Survey on Drug Use and Health (NSDUH) was 26.7% (95% CIs: 26.4, 27.1). Non-overlapping CIs between this estimate and smoking prevalence in the current study of 21.4% (95% CI:

20.4%, 22.5%) suggest a decrease in smoking prevalence over the past decade. The differences in the ages of study participants as well as slightly different definitions of current smoking used across surveys precludes a precise estimate of the magnitude of this decrease, but the results suggest a decrease of sufficient magnitude to be meaningful in terms of public health impact. While that is encouraging, it is also important to note that the prevalence of current cigarette smoking among women of reproductive age in the present study is still considerably higher than prevalence for U.S. adult women overall (15.1%,) reported in the 2014 NATS (Hu et al., 2016) and 15.6% reported in the 2013/2014 PATH Wave 1 (Kasza et al., 2017, Supplemental Appendix S7), underscoring the importance of continuing to monitor use and develop more effective interventions to reduce cigarette smoking among women of reproductive age. To our knowledge, the present study is the first to report prevalence of using individual non-cigarette tobacco products among U.S. women of reproductive age, thus reasonable comparison studies are again not available to understand how prevalence may be changing over time. However, as noted with cigarettes, prevalence of current use of e-cigarettes, cigars, and hookah in the present sample of reproductive age women (e-cigarettes: 6.2%; cigars: 5.1%; hookah: 6.8%) is considerably higher than rates seen among U.S. adult women overall (e-cigarettes: 2.8%; cigars: 0.8%; hookah: 0.4%) (Hu et al., 2016).

It is well established that a sizeable proportion of women quit smoking upon learning of a pregnancy (Heil et al., 2014; Morasco et al., 2006; Solomon and Quinn, 2004) although the majority continue

Table 4

Multiple logistic regression analyses predicting current cigar and hookah smoking among non-pregnant females age 15–44 years (*n* = 12,848) – Population Assessment of Health and Tobacco (PATH) Study, United States, 2013–2014.

	Cigar smoking			Hookah smoking		
	OR	95% CI	p	AOR	95% CI	p
Cigarette smoking			< .001			< .001
Never smoker	Reference			Reference		
Former smoker	3.81	(2.75, 5.27)		2.78	(2.20, 3.50)	
Current smoker	19.20	(14.13, 26.07)		6.59	(5.09, 8.52)	
Age			< .001			< .001
15 to 24 years old	2.03	(1.68, 2.44)		6.05	(5.04, 7.26)	
25 to 44 years old	Reference			Reference		
Education			.03			< .001
Adolescent	1.01	(0.69, 1.47)		0.27	(0.19, 0.38)	
Less than high school/GED	1.63	(1.16, 2.28)		0.67	(0.51, 0.88)	
High school graduate	1.32	(0.94, 1.85)		0.74	(0.57, 0.95)	
Some college/associates degree	1.34	(1.04, 1.73)		1.07	(0.85, 1.36)	
Bachelor's degree or higher	Reference			Reference		
Race[a]			< .001			< .001
Non-Hispanic White	Reference			Reference		
Non-Hispanic Black	3.71	(2.96, 4.65)		2.10	(1.63, 2.70)	
Other	1.48	(1.04, 2.11)		1.78	(1.28, 2.50)	
Hispanic	1.64	(1.35, 2.01)		1.86	(1.51, 2.30)	
Region			.21			< .001
West	Reference			Reference		
Northeast	1.21	(0.89, 1.64)		1.09	(0.86, 1.39)	
Midwest	1.17	(0.91, 1.50)		0.63	(0.48, 0.83)	
South	1.30	(1.00, 1.69)		0.68	(0.54, 0.84)	
Other substance use						
Past year alcohol use[b]	1.30	(1.00, 1.69)	.0496	1.86	(1.51, 2.30)	< .001
Past year illicit drug use[c]	3.05	(2.55, 3.64)	< .001	2.59	(2.20, 3.06)	< .001
GAIN-SS[d]						
Externalizing	1.04	(0.98, 1.11)	.22	1.08	(1.00, 1.16)	.049
Internalizing	1.02	(0.96, 1.09)	.46	0.96	(0.90, 1.01)	.12

Notes.

[a] The four racial/ethnicity categories (White, Black, Other, Hispanic) are mutually exclusive; persons identifying as Hispanic are categorized as such, regardless of race, "Other" includes non-Hispanic persons of two or more races and persons belonging to racial groups other than non-Hispanic White or non-Hispanic Black.

[b] Self-reported alcohol use within the past year.

[c] Self-reported use of at least one of the following illicit drugs with in the past year: marijuana, cocaine or crack, stimulants like methamphetamine or speed, or any other drugs such as heroin, inhalants, solvents, or hallucinogens.

[d] Represents the average number of symptoms experienced in the past year reflecting a possible internalizing or externalizing psychiatric disorder (max score = 4 and 5, respectively), as measured by the Gain Short Screener (GAIN-SS).

smoking through the pregnancy. According to a CDC study using U.S. birth certificates, 10.9% of women who gave birth smoked before pregnancy with approximately 45% discontinuing smoking by late pregnancy (Curtin and Matthews, 2016). We know of no published reports that can be used to estimate quit rates for non-cigarette tobacco and nicotine products during pregnancy, meaning that the present results and those in our parallel studies with pregnant women will provide unique opportunities to address those knowledge gaps (Kurti et al., 2017; Kurti et al., under review).

The present results underscore the need for additional tobacco regulatory and control strategies to reduce cigarette smoking in this vulnerable population. One potential tobacco regulatory strategy in that direction is to reduce the nicotine content in cigarettes and other combusted tobacco products such that tobacco smoking would be less addictive (Donny et al., 2015; Higgins et al., 2017a). Lowering nicotine content would lower addiction severity among current smokers making it easier for them to quit smoking should they choose to do so. Nicotine content reduction could also make it easier for smokers to transition to less harmful tobacco and nicotine delivery products if that was a more preferred option, while those newly introduced to smoking would be less likely to become dependent. Regarding currently available commercial cigarettes, women who use cigarettes with the highest machine-estimated nicotine yield (full-flavor cigarettes) have greater risk of nicotine dependence and of continuing to smoke during pregnancy (Higgins et al., 2017b). Furthermore, efforts could be made to increase health messaging about tobacco use that are unique to women (e.g.,

breast and cervical cancers, diminished fertility; CDC, 2014). Not only would this be relevant for cigarette use, but also for other combustible products such as hookah. There seems to be considerable misunderstanding regarding the health risks of hookah use including risk of becoming addicted (Afifi et al., 2013; Akl et al., 2015). However, the overall amount of toxicants that hookah users are exposed to can be many times higher than the amount found from a single cigarette, posing additional adverse health risks, including the potential for addiction (Shihadeh et al., 2015; see also Lopez et al., 2017 for a review). Regarding tobacco control efforts, there needs to be greater efforts to prevent initiation of cigarette smoking among girls and young women (e.g., most smoking initiation happens by 26 years of age; Centers for Disease Control and Prevention, 2014), encourage those who have begun smoking to try to quit or reduce how much they smoke, and offering evidence-based smoking cessation interventions to women of reproductive age (Bauld et al., 2017; Higgins and Chilcoat, 2009; Higgins and Solomon, 2016).

Further research is clearly warranted based on the given findings. By focusing on only Wave 1 data from non-pregnant women of reproductive age, a baseline has been established in order to track rates over time as additional Waves from PATH become available for analysis. It will be important to continue to monitor trends in prevalence of current use of other tobacco and nicotine delivery nicotine products, especially among current and never smokers. It will also be important to examine how patterns of tobacco and nicotine product use change among women of reproductive age as they transition into and out of

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