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Waterpipe tobacco package warning exposure's impact on risk perceptions and use among young adults in the USA: a longitudinal analysis of the population assessment of tobacco and health study

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Abstract

Background—Although Food and Drug Administration (FDA)-mandated waterpipe tobacco warnings were not required until August 2018, some waterpipe tobacco packaging (WTP) sold in the USA, contained warnings prior to this date. We examined the prevalence of WTP warning exposure and whether exposure influenced risk perceptions or use among young adult (aged 18–24 years) current waterpipe users.

Methods—We used data from waves 1 (2013–2014) and 2 (2014–2015) of the Population Assessment of Tobacco and Health Study, a nationally representative longitudinal study of US adults and youth. We conducted logistic regression analyses to identify factors associated with wave 1 warning exposure, and whether wave 1 WTP warning exposure predicted wave 2 relative risk perceptions and waterpipe use.

Results—More than one-third of our sample (35.9%, 95% CI 33.5 to 38.4) reported past-month WTP warning exposure. Exposure was higher among males (adjusted OR (AOR)=1.34, 95% CI 1.04 to 1.72), those who usually do not share the waterpipe (AOR=3.10, 95% CI 1.45 to 6.60), those who purchased waterpipe tobacco (AOR=1.73, 95% CI 1.28 to 2.34), and those with a regular brand (AOR=1.84, 95% CI 1.26 to 2.68). Those exposed to WTP warnings at wave 1 were more likely than those not exposed to perceive waterpipe tobacco to be as or more harmful than

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cigarettes at wave 2 (AOR=1.35, 95% CI 1.02 to 1.78). There was no association between wave 1 WTP exposure and wave 2 waterpipe use.

Conclusions—More than one-third of US young adult current waterpipe users reported WTP warning exposure prior to FDA-mandated warning implementation. Findings suggest the mandated warning may result in high exposure among users; it will be critical to assess exposure's impact on risk perceptions and behaviour after FDA-mandated warnings are implemented.

INTRODUCTION

Waterpipe tobacco (hookah, shisha) is one of the most commonly used tobacco products among young adults in the USA. Waterpipe tobacco use is particularly common among young adults, who account for over half of all current users.[12] According to Population Assessment of Tobacco and Health Study (PATH) data from 2013 to 2014, 11.0% of US young adults reported past 30-day use in 2013–2014.[3] Often, young adults perceive waterpipe tobacco use as safer than smoking cigarettes.[4–8] However, several systematic reviews and meta-analyses have found that health effects from waterpipe tobacco use are comparable to those from cigarette use.[9–11] For example, waterpipe tobacco use exposes users to similar (and potentially higher) levels of nicotine, tar and carbon monoxide as cigarette use, and leads to increased risk for heart disease and various cancers.[9–12]

One way the US Food and Drug Administration (FDA) educates consumers about potential tobacco product risks is through warnings. Warnings are intended to inform consumers about the health risks of tobacco use.[13] Warnings on cigarette packaging are associated with changes in risk perceptions[13–16] and increased quit attempts among adults.[1718] However, for warnings to educate consumers effectively, users must be exposed to the warning. According to the Message Impact Framework (MIF), developed using communication, psychology and tobacco warnings theory and research, warning exposure is a necessary precursor to emotional and cognitive reactions and subsequent changes in knowledge, beliefs, attitudes, behavioural intentions and behaviour.[14] Therefore, it is important to understand whether users are being exposed to warnings. To our knowledge, there are no published studies on reported exposure to waterpipe tobacco package warnings in the USA. In US cigarette package warning exposure studies, exposure ranged from 89.9% of youth smokers reporting any exposure[19] to 28% of US adults reporting exposure often or very often.[20] However, as one cross-sectional survey study in Egypt[21] and one qualitative study in London[22] each found, warnings on waterpipe tobacco packages might not be noticed because users within waterpipe cafés (where a significant portion of waterpipe smoking takes place) report limited exposure to waterpipe tobacco packaging. This, in addition to lack of mandated waterpipe warnings in the USA, prior to August 2018 (compared with mandated warnings for cigarettes since the 1960s), we hypothesise reported waterpipe package warning exposure will be relatively low. We also expect those who have increased likelihood to interact with the packaging to report greater exposure. In a recent PATH Study, males and those with lower incomes were more likely to use waterpipe more frequently than their respective counterparts.[2] Therefore, we hypothesise they will be more likely to be exposed to warnings on waterpipe packaging.

In addition to determining whether and which users are exposed, we can assess whether warning exposure is associated with other outcomes within the MIF, including perceptions of waterpipe use risk compared with cigarette use. Research on cigarette package warnings suggests warnings can increase risk perceptions.[13152324] Many users often underestimate the risk of waterpipe use and perceive waterpipe use to be safer than smoking cigarettes.[4–6] Therefore, educating consumers about the harms of waterpipe tobacco use via package warnings may increase risk perceptions. Additionally, exposure to cigarette package warnings has been associated with increased quit attempts.[1718] Thus, exposure to waterpipe tobacco package warnings may also impact waterpipe tobacco use.

The FDA's 2016 Final Deeming Rule requires a health warning on all waterpipe tobacco packaging by 10 August 2018, with a 30-day sell-off period for existing stock.[25] The FDA mandates all waterpipe tobacco packaging contain the following text covering at least 30% of the two principal display panels of the package (defined as the panels of a package that are most likely to be displayed, presented, shown or examined by the consumer), in 12-point bold, black-and-white, sans serif font: 'WARNING: This product contains nicotine. Nicotine is an addictive chemical'.

Some waterpipe tobacco packaging sold in the USA may have included warnings prior to the FDA-mandate. For example, California's Safe Drinking Water and Toxic Enforcement Act of 1986, requires warnings on products that cause cancer or reproductive toxicity (Proposition 65).[26] Therefore, waterpipe tobacco packaging distributed in California includes the following text: 'This product contains chemicals known to the State of California to cause cancer and birth defects and other reproductive harm'. According to the regulations, the warning must be 'clear and reasonable'; however, there are no additional size or placement requirements.[26] Additionally, with the history of cigarette manufacturers being sued for damages due to smoking, some waterpipe tobacco manufacturers may voluntarily include a statement to protect themselves from future liability. Analyses of tobacco industry documents and legal proceedings highlight the tobacco industry's focus to shift responsibility for health consequences from smoking away from the industry to the consumer.[27–29] Thus, some waterpipe tobacco users may have been exposed to package warnings prior to the FDA-mandate.

To our knowledge, no studies in the USA have examined exposure to waterpipe tobacco package warnings or the longitudinal associations with relative risk perceptions and use.[30] In the current study, we had four research questions: (1) How often are young adult waterpipe users exposed to waterpipe tobacco package warnings? (2) Which demographic and behavioural factors are associated with warning exposure? (3) Is waterpipe tobacco package warning exposure at wave 1 associated with waterpipe tobacco relative risk perceptions at wave 2? (4) Is waterpipe tobacco package warning exposure at wave 1 associated with waterpipe tobacco use at wave 2?

METHODS

Data source

We conducted a longitudinal analysis using data from wave 1 (September 2013–December 2014, n=32 311) and wave 2 (October 2014–October 2015, n=28 357) of the PATH Study, a nationally representative longitudinal study of 45 971 civilian, non-institutionalised adults and youth (over 12 years) in the USA. The PATH Study used a four-stage stratified area probability sample design that used addresses to generate a representative sample and uses audio computer-assisted self-interviewing to conduct interviews. The weighted response rate for wave 1 was 74.0%. The weighted retention rate at wave 2 was 83.1%.[31] Further details on the PATH Study are published elsewhere.[32]

Sample

The analytic sample for the current study consisted of young adult (aged 18–24 years) current waterpipe tobacco users at wave 1 (n=2081) who responded to the warning exposure item (n=2070) and completed the survey at wave 2 (analytic sample n=1644). We defined current waterpipe use as daily or some days, based on the item *Do you now smoke a hookah…* with response options *every day*, *some days* or *not at all*.[3334]

Measures

Wave 1 warning exposure—Exposure to waterpipe tobacco package warnings was assessed in wave 1 with the following item: *In the past 30 days, how often, if at all, have you noticed the health warnings on packages of shisha or hookah tobacco?* Participants responded using a 5-point response scale: *never, rarely, sometimes, often* or *very often*. For analyses, we combined rarely, sometimes, often and very often to compare those who reported exposure with those never exposed. We defined exposure as ever versus never because we were interested in exposure rather than frequency of exposure.[19] Exposure and recall are important precursors to warning effectiveness,[14] therefore, even if participants had a single exposure to a warning in the past 30 days, but recalled such exposure, we think that is important to distinguish from those who did not recall warning exposure or were not exposed.

Wave 1 waterpipe use behaviours—We examined the following waterpipe use behaviours at wave 1: waterpipe use frequency (everyday/weekly/monthly/every couple of months/about once a year), owning a waterpipe (yes/no), usually sharing a waterpipe with others (yes/no), usually smoking at home (yes/no), usually smoking at a café (yes/no), usually smoking at a friends' house (yes/no), usual method of purchasing waterpipe tobacco (in person, internet or telephone/do not purchase) and having a regular waterpipe tobacco brand (yes/no). Specific wording for each of the measures is available in the PATH Questionnaire, available online (https://www.icpsr.umich.edu/icpsrweb/NAHDAP/series/606).

Wave 2 relative risk perception—To assess relative risk perception at wave 2, participants were shown a generic image of a waterpipe and asked *Is smoking tobacco in a*

hookah less harmful, about the same, or more harmful than smoking cigarettes? For analyses, we combined about the same and more harmful to compare with less harmful.[3536]

Wave 2 current waterpipe use—To assess waterpipe tobacco use at wave 2, we used the item: *Do you now smoke a hookah…* with response options *every day*, *some days*, or *not at all*. For analyses, we classified those who responded every day or some days as still using waterpipe tobacco and classified those who responded not at all as no longer using.

Demographics—We used imputed variables from wave 1 to control for sex (male/female), ethnicity (Hispanic/not Hispanic) and race (white alone/black alone/other). For individuals with missing self-report information, imputation methods were used by the PATH data management team to assign values based on responses from the household screener or extended interview questionnaire when available.[31] We used derived variables from wave 1 to control for sexual orientation (straight/lesbian, gay, bisexual or something else) and poverty level (<100% of the poverty guidelines/≥100% of the poverty guidelines). Derived variables are those that the PATH data management team recoded prior to public release.

Analyses

We calculated frequencies and weighted percentages to characterise the sample of young adult waterpipe users and the prevalence of wave 1 past 30 days waterpipe tobacco package warning exposure. We examined associations between wave 1 waterpipe tobacco package warning exposure and wave 1 demographics and waterpipe behaviours using multivariable logistic regression models. We conducted separate multivariable logistic regression models to examine the relationships between waterpipe tobacco package warning exposure and relative risk perceptions/waterpipe tobacco use, while controlling for demographics and waterpipe use behaviours.

To account for complex study design and non-responsiveness across waves, all analyses applied PATH Study population and replicate weights and used balanced repeated replication method with fay=0.3 as recommended.[31] We used the modified Wilson method for confidence limits. We used SAS V.9 to conduct all analyses. Few respondents had missing covariate data for the variables included within the study. The only demographic characteristic or waterpipe use behaviour with >2% missingness was poverty (11%).

RESULTS

The analytic sample consisted of 1644 young adults (aged 18–24 years) every day or some day waterpipe users at wave 1: 45.1% female, 71.1% white and 22.6% Hispanic (table 1). Few (2.1%) were every day users. Just more than one-third (35.9%) of young adult waterpipe users reported past 30-day exposure to waterpipe tobacco package warnings at wave 1. Frequency of warning exposure ranged from rarely (50.8%, n=289), to sometimes (28.1%, n=167), often (12.8%, n=78) and very often (8.3%, n=47).

Factors related to exposure

Waterpipe tobacco package warning exposure was higher among males than females in adjusted models (39.8% vs 31.2%, adjusted OR (AOR)=1.3, 95% CI 1.0 to 1.7). There were

no differences in exposure based on race, ethnicity, sexual orientation or poverty level (table 2).

Waterpipe tobacco package warning exposure was related to several waterpipe use behaviours in adjusted models. Those who usually did not share the same waterpipe with others were more likely than those who usually shared the same waterpipe with others to report exposure (53.6% vs 34.9%, AOR=3.1, 95% CI 1.5 to 6.6). Those who usually purchased waterpipe tobacco were more likely than those who did not usually purchase waterpipe tobacco to report exposure (45.1% vs 24.2%, AOR=1.7, 95% CI 1.3 to 2.3). Finally, those who had a regular brand of waterpipe tobacco were more likely than those who did not have a regular brand to report exposure (53.5% vs 32.2%, AOR=1.8, 95% CI 1.3 to 2.7). Exposure was not related to waterpipe use frequency, owning a waterpipe, smoking at home, smoking at a café or smoking at a friend's house in adjusted models.

Waterpipe tobacco package warning exposure and relative risk perceptions

At wave 2, 39.6% (95% CI 36.4% to 42.5%) perceived waterpipe to be less harmful than cigarettes, whereas 60.4% (95% CI 57.5% to 63.6%) reported it was as or more harmful than cigarettes. Those who reported past 30-day exposure to waterpipe tobacco package warnings at wave 1 were more likely than those who did not report exposure to perceive waterpipe use to be as or more harmful than cigarettes at wave 2 (AOR=1.3, 95% CI 1.0 to 1.8; see table 3).

Waterpipe tobacco package warning exposure and waterpipe tobacco use

Less than half of the sample (42.2%; 95% CI 39.5% to 44.9%) reported continued waterpipe use at wave 2. Among those who continued use at wave 2, 59.8% (95% CI 56.7% to 62.9%) had no change in use between wave 1 and wave 2, 39.3% (95% CI 36.2% to 42.5%) decreased use (ie, went from using every day to some days) and 0.8% (95% CI 0.5% to 1.4%) increased use (ie, from some day to every day). Waterpipe tobacco package warning exposure at wave 1 was not associated with waterpipe tobacco use at wave 2 in unadjusted (p=0.2) or adjusted (p=0.9) models (table 4).

DISCUSSION

This study aimed to determine whether young adult current waterpipe tobacco users reported past 30-day exposure to waterpipe tobacco package warnings in the USA, prior to the federal requirement being implemented. We also identified which demographic and behavioural factors were associated with warning exposure, and whether warning exposure was prospectively associated with relative risk perceptions and waterpipe use.

Prior to FDA-mandated warnings going into effect, one-third of young adult current waterpipe tobacco users in the USA reported exposure to waterpipe tobacco package warnings. Although we do not know the content or format of warnings when these data were collected (2013–2014), each of the two most common brands reported by this sample (Starbuzz and Fantasia) contained warnings about health effects related to use in Spring 2018. Starbuzz waterpipe tobacco packaging contained the following text: 'Surgeon Generals Warning: smoking causes lung cancer, heart disease, emphysema, and may

complicate pregnancy'. Fantasia waterpipe tobacco packaging contained California's Proposition 65 warning: 'This product contains a chemical known to the State of California to cause cancer and/or birth defects or other reproductive harm'. Each of these warnings were on a side panel or bottom of the package and appeared in small text. In contrast, the FDA-mandated waterpipe tobacco package warning is required to occupy at least 30% of each of the two principal display panels (eg, the front and back for a box, or the top and side of a round container) and contain text specific to nicotine. Because the FDA-mandated warning will be larger and occupy the two principal display panels, it may be more likely to attract attention than smaller warnings on the back, bottom or sides of the package.[13]

Although the FDA-mandated waterpipe tobacco package warnings will occupy a greater portion of the packaging than current warnings, they will not meet the full criteria established by the WHO's Framework Convention on Tobacco Control (FCTC). The FCTC includes several guidelines to address packaging and labelling of tobacco products, and global evidence suggests strong support for implementing Article 11 policies.[3738] Specifically, Article 11 recommends warnings cover at least 50% of the front and back of the package and include graphic warnings instead of text.[37] Additionally, Article 11 recommends multiple warning texts that rotate, so consumers are exposed to new information over time.[37] Finally, Article 11 of the FCTC recommends waterpipe-specific warnings, which are not mandated in the USA, or most other nations. The warnings currently on US waterpipe tobacco packaging, as well as the FDA-mandated warnings, do not explicitly state that waterpipe tobacco causes health effects. It is possible consumers presume these statements to be general warnings about cigarettes or other tobacco products, and are less likely to translate those messages to increased risk perceptions about waterpipe. It will be important to monitor exposure and subsequent risk perception and behaviour changes after implementation of FDA-mandated warnings, to help determine whether the FDA warning mandates are sufficient or whether additional strategies, including those recommended by the FCTC, are warranted to better inform consumers about the harms associated with use.

Despite some users reporting exposure prior to the FDA-mandate going into effect, the majority of users did not report seeing a waterpipe tobacco package warning. Additionally, among those exposed, few (<25% of those exposed) reported being exposed often or very often. This suggests most of those exposed are not being regularly exposed, and, therefore, policy benefits may be limited. Furthermore, exposure varied by some expected behavioural patterns. For example, those who did not purchase waterpipe tobacco were less likely to report warning exposure. This included almost half of the sample of users (45%). Similarly, those who shared the same waterpipe with others were less likely to report warning exposure than those who did not share the same waterpipe with others. These groups reporting lower exposure rates may be less likely to interact with the waterpipe tobacco package itself. For these individuals, who represent a large portion of waterpipe users, it is vital to consider alternative avenues for warning placement. The FDA-mandate will also include warnings on all waterpipe tobacco advertisements and websites, which may reach additional consumers. However, it may be important to also consider other opportunities for warning exposure, such as warnings on waterpipe devices or within commercial waterpipe establishments, as

other countries, including Turkey, have explored.[2139–43] For example, Turkey requires health warnings on both sides of the waterpipe apparatus, which cover 65% of the surface area.[44]

Notably, those who reported past 30-day warning exposure at wave 1 were more likely than those who did not report exposure to perceive waterpipe tobacco to be as or more harmful than cigarette use at wave 2. These findings are similar to research on warning exposure and risk perceptions for other tobacco packaging.[45–48] For example, a study analysing smokeless tobacco package warning exposure data from the 2012 National Adult Tobacco Survey found warning exposure was related to higher harm perceptions.[45] Additionally, an experimental study assessing the impact of voluntary e-cigarette warning labels concluded the warning was noticed by consumers and may influence risk perceptions.[46] Often, young adults perceive waterpipe to be less harmful than cigarettes, due to misconceptions such as water purifying the combustion process.[4–649] Warnings are one way to convey product harms and correct misperceptions.[41] Our findings suggest waterpipe tobacco packaging warnings may be an important component of educating consumers about the harms of waterpipe tobacco use.

Waterpipe tobacco packaging warnings may influence risk perceptions, but we did not find evidence to suggest exposure to waterpipe tobacco packaging warnings influences waterpipe use. Interestingly, we did not find that more frequent use was associated with exposure (table 1), which may suggest that more frequent users were not likely to report exposure due to wear out effects, which has been noted in other tobacco research.[135051] As discussed, we do not know the prevalence or content of waterpipe warnings from 2013 to 2014, but it is possible the content, placement and size of warnings waterpipe tobacco users in the present study were exposed to were not strong enough to lead to behaviour change.

Limitations

These findings are subject to several limitations. First, self-reported warning exposure may not reflect actual exposure, as reported exposure may be subject to social desirability bias. For example, over half of our sample (62.9%) reported using waterpipe either ‘every couple of months’ or ‘once a year’, yet among those, 35.5% and 25.8%, respectively, reported past 30-day exposure. It is possible those individuals who smoked waterpipe tobacco once a year happened to do so within the 30 days prior to completing the survey or were around others who smoked waterpipe within the past 30 days prior to completing the survey, in order to be exposed to the packaging However, it is more likely that warning exposure was overestimated. Additionally, we do not know the content, size or placement of the warnings individuals were exposed to, which significantly limits our full understanding of warning impact.

Conclusions

These findings contribute to the waterpipe tobacco literature by providing the first estimates for US exposure to waterpipe tobacco package warnings, and insight into waterpipe tobacco package warning exposure’s potential impact on risk perceptions and use among a nationally representative sample of US young adult waterpipe users. Our findings suggest the FDA-mandated warning may result in high exposure among users, particularly those who

purchase waterpipe tobacco or do not share the waterpipe with others; however, it will be critical to assess exposure and impact on harm perceptions and behaviour after the FDA-mandated warnings are in place.

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Table 1

Sample characteristics and factors related to wave 1 waterpipe tobacco package warning exposure

	Full analytic sample n=1644	**Exposed to warning n=581**	**Not exposed to warning n=1063**
	Weighted % (95% CI)	**Weighted % (95% CI)**	**Weighted % (95% CI)**
Sex			
Female	45.1 (42.6 to 47.6)	31.2 (28.1 to 34.5)	68.8 (65.5 to 71.9)
Male	54.9 (52.4 to 57.4)	39.8 (36.2 to 43.4)	60.2 (56.6 to 63.8)
Race			
White alone	71.1 (67.4 to 74.4)	35.6 (32.9 to 38.5)	64.4 (61.5 to 67.1)
Black alone	12.9 (10.7 to 15.4)	33.6 (28.5 to 39.1)	66.4 (60.9 to 71.5)
Other	16.1 (13.9 to 18.5)	39.0 (31.7 to 46.7)	61.0 (62.0 to 67.5)
Ethnicity			
Hispanic	22.6 (19.8 to 25.7)	38.4 (33.7 to 43.2)	61.6 (56.8 to 66.3)
Not Hispanic	77.4 (74.3 to 80.2)	35.2 (32.5 to 38.0)	64.8 (62.0 to 67.5)
Sexual orientation			
LGB+other	13.1 (11.2 to 15.3)	34.7 (28.2 to 41.8)	65.3 (58.2 to 71.8)
Straight	86.9 (84.7 to 88.8)	35.9 (33.4 to 38.6)	64.1 (61.4 to 66.6)
Poverty			
<100% of poverty guideline	49.9 (46.4 to 53.4)	36.9 (33.3 to 40.6)	63.1 (59.4 to 66.7)
≥100% of poverty guideline	50.1 (46.6 to 53.6)	33.4 (29.4 to 37.7)	66.6 (62.3 to 70.6)
Waterpipe use frequency			
About once a year	14.0 (12.3 to 15.8)	25.8 (20.4 to 32.0)	74.2 (68.0 to 79.6)
Every couple of months	48.9 (45.9 to 52.0)	35.5 (32.1 to 39.1)	64.5 (60.9 to 67.9)
Monthly	21.2 (18.6 to 24.0)	40.5 (35.1 to 46.1)	59.5 (53.9 to 64.9)
Weekly	13.8 (12.1 to 15.7)	44.6 (37.6 to 51.8)	55.4 (48.2 to 62.4)
Everyday	2.1 (1.5 to 3.2)	46.0 (28.3 to 64.8)	54.0 (35.2 to 71.7)
Own a waterpipe			
No	69.4 (66.7 to 71.9)	29.8 (27.2 to 32.6)	70.2 (67.4 to 72.8)
Yes	30.6 (28.1 to 33.3)	49.7 (44.9 to 54.6)	50.3 (45.4 to 55.1)
Smoke at home			

	Full analytic sample n=1644 Weighted % (95% CI)	Exposed to warning n=581 Weighted % (95% CI)	Not exposed to warning n=1063 Weighted % (95% CI)
No	67.9 (64.9 to 70.8)	31.2 (28.3 to 34.2)	68.8 (65.8 to 71.7)
Yes	32.0 (29.2 to 35.1)	46.0 (40.8 to 51.2)	54.0 (48.8 to 59.2)
Smoke at a café			
No	33.6 (30.5 to 36.9)	40.9 (36.9 to 45.0)	59.1 (55.0 to 63.1)
Yes	66.4 (63.1 to 69.5)	33.4 (30.2 to 36.8)	66.6 (63.2 to 69.8)
Smoke at a friends' house			
No	39.0 (35.9 to 42.1)	32.4 (28.7 to 36.4)	61.8 (58.9 to 64.6)
Yes	61.0 (57.9 to 64.1)	38.2 (35.4 to 41.1)	67.6 (63.6 to 71.3)
Share waterpipe with others			
Yes	95.2 (94.1 to 96.1)	34.9 (32.4 to 37.5)	65.1 (62.0 to 67.1)
No	4.8 (3.9 to 5.9)	53.6 (41.6 to 65.2)	46.4 (34.8 to 58.4)
Purchase waterpipe tobacco			
Does not purchase	43.9 (41.4 to 46.5)	24.2 (20.9 to 27.8)	75.8 (72.2 to 79.1)
In person, internet, telephone	56.1 (53.3 to 58.6)	45.1 (41.6 to 48.8)	54.9 (51.2 to 58.4)
Regular brand			
No	82.3 (80.1 to 84.3)	32.1 (29.7 to 34.6)	57.9 (65.4 to 70.3)
Yes	17.7 (15.7 to 19.9)	53.5 (46.7 to 60.3)	46.5 (39.7 to 53.3)

Language (categories) used reflects that within the PATH Study, wherever possible.

LGB, lesbian, gay, bisexual; PATH, Population Assessment of Tobacco and Health.

Table 2

Factors related to wave 1 waterpipe tobacco package warning exposure

	Unadjusted odds of exposure to warning OR (95%CI) n=1644	Adjusted odds of exposure to warning AOR (95%CI) n=1376
Sex		
Female	Ref	Ref
Male	**1.46 (1.17 to 1.80)**	**1.34 (1.04 to 1.72)**
Race		
White alone	Ref	Ref
Black alone	0.91 (0.69 to 1.20)	0.91 (0.64 to 1.30)
Other	1.15 (0.81 to 1.63)	1.07 (0.75 to 1.52)
Ethnicity		
Hispanic	Ref	Ref
Not Hispanic	0.87 (0.77 to 1.3)	1.0 (0.77 to 1.30)
Sexual orientation		
LGB+other	Ref	Ref
Straight	1.06 (0.76 to 1.47)	0.98 (0.67 to 1.44)
Poverty		
<100% of poverty guideline	Ref	Ref
≥100% of poverty guideline	0.86 (0.66 to 1.11)	0.91 (0.69 to 1.21)
Waterpipe use frequency		
About once a year	Ref	Ref
Every couple of months	**1.59 (1.35 to 2.85)**	1.40 (0.96 to 2.04)
Monthly	**1.96 (1.35 to 2.85)**	1.32 (0.84 to 2.08)
Weekly	**2.32 (1.57 to 3.43)**	1.08 (0.67 to 1.76)
Everyday	**2.46 (1.04 to 5.82)**	0.71 (0.26 to 1.89)
Own a waterpipe		
No	Ref	Ref
Yes	**2.33 (1.85 to 2.94)**	1.34 (0.90 to 1.99)
Smoke at home		
No	Ref	Ref
Yes	**1.88 (1.44 to 2.44)**	1.05 (0.67 to 1.65)
Smoke at a café		
No	Ref	Ref
Yes	**0.72 (0.57 to 0.92)**	0.82 (0.64 to 1.04)
Smoke at a friend's house		
No	Ref	Ref
Yes	**1.29 (1.05 to 1.58)**	1.22 (0.98 to 1.53)
Share waterpipe with others		
Yes	Ref	Ref
No	**2.16 (1.30 to 3.58)**	**3.10 (1.45 to 6.60)**

	Unadjusted odds of exposure to warning	**Adjusted odds of exposure to warning**
	OR (95%CI)	**AOR (95%CI)**
	n=1644	**n=1376**
Purchase waterpipe tobacco		
Does not purchase	Ref	Ref
In person, internet, telephone	**2.58 (2.00 to 3.32)**	**1.73 (1.28 to 2.34)**
Regular brand		
No	Ref	Ref
Yes	**2.43 (1.81 to 3.27)**	**1.84 (1.26 to 2.68)**

Bold indicates significant at $p<0.05$. All variables listed are included in adjusted models.

AOR, adjusted OR; LGB, lesbian, gay, bisexual.

Table 3

Unadjusted and adjusted odds for perceiving waterpipe tobacco to be as or more harmful than cigarettes vs less harmful at wave 2

	Unadjusted odds for perceiving waterpipe to be as or more harmful than cigarettes	Adjusted odds for perceiving waterpipe to be as or more harmful than cigarettes
	OR (95%CI)	**AOR (95%CI)**
	n=1635	**n=1367**
Waterpipe tobacco package warning exposure		
Never exposed	Ref	Ref
Ever exposed	**1.37 (1.09 to 1.74)**	**1.35 (1.02 to 1.78)**
Sex		
Female	Ref	Ref
Male	1.16 (0.92 to 1.47)	0.99 (0.76 to 1.30)
Race		
White alone	Ref	Ref
Black alone	0.83 (0.57 to 1.22)	1.00 (0.67 to 1.51)
Other	1.08 (0.78 to 1.50)	0.98 (0.69 to 1.40)
Ethnicity		
Hispanic	Ref	Ref
Not Hispanic	0.92 (0.74 to 1.14)	0.92 (0.72 to 1.18)
Sexual orientation		
LGB+	Ref	Ref
Straight	**1.67 (1.22 to 2.30)**	**1.66 (1.15 to 2.39)**
Poverty		
<00% of poverty guideline	Ref	Ref
≥100% of poverty guideline	0.98 (0.78 to 1.22)	0.97 (0.75 to 1.24)
Waterpipe use frequency		
About once a year	Ref	Ref
Every couple of months	0.75 (0.53 to 1.05)	0.72 (0.50 to 1.10)
Monthly	0.78 (0.54 to 1.12)	0.70 (0.47 to 1.04)
Weekly	0.78 (0.52 to 1.19)	0.65 (0.39 to 1.08)
Every day	0.55 (0.26 to 1.18)	0.46 (0.19 to 1.11)
Own a waterpipe		
No	Ref	Ref
Yes	1.19 (0.93 to 1.52)	1.10 (0.70 to 1.73)
Usually smoke at home		
No	Ref	Ref
Yes	1.15 (0.90 to 1.48)	0.94 (0.63 to 1.40)
Usually smoke at a café		
No	Ref	Ref
Yes	0.86 (0.68 to 1.09)	0.82 (0.64 to 1.06)
Usually smoke at a friend’s house		
No	Ref	Ref

	Unadjusted odds for perceiving waterpipe to be as or more harmful than cigarettes	**Adjusted odds for perceiving waterpipe to be as or more harmful than cigarettes**
	OR (95%CI)	**AOR (95%CI)**
	n=1635	**n=1367**
Yes	1.13 (0.87 to 1.45)	1.03 (0.78 to 1.36)
Usually share waterpipe with others		
Yes	Ref	Ref
No	0.65 (0.41 to 1.03)	**0.48 (0.28 to 0.82)**
Purchase waterpipe tobacco		
Does not purchase	Ref	Ref
In person/internet/telephone	**1.32 (1.09 to 1.61)**	**1.39 (1.08 to 1.80)**
Regular brand		
No	Ref	Ref
Yes	1.02 (0.72 to 1.45)	0.96 (0.64 to 1.45)

Bold indicates significant at $p<0.05$. All variables listed are included in adjusted models.

AOR, adjusted OR; LGB, LGB, lesbian, gay, bisexual.

Table 4

Unadjusted and adjusted odds for using waterpipe tobacco at wave 2

	Unadjusted odds for still using waterpipe tobacco at wave 2	**Adjusted odds for still using waterpipe tobacco at wave 2**
	OR (95%CI)	**AOR (95%CI)**
	n=1643	**n=1375**
Waterpipe tobacco package warning exposure		
Never exposed	Ref	Ref
Ever exposed	1.28 (0.92 to 1.78)	1.01 (0.76 to 1.35)
Sex		
Female	Ref	Ref
Male	0.93 (0.75 to 1.16)	0.84 (0.65 to 1.09)
Race		
White alone	Ref	Ref
Black alone	**1.44 (1.05 to 1.99)**	1.28 (0.89 to 1.83)
Other	**1.43 (1.04 to 1.98)**	**1.46 (1.02 to 2.08)**
Ethnicity		
Hispanic	Ref	Ref
Not Hispanic	0.97 (0.76 to 1.24)	1.05 (0.803 to 1.38)
Sexual orientation		
LGB+	Ref	Ref
Straight	0.72 (0.50 to 1.04)	0.67 (0.44 to 1.02)
Poverty		
<100% of poverty guideline	Ref	Ref
≥100% of poverty guideline	0.81 (0.64 to 1.03)	0.86 (0.66 to 1.10)
Waterpipe use frequency		
About once a year	Ref	Ref
Every couple of months	**2.39 (1.69 to 3.36)**	**2.33 (1.60 to 3.38)**
Monthly	**3.97 (2.70 to 5.82)**	**4.28 (2.62 to 6.99)**
Weekly	**6.01 (3.85 to 9.39)**	**5.39 (3.10 to 9.38)**
Every day	**13.42 (5.19 to 34.74)**	**11.17 (3.68 to 33.94)**
Own a waterpipe		
No	Ref	Ref
Yes	**1.74 (1.32 to 2.31)**	1.31 (0.83 to 2.08)
Usually smoke at home		
No	Ref	Ref
Yes	**1.33 (1.02 to 1.73)**	**0.70 (0.49 to 0.996)**
Usually smoke at a café		
No	Ref	Ref
Yes	**1.40 (1.10 to 1.78)**	**1.48 (1.12 to 1.96)**
Usually smoke at a friend’s house		
No	Ref	Ref
Yes	1.07 (0.86 to 1.32)	1.18 (0.92 to 1.52)

	Unadjusted odds for still using waterpipe tobacco at wave 2	**Adjusted odds for still using waterpipe tobacco at wave 2**
	OR (95%CI)	**AOR (95%CI)**
	n=1643	**n=1375**
Usually share waterpipe with others		
Yes	Ref	Ref
No	1.31 (0.81 to 2.12)	1.59 (0.90 to 2.82)
Purchase waterpipe tobacco		
Does not purchase	Ref	Ref
In person/internet/telephone	**2.05 (1.61 to 2.61)**	**1.73 (1.26 to 2.36)**
Regular brand		
No	Ref	Ref
Yes	**1.91 (1.47 to 2.48)**	1.09 (0.78 to 1.53)

Bold indicates significant at $p<0.05$. All variables listed are included in adjusted models.

AOR, adjusted OR; LGB, lesbian, gay, bisexual.