

Young adult waterpipe tobacco users' perceived addictiveness of waterpipe tobacco

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ABSTRACT

INTRODUCTION Young adults generally do not perceive waterpipe tobacco smoking (WTS) to be addictive. Underlying reasons for these false perceptions have received limited research attention and little is known about effective WTS prevention messaging. This study examined perceptions of the addictiveness of WTS among young adults and ascertained their feedback on WTS prevention message content.

METHODS Young adult (n=44, Mean [M] age 25.3, SD 2.7, range 18-30) waterpipe tobacco users were recruited online for a cross-sectional survey. Closed-ended measures assessed demographics, waterpipe use, other tobacco consumption, and perceived addictiveness of WTS. Open-ended items assessed perceptions of WTS and ascertained feedback on WTS prevention message content. Quantitative data were analyzed descriptively. Open-ended data were coded to identify emerging themes.

RESULTS Participants reported low perceived addictiveness of WTS (Mean 2.0, SD 0.9, range 1- not at all, 4 - very), perceived chances of becoming addicted (Mean 3.0, SD 1.6, range 1- no chance, 7- certain), and desire to quit (Mean 3.0, SD 1.8, range 1- not at all, 7- very). In open-ended responses, participants indicated social WTS does not lead to addiction and believe it is easy to quit. Some expressed concerns that WTS addiction may lead to health harms, social stigma, and financial costs. Participants indicated messages using vivid imagery and conveying negative health effects could motivate cessation.

CONCLUSIONS Young adults view that WTS is not addictive, particularly related to use in social settings. Research can build from this study by developing and testing messages to motivate WTS cessation in young adults.

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INTRODUCTION

Waterpipe tobacco smoking (WTS) among U.S. young adults is a growing public health concern. Among young adults ages 18-24 years, the combined prevalence of regular and intermittent (i.e. every day, some days, or rarely) WTS in 2013-2014 was 20.2%¹. As a consequence, many young adults may face health risks due to WTS. The amount of smoke inhaled by a single waterpipe session lasting 30 to 60 minutes can equal that produced by 100 or more cigarettes². Smoke inhaled by waterpipe users contains heavy metals, carcinogenic hydrocarbons³, volatile aldehydes⁴, carbon monoxide⁵⁻⁷, and nicotine⁶⁻⁸. Inhalation of these toxins is likely to be the reason why WTS has been related to cancer, poor pulmonary function, and heart disease⁹⁻¹².

Further, WTS is addictive¹³, with some data suggesting nicotine dependence from WTS occurs faster than from cigarettes¹⁴. Addiction to WTS is shown by four dependence indicators. First, delivery of nicotine^{9, 15} indicates the potential for WTS to foster physical dependence (i.e. cellular adaptation to chronic exposure)¹⁶. Second, a hallmark of dependence is failed quit attempts, which occur among waterpipe users^{13, 17}. Third, waterpipe tobacco users endorse items indicating that they are 'hooked' on waterpipe and users' testimonials signify they are addicted¹⁸. Fourth, abstinent daily waterpipe users report withdrawal symptoms they suppress with waterpipe use¹⁹. The data from multiple clinical studies, population surveys, and in-depth interviews converge to support the hypothesis that

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WTS can lead to nicotine dependence. This increases the chance that many young adults will sustain or escalate use, potentially leading to health harms.

Despite evidence to the contrary, many young adults maintain the belief that WTS is less addictive than cigarettes²⁰⁻²². However, much of the evidence on young adults' WTS beliefs and perceptions comes from population surveillance surveys²⁰⁻²². There is limited research on the potential reasons underlying the perception that WTS is less addictive than cigarette smoking among young people²³⁻²⁴. Moreover, there is limited evidence for effective public health communication messages to correct such misperceptions about WTS²⁵. This evidence is needed to provide information for tobacco regulations and public education messaging, aimed at preventing and reducing WTS.

In 2016, the U.S. Food and Drug Administration finalized a rule deeming waterpipe tobacco to be under the agency's tobacco regulatory authority²⁶. The deeming rule requires a warning label, on waterpipe tobacco packaging, conveying the potential for addiction to consumers. Also as part of the FDA's regulatory authority, the agency is mandated to engage in public education to inform consumers of the potential risks of tobacco products²⁷. The FDA's ongoing public education efforts include mass media campaigns targeting youth, at risk of cigarette smoking, with anti-smoking messages²⁸. Now that waterpipe is a regulated tobacco product, FDA could engage in similar public education efforts communicating potential harms and addictiveness of WTS, targeting high-risk groups like young adults.

Some prior studies provide insight into the design and potential effects of public health messages for WTS. Lipkus and colleagues tested the effects of educational messages designed to inform college age waterpipe users of the addictiveness, toxicant exposure, and health risks²⁹. This study showed mixed effects of the messages on perceptions of risk and concern about addiction, but the experimental design could not identify which message component(s) (e.g. addiction, health risks) produced these effects. Mays and colleagues tested the effects of messages about waterpipe tobacco harms and addictiveness among young adult waterpipe tobacco users³⁰. Participants were randomized to a control group receiving no messages, a group receiving messages about harms of WTS, and a group receiving messages about harms and addictiveness of WTS. Participants in both groups receiving education messages reported higher perceived risk, concern about becoming addicted, and greater desire to quit WTS than the control group. However, these outcomes did not differ between the former two groups. These findings indicate that providing information about the addictiveness of WTS did not produce an added effect on perceived risk, concerns about

addiction, or the desire to quit. The lack of effect of messages about the addictiveness of WTS in this study may be because they did not resonate with young adult waterpipe tobacco users or they failed to deliver information that was sufficiently targeted toward their perceptions of the addictiveness of WTS. The current study sought to address these gaps in WTS research by examining young adult waterpipe tobacco users' views of the addictiveness of WTS and ascertaining their feedback on potential education message content.

METHODS

Setting and sample

Participants ($n = 44$) were recruited in May 2015 using the online crowdsourcing website, Amazon Mechanical Turk, for a cross-sectional study. This recruitment and data collection method has been used in similar prior studies³¹⁻³⁶ and research demonstrates it is a highly efficient strategy for recruiting diverse samples of young adult tobacco users for behavioral research³⁷. Potential participants initially reviewed a brief study description with a link to an online informed consent form and eligibility screener. Eligible participants were young adults, between the ages of 18 and 30 years, who had used waterpipe tobacco in the past 30 days. We focused on this age range because it includes the population subgroup where the prevalence of WTS is highest; it is a vulnerable period when addictions unfold and transitions to regular tobacco use occur³⁸, and there is growing evidence this occurs with WTS in this population³⁹⁻⁴¹. Access to the survey was restricted to those registered in the USA. Eligible, consenting participants proceeded to complete a brief survey on their perceptions of the addictiveness of WTS with closed- and open-ended questions, and preferences on messaging to communicate the addictiveness of WTS. Closed-ended items were guided by behavioral theories indicating that risk perceptions and appraisals are key factors influencing tobacco use behavior⁴²⁻⁴⁴. Open-ended items were developed to gather additional information on these perceptions, as described below. Participants completing all procedures were provided with a small monetary credit through Amazon Mechanical Turk. The data collection protocol was reviewed by the University Institutional Review Board and approved as exempt. Informed consent was obtained from each participant online.

Measures

Demographics. Demographics assessed included: age, gender, race, ethnicity, college/university student status, education, and employment status.

Waterpipe tobacco use. Waterpipe tobacco use was measured using two items²⁹. The first asked if participants smoked

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waterpipe tobacco daily, weekly or monthly. Based on their responses, participants were asked how often they smoked waterpipe tobacco each day, week or month. For descriptive purposes, a single variable was created converting responses to the number of times used per week³⁰.

Other tobacco use. Cigarette smoking was measured using two items with current smokers, defined as participants who smoked 100 cigarettes or more during their lifetime, and now smoke on all or some days. The number of cigarettes per day was assessed among current smokers⁴⁵. Participants also reported if they used large cigars, little cigars/cigarillos, smokeless tobacco, and electronic cigarettes. These data were used to create a variable indicating whether participants smoked waterpipe tobacco only, waterpipe tobacco and one other tobacco product (i.e. dual-users), or waterpipe tobacco and more than one other tobacco product (i.e. poly-users), for descriptive purposes³⁰.

Perceived addictiveness. Perceived addictiveness of WTS was measured with two items^{29,30}. Absolute perceived addictiveness was measured by asking ‘Overall, would you say waterpipe tobacco use is...?’ with response options: 1 - Not at all addictive, 2 - Slightly addictive, 3 - Somewhat addictive, and 4 - Very addictive. Perceived addictiveness relative to cigarettes was measured by asking ‘Compared to regular cigarettes, how addictive do you think waterpipe tobacco use is?’. Responses were based on a five-point scale (1 - Much less addictive, 2 - Less addictive, 3 - As addictive, 4 - More addictive, 5 - Much more addictive).

Perceived risk of addiction. Perceived risk of addiction to WTS was assessed using two items^{29,30}. The first asked ‘What do you think is your chance of becoming addicted to nicotine in tobacco from waterpipe if you continue to smoke?’. The second asked ‘How likely is it that smoking waterpipe tobacco occasionally (1 or 2 times a month) will lead to addiction?’. Response options ranged from 1- No chance, to 7- Certain to happen.

Desire to quit. Desire to quit waterpipe tobacco was measured by asking ‘How strong is your desire to quit waterpipe smoking right now?’, with response options ranging from 1- Not at all, to 7-Very^{29,30}.

Open-ended items. Open-ended questions were developed for this study based on prior research on waterpipe tobacco use behavior, perceptions, and addiction^{13,20,21}. These questions probed at perceptions of the addictiveness of WTS, thoughts on what it means to be addicted to WTS, and feedback on what message content may be effective to convey the addictiveness of WTS. These items build on previous studies’ methodology by gathering open-ended response data related to WTS through this data collection platform^{30,46}. The specific questions were:

1. What thoughts come to mind when you think about getting addicted to smoking waterpipe tobacco?
2. If someone said you are addicted to smoking waterpipe tobacco, would you agree with this person? Why or why not?
3. What, if anything, would you worry about if you were addicted to smoking waterpipe tobacco? Please describe why you would worry, if at all.
4. Health professionals create messages to educate people about the potential addictiveness of tobacco use. What types of messages about waterpipe tobacco addiction could make you more likely to quit waterpipe tobacco? Please describe why you think the message(s) would make you more likely to quit.

Analytic strategy

Closed-ended items were analyzed using descriptive statistics to characterize the sample. Responses to open-ended items were coded and analyzed using an iterative, constant comparison method where responses are reviewed, initial codes are developed, responses are re-reviewed, codes are revised, and applied to the data^{47,48}. Similar methods were used in recent studies of youth and young adult perceptions of WTS and other emerging tobacco products^{22,49-52}. Two trained coders reviewed open-ended responses independently to inductively identify common themes in the data, developed a codebook comparing themes identified, and coded the data. A third research team member was consulted in the development of the codebook, independently reviewed the initial coding, and determined a final coding where there were any discrepancies. There were few coding discrepancies between the two initial coders and the third coder for major themes, indicating our coding scheme achieved >95% agreement across coders. The results were summarized by themes and in some instances by subtheme, with illustrative quotes provided verbatim as examples. For each question participants’ responses could have included multiple themes.

RESULTS

Sample characteristics

Overall, 129 participants responded to eligibility screening questions, and 44 (34.1%) were eligible and completed procedures. Table 1 displays characteristics of the sample. Participants averaged 25.3 (Standard Deviation [SD] 2.7) years of age, 52.3% were female, and 79.5% self-identified as white race. Out of those surveyed, 59.1% reported smoking waterpipe tobacco on a monthly basis, 13.6% used waterpipe tobacco only, 43.2% reported dual-use, and 43.2% reported poly-use (Table 1).

Table 1. Sample characteristics ($n = 44$)

| | <i>N</i> or <i>Mean</i> | <i>%</i> or <i>Std Dev.</i> |
|---|-------------------------|-----------------------------|
| Demographics | | |
| Age (M, SD) | 25.3 | 2.7 |
| Gender | | |
| Male | 21 | 47.7% |
| Female | 23 | 52.3% |
| Race | | |
| Black/African American | 4 | 9.1% |
| White | 35 | 79.5% |
| Other | 5 | 11.4% |
| Hispanic ethnicity | 2 | 4.5% |
| Current student | 12 | 29.3% |
| Non-student | 29 | 70.7% |
| Education | | |
| Less than college education | 5 | 11.4% |
| College degree or higher | 39 | 88.6% |
| Employment | | |
| Not full-time employed | 16 | 36.4% |
| Full-time employed | 39 | 88.6% |
| Waterpipe tobacco smoking | | |
| Frequency of waterpipe tobacco use | | |
| Monthly | 26 | 59.1% |
| Weekly | 16 | 36.4% |
| Daily | 2 | 4.6% |
| Waterpipes smoked per week (M, SD) | 3.8 | 11.5 |
| Cigarette smoking | | |
| Current cigarette smoker | | |
| Yes | 29 | 65.9% |
| No | 15 | 34.1% |
| Cigarettes smoked per day (M, SD) | 12.3 | 13.3 |
| Other tobacco product past month use | | |
| Large cigars | 6 | 13.6% |
| Little cigars/cigarillos | 9 | 20.4% |
| Smokeless tobacco | 3 | 6.8% |
| Electronic cigarettes | 18 | 40.9% |
| Tobacco product use | | |
| Waterpipe only | 6 | 13.6% |
| Dual-use (waterpipe and 1 other product) | 19 | 43.2% |
| Poly-use (waterpipe and ≥ 2 other products) | 19 | 43.2% |
| Perceived addictiveness of waterpipe (M, SD, range 1-4) | 2.0 | 0.9 |
| Perceived addictiveness of waterpipe relative to cigarettes (M, SD, range 1-5) | 1.8 | 0.8 |
| Perceived risk of addiction to waterpipe tobacco (M, SD, range 1-7) | 3.2 | 1.6 |
| Occasional smoking leads to addiction (range 1-7) | 2.9 | 1.4 |
| Desire to quit smoking waterpipe tobacco (range 1-7) | 3.1 | 1.8 |

Note: Data display N and % of the sample unless otherwise indicated.

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Perceptions of waterpipe tobacco

Table 1 displays summary statistics for closed-ended measures of WTS perceptions. Participants reported low perceived addictiveness of WTS (Mean [M] 2.0, SD 0.9, 34.9% indicated Not At All Addictive, 32.6% Somewhat, 30.2% Slightly, and 2.3% Very Addictive) and lower perceived addictiveness of WTS relative to cigarettes (M 1.8, SD 0.8, 34.9% indicated Much Less Addictive, 48.8% Less Addictive, 14.0% About the Same, 2.3% More Addictive, 0% Much More Addictive). Participants also reported relatively low perceived risk of becoming addicted to WTS (M 3.2, SD 1.6), low perceived likelihood that occasional WTS leads to addiction (M 2.9, SD 1.4), and low desire to quit (M 3.1, SD 1.8). Correlations between measures of perceived addictiveness and perceived risk of addiction ranged from 0.54 to 0.72 (both p values $< .001$). Mean perceived addictiveness ($p = 0.24$) and perceived addictiveness of WTS relative to cigarettes ($p = 0.068$) did not differ significantly by monthly, weekly or daily WTS.

Open-ended responses

Prevailing themes about feelings related to becoming addicted to WTS with example quotes are shown in Table 2. Example quotes are exactly as the participants have written, including any typographical or grammatical errors to authentically represent answers. Ten participants (22.7%) indicated low perceived risk of harm and addiction from WTS. For example, one participant (female, age 27, weekly user) noted *I think you are less likely to get addicted to smoking waterpipes than cigarettes*.

Ten participants expressed concerns, primarily related to health and social consequences of becoming addicted. One participant (male, age 21, weekly user) noted *The impact on my health, long-term concerns about cancer. I wonder if I will be able to stop in the future*. Other common concepts included the effort and financial costs associated with waterpipe addiction ($n = 9$, 20.4%), as well as the ability to exercise self-control ($n = 6$, 13.6%) (Table 2).

Participants' responses when asked if they agreed or disagreed that they were addicted to WTS are shown in Table 3. A majority ($n = 31$, 70.4%) disagreed. The most common reason for disagreeing related to frequency of use ($n = 21$, 47.7%). One participant (male, age 29, monthly user) noted: *I would not because I can take it or leave it. If I am not out with friends, I never give it a thought*. Some participants ($n = 6$, 13.6%) also disagreed on the basis that they can easily quit. One (female, age 24, monthly user) noted: *I would disagree, because I have gone several months without doing it before [...]*. Other concepts emerging among those who disagreed included not craving waterpipe tobacco ($n = 3$, 6.8%) and use in relation to other tobacco products ($n = 3$, 6.8%) (Table 3).

Ten participants (22.7%) agreed that they are addicted to WTS. The most common topic, from their responses, related to frequency of use ($n = 5$, 11.4%). One participant (male, age 22, daily user) commented: *Yes because I smoke it everyday*, and another (female, age 24, monthly user) *Yes. It is something I do fairly regularly*. Some who agreed they were addicted also responded with ideas relating to craving ($n = 2$, 4.5%), quitting ($n = 2$, 4.5%), and use relative to other tobacco products ($n = 2$, 4.5%) (Table 3).

When asked how they could tell whether someone was addicted to WTS, the most common responses were frequency and intensity of use ($n = 24$, 54.5%). One participant (male, age 28, monthly user) noted: *I think the frequency and intensity of use are the most straightforward way to gauge it*. Twenty participants (45.4%) also indicated symptoms of craving or withdrawal. One (male, age 28, weekly user) noted: *Definitely [sic] the craving [sic] would be important*. Another (female, age 26, monthly user) indicated: *They would be similar to cigarette addiction, constant craving, needing one as soon as you wake up*. Some responses noted specific withdrawal symptoms such as *obsessiveness*, being *irritable when they don't have it*, *anxious*, and *nervous*. Three participants (6.8%) indicated home use is indicative of addiction, and three (6.8%) indicated waterpipe use impacting responsibilities or quality of life as a sign of addiction.

When asked what they would worry about if they were addicted to WTS, the most common theme was health effects ($n = 21$, 47.7%). One participant (female, age 28, monthly user) noted: *Lung cancer is my number one concern*. Another participant (female, age 24, monthly user) responded: *The health risk, although water pipes do carry a much lower health risk there is still some risk involved*. Nine (20.4%) participants indicated social or monetary costs. One (male, age 23, monthly user) noted: *Probably cost or social perception*. Another (male, age 28, monthly user) commented: *I would worry [...] about suspicion of marijuana [sic] use from people who don't know me. I would worry about becoming one of those people who is obsessed with the romance of tobacco pipes and the various setups*. Nine participants (20.4%) indicated they do not worry about WTS addiction, including one (female, age 25, monthly user) who exclaimed: *I don't really worry, I can control myself*. Others worried about addiction in general ($n = 3$, 6.8%) and waterpipe as a *'gateway'* to cigarette smoking ($n = 2$, 4.5%).

When asked what messages about the addictiveness of WTS would make them likely to quit, several concepts emerged. The most common was messaging about health harms ($n = 19$, 43.2%). One participant (female, age 27, weekly user) expressed: *If more emphasis [was] put on the damage to the throat and lungs, I would be more likely to quit*. Another (male,

Table 2. Themes in participants' thoughts about becoming addicted to waterpipe tobacco

| Theme | Count* | Exemplary quotes |
|--|--------|---|
| Less risk of harm and addiction | 10 | 'I think you are less likely to get addicted smoking water pipes than cigarettes'. 'It's not addictive. There's almost no nicotine, and it's an all natural leaf.' |
| Concern about health & social consequences | 10 | 'Scared. Worried. Anxious. I do not want to become addicted, but I do not think I will'. 'The impact on my health, long term concerns about cancer. I wonder if I will be able to stop anytime in the future'. 'I don't want to feel gross. I don't want to smell bad. I don't want to get cancer'. |
| Effort and financial costs | 9 | 'If someone has water pipe in their home then I can see them getting addicted to it'. 'The effort, having to get my own pipe, it seems like a lot of work and expense'. 'A water pipe isn't as accessible as a cigarette and takes a bit of time to set it up so for me it isn't a regular habit and I don't find it addictive. It's just something relaxing to do every once and again'. |
| Self-control | 4 | 'You can be addicted to anything, you just have to control yourself'. 'I know that it's a bad thing but I don't really care, because I know I can quit when I want'. |
| Frequency of use | 6 | 'I only do it recreationally, so I don't feel addicted'. 'I just do it socially so I can't imagine getting addicted to it, but I guess someone could'. 'I don't think getting addicted to waterpipe tobacco is a thing – most tobacco users only smoke them occasionally'. |
| None or something else | 5 | 'None really'. 'I think it is embarrassing'. |

Note: Participants' responses could include multiple themes, counts not mutually exclusive.

Table 3. Themes in participants' disagreement and agreement that they are addicted to waterpipe tobacco smoking**Disagree: Not Addicted (N = 31)**

| Theme | Count | Exemplary quote(s) |
|-------------------|-------|---|
| Frequency of use | 21 | 'I would disagree [...] I smoke water pipes only when I go to hooka [sic] bars'. 'I would not because I can take it or leave it. If I am not out with friends, I never give it a thought'. 'I would not agree since I don't think about it much if I'm not with a particular group of people, and I can go 3-5 days without it'. |
| Quitting | 6 | 'I would disagree, because I have gone several months without doing it before[...]'. 'No, I am confident I can quit anytime'. |
| Craving | 3 | 'No I would not because I do not crave water pipe'. 'No, I'm not addicted because I don't feel an urge'. |
| Other tobacco use | 3 | 'No, because I can quit. I am addicted to cigarettes'. 'I would say no. I could easily quit. it's more of a social thing for me and it could easily be exchanged for an ecig'. 'I would say no. I realize there is a risk but I would say my usage is low enough to fall short of the threshold for addiction. Plus, I'm clearly addicted to regular cigarettes and I admit that openly, so it's not like I am in denial about addiction in general'. |

Agree: Addicted (N = 10)

| Theme | Count | Exemplary quote(s) |
|-------------------|-------|---|
| Frequency of use | 5 | 'Yes because I smoke it everyday'. 'Yes. It is something I do fairly regularly'. |
| Craving | 2 | 'I would agree, I am hooked. I can't go even a few days without it, I get jittery and don't feel well if I try and go to long without it'. 'I would agree somewhat, because I do crave it at times and I do feel like I need it to relax sometimes'. |
| Quitting | 2 | 'I think I could quit if I tried hard enough'. |
| Other tobacco use | 2 | 'Yes. I often use it to avoid detection of the cig[arette] smell'. 'I use other tobaco [sic] products, so it wouldn't be cold turkey or anything'. |

Note: Participants' responses to open-ended questions assessing if they disagree or agree they are addicted to waterpipe tobacco smoking, and reasons for agreement/disagreement. Responses could include multiple themes so counts within these groups are not mutually exclusive.

age 23, weekly user) commented: *If only smoking once a week makes you immediately get cancer or risk death, that would make me likely to quit*. Fourteen participants (31.8%) also suggested messaging/conveying similarities to cigarettes would be motivating. One (male, age 23, monthly user) noted: *If there were strong evidence that it were as addictive as cigarettes* and

another (male, age 30, weekly user) indicated *The main thing would be to emphasize how similar it is to cigarettes, how people are fooling themselves into thinking it's safer*. Another theme was the use of graphic imagery ($n = 7$, 15.9%). One (male, age 21, weekly user) noted: *The messages need to be very graphic in displaying the effects of tobacco addictiveness and what the outcome*

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of it does to your body. That would get my attention and probably scare me into stopping'. Other responses included messages emphasizing research evidence or personal testimonials ($n = 4$, 9.1%), and five participants (11.4%) indicated no messages would be effective.

DISCUSSION

This study examined young adult waterpipe tobacco users' perceptions of the addictiveness of WTS and investigated what education message content may resonate with this group to convey the addictiveness of WTS. Consistent with other findings²¹, closed-ended measures indicated participants' perceived addictiveness, perceived risk of addiction, and desire to quit WTS were low. Responses to open-ended items reinforced these findings, with most participants indicating that they do not perceive WTS to be addictive. However, despite not perceiving WTS to be addictive participants identified several known indicators of nicotine dependence, such as increasing use, withdrawal and cravings, in their responses⁵³. Additionally, when asked about their concerns about waterpipe addiction and what messages may be effective to convey such information, participants predominantly indicated messages conveying the health harms that ensue from long-term addicted WTS would be most effective. These findings have implications for future research to investigate the design and delivery of public health messages targeting waterpipe tobacco users.

Participants' responses to the closed-ended items are consistent with research indicating young adults do not perceive WTS to be addictive and believe they can easily quit²¹. Although research indicates WTS is influenced by a number of factors, such as social use and product features like appealing flavorings, studies have consistently shown that such WTS perceptions are associated with waterpipe tobacco initiation and current use⁵⁴⁻⁵⁹. Consistent with behavioral and risk communication theories⁴²⁻⁴⁴, this suggests research is needed to develop and test persuasive messages designed to shift perceptions of the addictiveness of WTS, as a strategy to reduce WTS and promote cessation in young adults.

Prior research^{29,30} has shown that messages conveying the potential harms of WTS affect the perceived harm and desire to quit of young adult waterpipe tobacco users'. However, in one recent study additional message content about the addictiveness of WTS had no added effect on young adults' perceived addictiveness or desire to quit³⁰. The present findings provide useful context to interpret this prior work. Participants largely did not view WTS to be addictive and overall they tended to favor messages conveying health harms associated with long-term WTS, to motivate cessation. This suggests that

messages could make the addictiveness of WTS more salient and resonate with young adult waterpipe users by explicitly linking addiction to health harms associated with long-term use, such as cancer¹⁰. Additionally, conveying information such as nicotine content in waterpipe tobacco¹³ would be consistent with participants' responses, which indicated they recognize common nicotine dependence symptoms. Some participants also indicated communications incorporating visual imagery, as is done with tobacco product warning labels⁶⁰, and tobacco control media campaigns⁶¹, may also be effective. Such visual imagery has been shown to increase persuasive appeal and efficacy of tobacco-related messaging in prior research⁶². Although endorsed by a small number of participants, other message content that could be explored in future studies includes the potential social and monetary costs of WTS addiction.

The context of WTS creates unique challenges for conveying potential harms and addictiveness of WTS. Approaches such as warning labels on tobacco product packaging may be less effective in this case because waterpipe tobacco is often used in settings, such as hookah cafes and other venues, where users infrequently encounter product packaging. Although warning labels could be positioned in a way that waterpipe tobacco users would be more likely to encounter them (e.g. on WTS cafe menus)⁶³, research examining alternative message delivery channels appears warranted. Prior studies have indicated that online message delivery^{29,30}, and delivery channels such as mobile phone text messaging, may be useful among young adults, because of their nearly ubiquitous use in this population⁶⁴. This could provide the ability to reach young people in social settings where WTS occurs^{65,66}. Such technology-based delivery would also allow for testing of messaging strategies that have been shown to be effective for promoting tobacco cessation, such as personalizing message content through individual tailoring^{65,66}. This study provides some initial insights into potential message themes, but additional research is needed to examine ways in which the design and delivery of waterpipe tobacco messages can be optimized to promote behavior change.

The study findings also have potential implications for tobacco regulations for waterpipe tobacco in the USA. In 2016, the FDA finalized a rule deeming waterpipe tobacco and other previously unregulated products to be regulated products under the FDA's tobacco regulatory authority²⁶. This rule requires a warning label on waterpipe tobacco packaging to convey its addictiveness to consumers. Additionally, now that waterpipe tobacco is a regulated product, the FDA could engage in public education to inform consumers, such as young adults, about the potential risks of waterpipe tobacco. The

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study findings indicate young adult waterpipe users largely do not recognize the potential addictiveness of WTS, highlighting a need for public health messaging targeting this group. The findings also suggest public health messages conveying potential health harms associated with WTS addiction are a potentially promising messaging strategy to be examined further. These results can contribute to future research on waterpipe tobacco product warning label content, as well as studies for the design of public education messages by FDA that target young waterpipe users with information about the potential risks of WTS.

Although the study findings add uniquely to this research area, the results should be interpreted in light of important limitations. The study involved a convenience sample recruited through an online crowdsourcing data collection platform. This limits the generalizability of findings to broader populations of young adults. The majority of participants used other tobacco products in addition to waterpipe, which may affect the findings reported, including preferences for message content. Research with exclusive waterpipe tobacco users may be informative for the development of messages targeting this group. The survey used brief measures of WTS perceptions and the open-ended responses could not be probed further as they were administered online. More nuanced open-ended questions (e.g. those aimed at separately assessing young adults' perceptions of harms and addictiveness) and methods that allow for further probing of responses, could help clarify some aspects of the findings in future research. It is also possible the order of questions, with closed-ended items assessing perceptions administered first, may have affected responses to open-ended items. These limitations can be addressed by using qualitative methods that allow for probing in future research on this topic (e.g. in-depth interview, focus groups).

CONCLUSIONS

Despite limitations and consistent with prior research, the study findings showed that young adults surveyed largely viewed WTS as not addictive. This study adds new information to this research area by demonstrating some of the reasons why young adults do not view WTS to be addictive. The results also point to potential messaging strategies to motivate cessation in young adult waterpipe users, including messaging that vividly conveys the health harms associated with long-term addiction. Future research is needed to investigate optimal ways to design and deliver messages targeting young adult WTS based on these findings, to maximize their effects for reducing waterpipe use in this population.

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CONFLICT OF INTERESTS

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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