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Research Article

Waterpipe Smoking: Gateway to or Escape from Cigarette Use among Current Waterpipe Users in Riyadh, Saudi Arabia

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Abstract

Introduction: The purpose of this study is to determine whether waterpipe use may contribute to the onset of cigarette use or if it may help current cigarette smokers reduce or quit cigarette smoking.

Method: This is a cross-sectional study of 622 current waterpipe smokers selected randomly from within 15 different randomly selected waterpipe lounges in Riyadh, Saudi Arabia. Using an iPad volunteers completed a self-administered survey regarding their smoking history, tobacco withdrawal symptoms, and demographics. Those who initially started smoking with waterpipe and those who initially started smoking with cigarettes were analyzed separately.

Results: Logistic regression showed that both the years of waterpipe use and withdrawal symptoms significantly predicted being a current cigarette smoker (waterpipe starters: years of waterpipe use: OR=1.18, C.I.=[1.07-1.30] withdrawal symptoms: OR=1.11, C.I.=[1.01-1.22] and cigarette starters: years of waterpipe use: OR=1.08, C.I.=[1.00-1.17] withdrawal symptoms: OR=1.15, C.I.=[1.03-1.27]. However, the likelihood of being a current cigarette smoker decreased as age and frequency of waterpipe use increased. Additionally, there was evidence that waterpipe withdrawal symptoms were predicted by frequency of waterpipe use.

Conclusions: Waterpipe use may be a potential gateway to cigarette use. However, among those who initially started smoking with cigarettes, older age and greater frequency of waterpipe may protect against cigarette use.

Implications: The study findings add additional evidence that smoking waterpipe may lead to initiate another smoking behavior, in a particular cigarette use, especially among young individuals. However, long history and greater use of waterpipe could be associated with less likelihood of being a current cigarette user. Health promotion and intervention programs must consider the mutual association between waterpipe and cigarette use among youth and young adults in order to develop effective health promotion programs.

Introduction

Waterpipes have been used to smoke tobacco or other substances for at least 400 years in Asia and Africa [1]. It is estimated that there are around 100 million waterpipe smokers worldwide who smoke using the waterpipe daily [2,3]; this number is expected to increase annually. Using waterpipes has become popular among adolescents and young adults [4,5] especially since the introduction of massal in the 1990's in the Middle East. Massal is a type of tobacco, which gets inserted in the head of the waterpipe. It is moist and sweetened and comes in a variety of flavors [6,7].

Medical literature has shown serious health problems, resulting from smoking the waterpipe. Waterpipe smoking is associated with Bronchogenic Carcinoma and waterpipe smokers have twice the risk of getting lung cancer [8] and tripling the odds of having severe arterial stenosis and coronary artery disease compared to non-waterpipe smokers [9]. Furthermore, waterpipe smoking may decrease pulmonary function significantly by decreasing expiratory flow rate [10]. Other health effects that have been associated with waterpipe use include increased heart rate and blood pressure, periodontal disease, and a low birth weight of infants born to females who smoke the waterpipe [8].

Problems associated with waterpipe smoking are not limited to increased negative health outcomes. Waterpipe smoking has been found to be very common among regular cigarette smokers [11]. Since both waterpipes and cigarettes deliver an addictive ingredient (i.e., nicotine), that may put smokers at a higher risk for nicotine dependency. It is possible for waterpipe smokers to satisfy their nicotine cravings by smoking cigarettes when waterpipe is unavailable and in circumstances that are inappropriate for waterpipe smoking, e.g. in the workplace. The WHO Study Group on Tobacco Product Regulation [1] highlighted the need for a thorough understanding of several issues related to waterpipe smoking, including the relationship between waterpipe use, the initiation of cigarette smoking, and the use of other addictive substances. The knowledge about waterpipe use and its role on initiating cigarette use is still in its early stages. Until now; we have little knowledge of the relationship between these types of smoking behaviors and how they affect each other.

Few studies have focused on waterpipe smoking as a possible bridge to or from cigarette use. In a longitudinal cohort study those who already smoked waterpipe were at high risk of becoming regular cigarette smokers within eight months. This progression increased as the initial frequency of waterpipe use increased [12]. Waterpipe smokers were twice as likely to become current cigarette smokers within two years and current waterpipe smoking was strongly associated with cigarette experimentation [13]. Waterpipe users were nine times more likely to experiment with cigarettes than non-waterpipe users [14]. Adolescents who smoked waterpipe were 4 to 16.5 times more likely to try cigarettes than those with no history of waterpipe smoking [15,16].

If there is an association between use of waterpipe and development of cigarette smoking it is important to understand what aspects of waterpipe use may contribute to the likelihood of being a cigarette smoker in individuals who started with waterpipe and in individuals who started with cigarettes. To our knowledge, this is one of the few studies that examine the roles of smoking waterpipe on being a cigarette user using scientific-based method. In addition, the iPad tablets were used as a method to collect data from participants to reduce the chances of error of entering and transcribing data which is one of the novelties of this study.

Methods

Study design

A list of 70 waterpipe lounges in Riyadh, Saudi Arabia was obtained from the Riyadh Municipality, Environmental Health Department. From this list, 15 different waterpipe lounges were selected randomly using Microsoft Excel. Each waterpipe lounge is usually divided into smaller sections so that sections may be separated for the customers' privacy. Within each lounge, a number was assigned to each section, and then the section numbers were sorted into random order using Microsoft Excel. Finally, beginning at the top of the list, all participants in each selected section were contacted. This process continued until at least 40 participants were recruited from each lounge. This allowed a total of at least 600 participants across the 15 lounges.

Participants

The study response rate was 79%. In the winter of 2015, the primary investigator of this paper surveyed 622 current waterpipe smokers in 15 waterpipe lounges in Riyadh, Saudi Arabia. Inclusion criteria were (a) being a current waterpipe smoker, (b) being male, (c) being 18 years of age or older, and (d) having the ability to read and use an electronic device (the survey was in Arabic and self-administered using iPads). This study was approved by the Loma Linda University Institutional Review Board. All participants provided informed written consent. Six individuals were excluded. Of the participants 53.7% had ever smoked cigarettes and 46.3% were exclusive waterpipe smokers. Those who initially started smoking cigarettes, rather than waterpipe, represent 34.7% of the participants. Other characteristics of the sample can be found in table 1. Institutional Review Board approval from Loma Linda University was obtained before beginning data collection.

Procedures

Translation

Brislin's model [17,18] was used in the translation of the questionnaire from English into Arabic. Two translators bilingual in English and Arabic were used. One translated the original questionnaire from English into the target language, Arabic. Then the second translator translated it back to English from Arabic without having access to the original English version. Both versions were compared to check for accuracy and reliability of the questionnaire. This process was repeated until no discrepancies between the two versions were found.

Table 1: Sample Characteristics (n=622).

	Mean ± S.D. or n (%)
Age	27.19 ± 6.78
Waterpipe initiation age	21.02 ± 4.74
Cigarettes initiation age	18.55 ± 4.16
Years of waterpipe use	6.17 ± 5.36
No. of cigarettes smoked/week	35.64 ± 51.99
Waterpipe smoking session (min)	88.70 ± 46.40
Smoking status	
Daily cigarette users	80(12.9%)
< Daily cigarette users	117(18.8%)
Past cigarette users	137 (22%)
Exclusive waterpipe users	288 (46.3%)
Marital Status	
Single	396 (63.7%)
Others	226 (36.3%)
Education Level	
High school or less	293 (47.1%)
College and post graduate	329 (52.9%)
Work Status	
Government employee	225 (36.2%)
Non-government employee	153 (24.6%)
Self-employed	35 (5.6%)
Student	177 (28.5%)
Unemployed	32 (5.1%)
Monthly Income	
SR 3000 or Less	194 (31.2%)
SR 3001 to 6000	114 (18.3%)
SR 6001 to 9000	111 (17.8%)
More than SR 9000	203 (32.6%)
Exercise	
Never	201 (32.3%)
1 to 2 times / week	268 (43.1%)
3 to 4 times / week	86 (13.8%)
5 or more times / week	67 (10.8%)

Data collection tool

Instead of being given paper surveys, volunteers were loaned an iPad which contained the questionnaire. The questionnaire was loaded into the Qualtrics iPad app (Qualtrics, Provo, UT). Questions included smoking history (waterpipe and cigarette), tobacco withdrawal symptoms, and demographics (age, marital status, income, and education). The survey used was based on a survey for the assessment of waterpipe tobacco use in epidemiological studies [19]. The severity of tobacco dependency was assessed by using a modified version of the Hooked on Nicotine Checklist [20].

Dependent variable

The dependent variable was the binary outcome of whether the participant currently smokes cigarettes in addition to their waterpipe use. The National Survey on Drug Use and Health's definition of current cigarette use was used, which is that the participant smoked part or all of a cigarette during the last 30 days [21].

Independent variables

Waterpipe use: The independent variables included frequency and years of waterpipe use. Since all participants were recruited from waterpipe lounges while smoking, all participants were considered to be current waterpipe users. Frequency of waterpipe use was assessed by the number of bowls (heads) of waterpipe tobacco consumed per week. The years of waterpipe use was defined by the number of years the participants reported smoking the waterpipe.

Tobacco withdrawal symptoms: Tobacco withdrawal symptoms were measured by using a modified version of the Hooked on Nicotine Checklist [20]. Although this measure was developed for nicotine addiction and primarily used with cigarettes, "cigarette" was replaced by "waterpipe" and the content was modified to be relevant to waterpipe smoking characteristics. The measure contains ten yes/no questions and was scored based on the number of yes responses (Cronbach's alpha=0.83). A zero score (answering no to all ten questions) means a person enjoys full autonomy over tobacco use. Any score above zero indicates that a person has lost full autonomy over tobacco use. As the score increases, more autonomy over tobacco use is lost.

Smoking history and demographics: Five variables were used to evaluate the participants' smoking history: age of initiation of waterpipe use, ever smoked cigarettes, age of initiation of cigarette use, number of cigarettes smoked in a week (if they were cigarette users), and whether the participants initially started smoking waterpipe or cigarettes. Since one of the aims of this study was to explore how cigarette use could be affected by waterpipe use, participants were split into two groups: those who initially smoked cigarettes before starting waterpipe use and those who had initially smoked waterpipes. Then these two groups were analyzed separately. In addition, five demographic variables were re-categorized as follow: age (years), marital status (single & others), education level (high school or less & college and post graduate), employment status (government employee, non-government employee, self-employed, student, unemployed), and income (SR 3000 or Less, SR 3001 to 6000, SR 6001 to 9000, and more than SR 9000).

Statistical analysis: Descriptive statistics are presented as means and Standard Deviation (SD) or numbers (n) and percentages (%). Logistic regression models were used to examine the association between current cigarette smoking status and waterpipe use and. Based on significant association, the independent variables included in the model were age, frequency of waterpipe use, years of waterpipe use, and tobacco withdrawal score. A mediation analysis was carried out using Hayes Process macro for SPSS [22].

The variable for frequency of waterpipe use was the only variable that contained missing data. This variable had 5 responses excluded from the analysis. The values that were treated as missing data had conflicting values that did make logical sense to be a part of the analysis. For instance, participants reported that they smoked 45 heads (bowls) of waterpipe a day. It does not make sense because each waterpipe session takes about 30 to 60 minutes [23], so to smoke 45 heads require continually smoking for at least 22 hours a day. Such data were treated as missing.

Results

Study sample demographics

Participants' mean age was 27.19 years (SD=6.78). The participants' mean age of cigarette initiation 18.55 years (SD=4.16)

Table 2: Sample characteristics on continuous variables classified by cigarette smoking status and exclusive waterpipe use (n=622).

	Smoking status								
	Daily cigarette users(n=80)		Less than Daily cigarette users (n=117)		Past cigarette users (n=137)		Exclusive waterpipe users (n=288)		P-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Age	$26.44_{a,b}$	6.49	25.09_a	5.83	28.09_b	6.83	$27.82_{b,c}$	7.02	0.001*
Frequency of waterpipe use/ Week	4.20_a	5.74	8.36_b	7.83	9.08_b	7.13	7.70_b	6.71	<0.001*
Years of waterpipe use	6.56_a	4.9	5.82_a	5.25	6.39_a	5.56	6.10_a	5.44	0.749
Waterpipe initiation age	19.88_a	4.73	19.27_a	3.2	21.69_b	5.38	21.72_b	4.71	<0.001*
Cigarettes initiation age	18.04_a	4.34	18.96_a	4.35	18.51_a	3.89	NA	NA	0.311
No. of cigarettes smoked/ week	70.79_a	60.62	11.61_b	25.1	NA	NA	NA	NA	<0.001*
Waterpipe sessions time (minute)	88.78_a	44.44	97.62_a	48.94	85.28_a	47.97	86.67_a	44.87	0.134
Withdrawal symptoms score	5.34_a	3.17	$4.32_{a,b}$	2.97	4.21_b	2.96	$3.61_{b,c}$	2.88	<0.001*

Note: Means in the same row not sharing the same subscript are significantly different at p< 0.05.

*Significant at an alpha of 0.05.

NA - Not Applicable.

was statistically significant lower than the participants' mean age of waterpipe initiation 21.02 years (SD=4.74). Because our sample population was relatively young, the mean years of waterpipe use was 6.17 years (SD=5.36). In addition, the mean waterpipe smoking session lasted approximately 88.7 minutes (SD=46.4). Even though majority of the participants were not current cigarette users (68.3%), most had smoked cigarettes (53.7%) at some point in their life. As shown in Table 1, the largest subgroups of participants were single, college or post graduate educated, and government employees.

Waterpipe use characteristics

Tables 2 and 3 show the study sample characteristics stratified by the participants' smoking status. Table 2 shows that the age of current waterpipe users who smoked cigarettes less than daily was significantly lower (p=0.001) than the age of past cigarette users or those who were exclusive waterpipe users. In addition, waterpipe initiation age among current cigarette users (daily & less than daily) was significantly lower than those who were past cigarette or exclusive waterpipe users. The withdrawal symptoms score was significantly lower among those who were past (but not current) cigarette users and those who used waterpipe exclusively compared to daily cigarettes users. This is expected since those who smoked both waterpipe and cigarettes were exposed to a greater amount of addictive substances than those who only smoked waterpipe.

In table 3, the major differences were that those who used cigarettes less than daily were more likely to be single than past

cigarette users or exclusive waterpipe users, and to have a lower income than exclusive waterpipe users.

Association between current cigarette use and frequency and years of waterpipe use

Table 4 shows binary logistic regression analysis of whether or not a person was a current cigarette smoker regressed on age, frequency and years of waterpipe use, and tobacco withdrawal symptoms. The results are stratified by those who initially smoked a waterpipe and those who initially smoked cigarettes before they used a waterpipe.

Stratified analysis of waterpipe starters versus cigarette starters

For those who initially started smoking waterpipe, as the years of waterpipe use increased, there was an 18% increase (C.I.=[1.07-1.30]) of likelihood of being a current cigarette smoker. In addition, the likelihood of being a current cigarette smoker went up by 11% (C.I.=[1.01-1.22]) for every one unit increase in the tobacco withdrawal symptoms score. The chances of being a current cigarette user decreased by 8.3% (C.I.=[0.76-0.90]) for every year their age increased (Table 4).

For those who initially started smoking cigarettes before being current waterpipe smokers, for each additional year of waterpipe use, there was a 8% increase of likelihood (C.I.=[1.00-1.17]) of being a current cigarette smoker. In addition, for every point increase in the tobacco withdrawal symptoms score there was a 15% increase in the

Table 3: Sample characteristics on categorical variables classified by cigarettes smoking status and exclusive waterpipe use (n=622).

		Smoking status (n, %)								
		Daily cigarette users (n=80)		< Daily cigarette users (n=117)		Past cigarette users (n=137)		Exclusive waterpipe users (n=288)		P-value
		n	%	n	%	N	%	n	%	
Marital Status	**Single**	52 a,b	65.00%	95 a	81.20%	79 b	57.70%	170 b,c	59.00%	< 0.001*
	Others	28 a,b	35.00%	22 a	18.80%	58 b	42.30%	118 b,c	41.00%	
Education	**High school or less**	41 a	51.30%	61 a	52.10%	64 a	46.70%	127 a	44.10%	0.424
	College & post graduates	39 a	48.80%	56 a	47.90%	73 a	53.30%	161 a	55.90%	
Work Status	**Government employee**	24 a	30.00%	40 a	34.20%	53 a	38.70%	108 a	37.50%	0.279
	Non-government employee	17 a	21.30%	23 a	19.70%	33 a	24.10%	80 a	27.80%	
	Self-employed	7 a	8.80%	5 a	4.30%	8 a	5.80%	15 a	5.20%	
	Student	25 a	31.30%	43 a	36.80%	34 a	24.80%	75 a	26.00%	
	Unemployed	7 a	8.80%	6 a	5.10%	9 a	6.60%	10 a	3.50%	
Income/month	**SR 3000 or Less**	30 a,b	37.50%	47 a	40.20%	41 a,b	29.90%	76 b	26.40%	0.023*
	SR 3001 to 6000	14 a	17.50%	21 a	17.90%	31 a	22.60%	48 a	16.70%	
	SR 6001 to 9000	15 a	18.80%	24 a	20.50%	17 a	12.40%	55 a	19.10%	
	More than SR 9000	21 a,b	26.30%	25 a	21.40%	48 a,b	35.00%	109 b	37.80%	
Exercise	**Never**	32 a	40.00%	45 a	38.50%	51 a	37.20%	73 a	25.30%	0.076
	1 to 2 times/week	36 a	45.00%	44 a	37.60%	53 a	38.70%	135 a	46.90%	
	3 to 4 times/week	8 a	10.00%	15 a	12.80%	17 a	12.40%	46 a	16.00%	
	5 or more times/week	4 a	5.00%	13 a	11.10%	16 a	11.70%	34 a	11.80%	

Note: Values in the same row not sharing the same subscript are significantly different at p<0.05.

*Significant at an alpha of 0.05.

SR=Saudi Riyal ($1=SR3.75).

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Table 4: Logistic regression of current cigarette use stratified by the type of smoking participants started with.

	Waterpipe starters			Cigarette starters		
	95% C.I. for OR			95% C.I. for OR		
	OR	Lower	Upper	OR	Lower	Upper
Age	0.83	0.77	0.9	0.9	0.85	0.96
Frequency of waterpipe use-week	0.97	0.93	1.01	0.93	0.89	0.97
Years of waterpipe use	1.18	1.07	1.3	1.08	1	1.17
Withdrawal symptoms score	1.11	1.01	1.22	1.15	1.03	1.27
Constant	10.9			11.5		

Note: OR=Odd Raito.

odds (C.I.=[1.03-1.27]) of being a current cigarette smoker. On the other hand, age (OR=0.90, C.I.=[0.85-0.96]) and frequency (OR=0.93, C.I.=[0.89-0.97]) of waterpipe use were significantly associated with a decrease in the odds of being a current cigarette user.

Additional analysis

Additional analyses were done on exclusive waterpipe users (never smoked cigarettes) to understand the relationship of years and frequency of waterpipe use with waterpipe withdrawal symptoms. When years of waterpipe use and frequency were examined separately, each one predicted withdrawal symptoms, but when the withdrawal symptoms score was regressed on both together (the duration and frequency of waterpipe use), only frequency of waterpipe use was a significant predictor of withdrawal symptoms- Frequency of waterpipe: B=0.159, 95% C.I.=[0.11, 0.21], p=<0.001; Years of waterpipe use: B=0.031, 95% C.I.=[-0.03, 0.09], p=0.29. However, we found that the years of waterpipe use was a significant predictor of frequency of waterpipe use (p<0.005) and that the years of waterpipe use had a statistical significant indirect effect on tobacco withdrawal symptoms through frequency (B=0.036, 95% C.I.=[0.01, 0.08]). Therefore, frequency of waterpipe use was a mediator for the relationship between years of waterpipe use and tobacco withdrawal symptoms among exclusive waterpipe users. The longer they had used waterpipe in the past the more likely they were to frequently use waterpipe currently and that frequency predicted their withdrawal symptoms.

Discussion

This study adds further evidence to the increasing body of literature suggesting that waterpipe use could be a bridge to cigarette use [12-14,24,25]. In our sample, all participants were current waterpipe users, and most of them were either current or past cigarette users. We examined two groups of waterpipe smokers: (a) those who initially started smoking a waterpipe and (b) those who initially started smoking cigarettes. We examined both groups separately to determine whether they were current cigarette smokers or have been cigarette smokers in the past. The analysis suggests that smoking the waterpipe is a potential gateway toward cigarette use.

Waterpipe users are exposed to an addictive substance i.e. nicotine so they may become dependent on it. Waterpipe use may induce tobacco withdrawal symptoms when terminated [26,27]. Since the waterpipe is not accessible all the time and usually requires more time to smoke, waterpipe users may supplement their nicotine needs by smoking cigarettes to reduce or avoid tobacco withdrawal

symptoms. We found a strong association between withdrawal symptoms and being a current cigarette user among all waterpipe smokers. Therefore, as frequency and years of waterpipe use increase, dependence on nicotine can be foreseen. This study revealed that years of waterpipe use and tobacco withdrawal symptoms were associated with being a current cigarette smoker regardless of whether the participant initially started smoking waterpipes or cigarettes.

The relationship between years of smoking, frequency, and withdrawal symptoms among waterpipe users who never smoked cigarettes deserved additional analysis. Using Hayes process macro revealed that frequency of waterpipe use could be a mediator between years of waterpipe use and withdrawal symptoms. The test of mediation suggests that the reason the years of waterpipe smoking is associated with waterpipe withdrawal symptoms may be because the number of years smoking waterpipe is associated with an increase in frequency of waterpipe use. The longer they have been smoking waterpipe, the more frequent they smoke waterpipe and that leads them to have more withdrawal symptoms. Furthermore, it was found that years of waterpipe use was associated with frequency (daily, weekly, & monthly) of waterpipe use 28 and frequency of waterpipe use was associated with addiction [29]. Frequency of waterpipe use has been linked with increased smoking duration, reduced belief of ability to quit, and a strengthened perception that one is addicted on waterpipe smoking [30].

Age played a protective role against cigarette use in this data. As smokers got older, they were less likely to be current cigarette smokers. This may be due to a common misconception that waterpipe is less addictive and less harmful than cigarettes [31,32]. Smokers may choose to smoke waterpipes over cigarettes as they are aging because they become more aware and concerned of their health due to a misleading belief that the waterpipe is less harmful and addictive than cigarettes.

For those who initially started smoking cigarettes, age and frequency of waterpipe use was associated with lower odds of being a current cigarette user. These findings were also congruent with those who initially started smoking waterpipes, but the apparent protective effect of frequency of waterpipe use was not statistically significant for those who initially started smoking using a waterpipe. Furthermore, those who initially started smoking cigarettes consumed significantly more cigarettes a week compared to those who initially started smoking waterpipes then used cigarettes (mean =15.05, C.I.=[11.02, 20.55] and mean =6.96, C.I.=[4.93, 9.81] respectively). Our sample also showed that initiation age of waterpipe smoking was higher than initiation age of cigarette smoking. This may be because cigarettes are more accessible and easier to use than the waterpipe.

A worrisome issue about waterpipe smoking is that it may be used as a substitute for cigarettes when quitting [33]. Although we did not formally collect qualitative data but in the informal discussions during or after the data collection individuals sometimes made statements. Some participants had stated that smoking waterpipe were used to help them refrain from cigarettes. Participants explained that waterpipe is not accessible everywhere and it takes time for preparation and use, while cigarettes are much easier to access with less time to smoke, but they are much more difficult to quit. Consequently, shifting to waterpipe was of value to them because waterpipe was thought to be less addictive and harmful than cigarettes. Therefore, they think smoking waterpipe might reduce their use of cigarettes, which may allow them to gradually quit cigarettes in the future.

While our findings showed that frequent use of waterpipe was associated with a reduction in the likelihood of being a current cigarette smoker among cigarette starters; Rastam, et al (2011) reported that waterpipe smoking could impede smoking cessation attempts for cigarette users. This appears to contradict our findings; however Rastam and colleagues did not distinguish between cigarette cessation and tobacco cessation. They mentioned that waterpipe has a potential to thwart cigarette cessation [34], but based on their results, waterpipe may thwart tobacco cessation. Tobacco cessation has a broader meaning than cigarette cessation, which may put their results in line with our findings. One limitation is the inability of a cross-sectional design study to determine a causal relationship between waterpipe and cigarette use. Because we only sample waterpipe users, we did not have a cigarette only group for comparison like we had a waterpipe use only group. In addition, the results of this study may not be generalizable to female waterpipe smokers. However, the sample was randomly selected which reduced the selection bias and was highly representative of the population that was studied. The self-administered survey may have some responses bias; however, participants used an iPad to input and store their own data electronically, which reduced chances of error in transcribing responses.

There are some elements that were not adjusted for such as health status, peer pressure (waterpipe is mostly smoked in groups), and socioeconomic status, but in future analyses we plan to add more possible confounders. Further investigation with cohort design studies is needed to establish a causal relationship between waterpipe and cigarette use to determine whether waterpipe use may be a gateway for cigarette use or help in quitting cigarettes.

In conclusion, among male waterpipe users, the longer history a person smokes a waterpipe, the more likely that person is to be a current cigarette user-regardless of age. This is also true with tobacco withdrawal symptoms, the higher score of tobacco withdrawal symptoms; the more likely a person is to be a cigarette user. This suggests that smoking waterpipe could be a bridge to cigarette use. This could be alarming to public health as the prevalence of waterpipe use is growing among young individuals in the Middle East. Prompt action is required to combat this century-old smoking behavior and its consequences.

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