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Waterpipe smoking among jordanian adults: Predictors and correlates

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Abstract

Background and Objectives: Waterpipe tobacco use is a popular trend in smoking with an unsubstantiated belief of safety. The objectives were to determine the predictors of waterpipe smoking among a sample of adults in Jordan. Methods: A survey based cross-sectional study was conducted in a convenience sample of adults in Amman, Jordan (n=600) from July/2009-July/2010. Survey questions included socio-demographic characteristics, current and history of tobacco smoking, environmental and behavioral determinants of smoking like family and peer tobacco use, and perceived harm. Three multivariate logistic regression models were constructed to determine predictors of waterpipe use with the following outcomes: past ever use of a waterpipe to smoke tobacco vs. no use, past 30-day use vs. no use, and past 7-day use vs. no use. Results: Past cigarette, past cigar, past alcohol use, having friends and/or siblings that use waterpipes were significant predictors of waterpipes smoking, while gender was not. Perception of harm equivalent to cigarettes or more was associated with less use. Conclusion: Findings underscore the importance of developing interventions that incorporate the predictors identified and address the social encouragement that spreads waterpipe tobacco use.

INTRODUCTION

Tobacco use is responsible for approximately 443,000 premature deaths annually in the United States [1] and 5.4 million worldwide [2] and is the leading preventable cause of premature death [2-3]. It is projected to remain the leading cause of death and disability in both developed and developing countries in 2020 [4]. Economic losses to US society are estimated at $193 billion with $96 billion in direct medical costs annually [1].

Waterpipe smoking is an understudied form of tobacco use with a growing popularity [5]. It has been widely produced in the Middle East, India, and segments of Asia, and its use is increasing in Western countries [6]. When using a waterpipe, the smoke passes through water prior to inhalation [5,7], giving the unsubstantiated belief that the practice is relatively safe [5, 8, 9], especially among intermittent users [9]. With many sweetened flavors and an inviting scent [5, 10], waterpipe smoking has become more of a fashion trend among the youth.

Compared to cigarette smoking, waterpipe use is associated with more carbon monoxide (CO), smoke exposure [9, 11] and comparable nicotine exposure [11]. Waterpipe smoke has also been reported to have significant amounts of carcinogens including hydrocarbon and heavy metals [9, 12-13] as well as tar [14]. The American Lung Association (ALA) [15], the

World Health Organization (WHO) [16], and The American Cancer (ACS) Society [9] have warned against the associated health risks of waterpipe smoking which are expected to resemble those of cigarette smoking [15-16] and may even carry unique risks as well [16]. Waterpipe use can increase the risk of cancer [5, 10, 14, 17-18], cardiovascular disease [5, 10, 17], pulmonary disease [5, 10, 14, 18], poor fetal outcomes [5, 14, 18], and periodontal diseases [18]. It is reported to compromise lung function and elevate the risk of chronic obstructive pulmonary disease (COPD) [19]. In addition, communicable diseases may result from sharing the mouthpiece of the waterpipes in social gatherings [5, 14].

Jordan is a small Middle-Eastern country with a population of 5,600,000 where waterpipe smoking is relatively common [20] and, like other countries in the region [21] is prevalent even among both genders [20]. With an age adjusted current cigarette smoking prevalence of 40% among Jordanian adults, 50% among men, and tobacco use prevalence of 15-30% among students aged 13-15 Y, smoking related diseases in Jordan are on the rise. In 2006, chronic non-communicable diseases accounted for more than 50% of the deaths in Jordan. National estimates indicate that 250 million JDs per year are spent on tobacco products [22].

While previous studies have examined waterpipe smoking among university students in the region including Jordan [20-21], Lebanon [23], and Syria [24], studies addressing waterpipe smoking in the Jordanian adult population of all ages are lacking. The objectives of the current study were to examine the predictors of waterpipe smoking among a sample of adults in Jordan. Coming up with effective strategies to combat waterpipe smoking and prevent further spread will require knowledge of these predictors. It is the first step of a successful intervention.

MATERIALS AND METHODS

Participants and Study design

A cross-sectional study was conducted in a convenience sample of willing adults 18 years or older in Amman, Jordan over July/2009-July/2010. The G-power 3.1 statistical software [25] was used for power analysis and determined that 589 participants were needed for a two-tail analysis using logistic regression with 0.05 α-level, 0.10 β-level (90% power), and 1.4 odds ratio.

Survey procedures and measures

The survey was institutional review board exempt and was adapted from a previously used self-report survey [26-27]. Survey questions covered socio-demographic characteristics, current and history of cigarette and waterpipe tobacco smoking, perceived harm, family and friends' tobacco use, diagnoses of diseases linked to smoking, symptoms affected by smoking like shortness of breath, mental health, and use of other addictive substances like alcohol. Current and history of tobacco use was measured using the following questions: (During your lifetime, how many times did you try cigarettes? During your lifetime, how many times did you try cigars? During the last 30 days how many times have you tried cigarettes? During the last 30 days how many times have you tried cigars? How many cigarettes did you smoke in the last 30 days? How many cigarettes did you smoke in the last 7 days ? How many cigarettes did you smoke in the last 24 hours? Have you ever used argeela to smoke tobacco? How many times have you smoked tobacco using argeela in the last 30 days? How many times have you smoked tobacco using argeela in the last 7 days? How many times have you smoked tobacco using argeela in the last 24 hours?). Perceived harm was measured using the following question: (Do you believe argeela is harmful to your health?) Options for answers included: (1. Not at all, 2. Yes: same harm as cigarettes, 3. Yes: more harmful than cigarettes, 4. Yes: less harmful than cigarettes).

The variable selection was guided by two significant theories in the field of behavioral sciences. The Theory of Reasoned Action (TRA) [28] has been widely used as a behavioral prediction theory [29] and involves a reasoned path in which attitudes and subjective norm lead to behavioral intention leading to behavior. The constructs of the theory include the behavioral intention as a direct determinant of behavior, the attitude toward the behavior whether positive or negative, and subjective norm (social pressure to perform or not to perform a behavior). The Social Cognitive Theory (SCT) [30] explains psychological functioning in terms of a triadic causation. In this interactive model, behavioral, cognitive, and environmental factors operate as interacting determinants of the outcome and act bidirectionally with each other. It also illustrates how people acquire and maintain certain behavioral patterns and has been widely applied to health behavior with respect to prevention, health promotion, and modification of unhealthy lifestyles [29]. The constructs of the SCT include the environment (stimuli from the physical or social environment), person (personality, characteristics, or cognitive behavior), and behavior (acquired behavior).

Survey distribution sites included a physician clinic, 2 academic institutions, 3 shopping centers, and a marketing company. These various sites were used to include adult participants of different ages, socioeconomic statuses, and professions. Adults coming into the sites were asked if they were willing to participate in a survey regarding smoking habits and

attitudes that would need 15-20 minutes to fill out. If they agreed, they were given a survey and asked to drop in a sealed box that was available in each of these sites when finished.

Waterpipes are also known as Shishah [5-6, 10], hookah [5-6, 10], argeela, Goza [5-6], hubble-bubble [5-6], and narghile [6, 10]. The term argeela was used in this survey as it is the common name for waterpipes in Jordan, and all questions pertaining to waterpipe use specifically inquired about tobacco use in an argeela.

Three outcome variables were identified based on previously described questions: past ever use of a waterpipe to smoke tobacco vs. no use, past 30-day use of a waterpipe to smoke tobacco vs. no use and past 7-day use of a waterpipe to smoke tobacco vs. no use. The aim of examining three outcomes was to compare predictors among those who have tried waterpipes in the past, those that might use it intermittently, and those who could be frequent users.

Data Analysis

Descriptive statistics and chi-square analyses were used to determine the frequencies and associations of participant characteristics with the three outcomes previously defined. Bivariate logistic regression analyses of patient characteristics were carried out with the three outcome variables and results were presented as unadjusted odds ratios (OR) with 95% confidence intervals (CI). Prior to conducting the multivariate models, a multicollinearity analysis and correlation analyses were conducted to assess correlation between all variables. If any 2 variables showed a correlation coefficient of 0.7 or higher, or the variance inflation factor (VIF) was found greater than 10, one of the variables was removed from the model.

Three multivariate logistic regression models were carried out to determine predictors of being a waterpipe user with the three outcomes after assessing co-linearity between the independent variables. Significant variables ($p<0.2$) in the bivariate analyses were included and backward elimination was used to arrive at the final models. Gender was included in all multivariate models. Results were presented as adjusted ORs with 95% CIs. All statistical analyses were carried out using SAS statistical package version 9.2.

RESULTS

The response rate was approximately 60% with 600 respondents returning the survey out of 1000 distributed. As the survey needed 15-20 minutes to complete, the main reason for nonparticipation was lack of time. The overall rates of waterpipe smoking in the sample are presented in Figure 1 while the gender specific rates are shown in Figure 2. More than half of the sample had previously used a waterpipe to smoke tobacco (52.84%), about a third had a waterpipe in the past 30 days (33.94%) and over one in five had a waterpipe in the past week. Participant characteristics are described in Table 1. Approximately half of the participants were female and almost two thirds were younger than 25 years. Table 1 also summarizes the results of chi-square analysis of various patient characteristics with the three outcome variables: outcome 1: ever use of a waterpipe to smoke tobacco vs. not, outcome 2: past 30-day use of a waterpipe to smoke tobacco vs. not, outcome 3: past 7-day use of waterpipe to smoke tobacco vs. not.

Logistic regression analyses

Bivariate and multivariate logistic regression results with the three outcome variables are presented in Table 2. Participants that were older than 40 years of age were less likely to use a waterpipe in all 3 models compared to those less than 25 (OR=0.21, 95% CI=0.08 – 0.55 model 1, OR=0.04, CI=0.01 – 0.22 model 2, OR=0.12, CI=0.03 – 0.56 model 3) and those aged 26-40 were also less likely to ever use a waterpipe in model 1 (OR=0.47, 95% CI=0.27 – 0.82) and in the past 30 day use in model 2 (OR=0.34, 95% CI=0.19 – 0.60). Participants who previously used cigarettes in their lifetime were more likely to be waterpipe smokers in all 3 models (OR=6.37, 95% CI=3.47 – 11.70 model 1, OR=3.38, CI=1.64 – 6.96 model 2, OR=4.29, CI=2.01 – 9.16 model 3), and those who previously used cigars were also more likely to be waterpipe smokers in all 3 models (OR=3.44, 95% CI=1.80 – 6.59 model 1, OR=2.05, CI=1.12 – 3.78 model 2, OR=2.67, CI=1.43 – 4.98 model 3). Past 30-day cigarette use was associated with past 30 day use of a waterpipe (OR=2.69, 95% CI=1.38 – 5.25), and past alcohol use was associated with ever use of a waterpipe in model 1 (OR =2.10, 95% CI=1.09 – 4.06). Those who believed that the harm of waterpipe smoking is equivalent or more than cigarette use were less likely to use a waterpipe in the past 30 day use model (OR=0.26, 95% CI=0.11 - 0.63) and in the past 7-day or use model (OR=0.31, 95% CI=0.13 – 0.71). Participants who usually got lower grades in school were less likely to ever smoke a waterpipe than those who usually achieved A and B grades (OR=0.28, 95% CI=0.16 – 0.49). Having a brother or sister who uses a waterpipe was a significant predictor of waterpipe smoking in all 3 models (OR=3.18, 95% CI=1.95 – 5.18 model 1, OR=2.53, CI=1.53 – 4.18 model 2, OR=2.90, CI=1.73 – 4.86 model 3), while having close friends who use a waterpipe was a significant predictor of waterpipe smoking in the ever use model (OR=3.87, 95% CI=2.25 – 6.63) and the past 30 days use model (OR=2.74, 95% CI=1.40 – 5.36).

Table 1. Characteristics of past waterpipe use among a sample of Jordanian adults

		Ever use model		30-day use model		7-day use model	
		(52.84%)		(33.94%)		(21.84%)	
Characteristic	Total Frequency (Percentage)	Percentage	p-value	Percentage	p-value	Percentage	p-value
Demographics and health condition							
Gender							
Female	298 (51.56%)	50.00%	0.1189	27.44%	**0.0005***	17.74%	**0.0117***
Male	280 (48.44%)	56.85%		42.66%		27.27%	
Age,(years)							
25 years old or younger	380 (63.33%)	54.72%		34.94%		21.86%	
26-40 years old	183 (30.50%)	52.87%	0.1058	37.18%	**0.0045***	24.68%	0.091
40 years old or older	37 (6.17%)	36.11%		6.67%		6.67%	
Education level							
High school degree or less	66 (11.09%)	38.71%	**0.0174***	38.78%	0.4779	26.53%	0.4222
College degree or more	529 (88.91%)	54.76%		33.71%		21.52%	
Grades							
Mostly As and Bs	351 (59.19%)	56.77%	**0.0236***	32.36%	0.3808	21.43%	0.8965
Mostly Bs, Cs, Ds, Fs	242 (40.81%)	46.73%		36.22%		21.93%	
High school type							
Public	350 (59.42%)	49.19%	**0.0474***	33.10%	0.7499	22.30%	0.7467
Private	239 (40.58%)	58.02%		34.48%		21.08%	
Shortness of breath							
Sometimes or frequently	203 (34.29%)	63.01%	**0.0008***	44.05%	**0.0006***	27.54%	**0.0213***
Rarely	389 (65.71%)	47.41%		28.57%		18.52%	
Tobacco and other substances use experience							
Lifetime cigarettes use							
At least once	380 (64.41%)	66.09%	**<0.0001***	46.37%	**<0.0001***	30.28%	**<0.0001***
Never	210 (35.59%)	27.27%		11.56%		6.32%	
Lifetime cigars use							
At least once	210 (35.71%)	73.80%	**<0.0001***	51.96%	**<0.0001 ***	36.11%	**<0.0001***
Never	378 (64.29%)	40.66%		23.30%		13.27%	
Lifetime alcohol use							
At least once	111 (18.91%)	75.76%	**<0.0001***	52.08%	**<0.0001***	36.46%	**<0.0001***
Never	476 (81.09%)	47.14%		29.08%		17.81%	
Lifetime Xanax use							
At least once	36 (6.21%)	70.97%	**0.0321***	56.25%	**0.0052***	37.50%	**0.0220***
Never	544 (93.79%)	51.14%		32.08%		20.31%	
Past 30-day cigarettes use							
At least once	264 (44.90%)	63.75%	**<0.0001***	52.38%	**<0.0001***	35.38%	**<0.0001***
Never	324 (55.10%)	43.42%		19.78%		11.47%	
Past 30-day cigars use							
At least once	63 (10.71%)	73.58%	**0.0013***	56.86%	**0.0002***	44.23%	**<0.0001***
Never	525 (89.29%)	50.32%		31.05%		18.95%	
Past 30-day alcohol use							
At least once	54 (9.23%)	69.57%	**0.0158***	48.84%	**0.0276***	34.88%	**0.0255***
Never	531 (90.77%)	50.95%		32.21%		20.22%	
Perceived harm of argeela							
Harmful							
Not harmful	32 (6.50%)	70.37%		57.69%		42.31%	
Less harmful than cigarettes	39 (7.93%)	75.00%	**0.0075***	57.89%	**0.0003***	42.11%	**0.0007***
Same/more than cigarettes	421 (85.57%)	52.08%		31.95%		20.41%	
Relatives' and friends' argeela use							
Dad is an argeela smoker?							
No	399 (77.03%)	50.26%	**0.0032***	32.41%	0.1418	20.66%	0.0975
Yes	119 (22.97%)	66.07%		40.00%		28.18%	
Mom is an argeela smoker?							
No	463 (89.73%)	50.90 %	**<0.0001***	31.98%	**0.0011***	20.19 %	**0.0002***
Yes	53 (10.27%)	81.63%		54.90%		43.14%	
Siblings are argeela smokers?							
No	287 (55.62%)	40.88%	**<0.0001***	24.22%	**<0.0001***	14.29%	**<0.0001***
Yes	229 (44.38%)	69.86%		46.26%		32.39%	
Close friends are argeela smokers?							
No	153 (29.59%)	24.65%	**<0.0001***	12.88%	**<0.0001***	9.09%	**<0.0001***
Yes	364 (70.41%)	63.54%		42.77%		27.86%	

* p≤0.05

a. Total numbers do not add up to 600 because of missing value

Table 2. Univariate and multivariate logistic regression among the three different models

	Ever-use model		30-day use model		7-day use model	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Demographics and health condition						
Gender						
Female	Reference	Reference	Reference	Reference	Reference	Reference
Male	1.32 (0.93 – 1.87)	0.76 (0.42 – 1.38)	**1.97 (1.35 – 2.88)***	0.73 (0.40 – 1.34)	**1.74 (1.13 – 2.68)***	0.83 (0.45 – 1.52)
Age,(years)						
25 years old or younger	Reference	Reference	Reference	Reference	Reference	Reference
26-40 years old	0.93 (0.64 – 1.35)	**0.47 (0.27 – 0.82)***	1.10 (0.74 – 1.64)	**0.34 (0.19 –0.60)***	1.17 (0.75 – 1.84)	0.58 (0.34 – 1.01)
40 years old or older	**0.47 (0.23 – 0.96)***	**0.21 (0.08 – 0.55)***	**0.13 (0.03 – 0.57)***	**0.04 (0.01 –0.22)***	0.26 (0.06 – 1.10)	**0.12 (0.03 – 0.56)***
Education level						
High school degree or less	Reference		Reference		Reference	
College degree or more	**0.52 (0.30 – 0.90)***		1.25 (0.68 – 2.29)		1.32 (0.67 – 2.58)	
Grades						
Mostly As and Bs	Reference	Reference	Reference		Reference	
Mostly Bs, Cs, Ds, Fs	**0.67 (0.47 – 0.95)***	**0.28 (0.16 – 0.49)***	1.19 (0.81 – 1.74)		1.03 (0.66 – 1.60)	
High school type						
Public	Reference		Reference		Reference	
Private	**0.70 (0.49 – 0.99)***		0.94 (0.64 – 1.37)		1.08 (0.70 – 1.66)	
Shortness of breath						
Sometimes or frequently	Reference		Reference		Reference	
Rarely	**0.53 (0.36 – 0.77)***		**0.51 (0.34 – 0.75)***		**0.60 (0.39 – 0.93)***	
Tobacco and other substances use experience						
Lifetime cigarettes use						
At least once	Reference	Reference	Reference	Reference	Reference	Reference
Never	**5.20 (3.49 – 7.75)***	**6.37 (3.47– 11.70)***	**6.62 (3.95 –11.08)***	**3.38 (1.64 –6.96)***	**6.44 (3.34– 12.40)***	**4.29 (2.01 – 9.16)***
Lifetime cigars use						
At least once	Reference	Reference	Reference	Reference	Reference	Reference
Never	**4.11 (2.78 – 6.09)***	**3.44 (1.80 – 6.59)***	**3.56 (2.40 – 5.28)***	**2.05 (1.12 –3.78)***	**3.70 (2.36 – 5.78)***	**2.67 (1.43 – 4.98)***
Lifetime alcohol use						
At least once	Reference	Reference	Reference		Reference	
Never	**3.50 (2.13 – 5.77)***	**2.10 (1.09 – 4.06)***	**2.65 (1.68 –4.18)***		**2.65 (1.62 – 4.32)***	
Lifetime Xanax use						
At least once	Reference		Reference		Reference	
Never	**2.33 (1.05 – 5.17)***		**2.72 (1.32 – 5.62)***		**2.35 (1.11 – 4.99)***	
Past 30-day cigarettes use						
At least once	Reference		Reference	Reference	Reference	
Never	**2.29 (1.61 – 3.26)***		**4.54 (3.05 – 6.77)***	**2.69 (1.38 –5.25)***	**4.23 (2.66 – 6.72)***	
Past 30-day cigars use						
At least once	Reference		Reference		Reference	
Never	**2.75 (1.45 – 5.20)***		**2.93 (1.62 – 5.28)***		**3.39 (1.87 – 6.16)***	
Past 30-day alcohol use						
At least once	Reference		Reference		Reference	
Never	**2.20 (1.14 – 4.23)***		**2.01 (1.07 – 3.77)***		**2.11 (1.08 – 4.12)***	
Perceived harm of argeela						
Harmful						
Not harmful	Reference		Reference	Reference	Reference	Reference
Less harmful than cigarettes	0.79 (0.26 – 2.42)		0.99 (0.36 – 2.72)	1.09 (0.27 – 4.36)	1.01 (0.37 – 2.77)	0.98 (0.29 – 3.34)
Same/more than cigarettes	**0.36 (0.17 – 0.79)***		**0.34 (0.17 – 0.67)***	**0.26 (0.11- 0.63)***	**0.35 (0.18 – 0.70)***	**0.31 (0.13 – 0.71)***
Relatives' and friends' argeela use						
Dad is an argeela smoker?						
No	Reference		Reference		Reference	
Yes	**1.93 (1.24 – 2.99)***		1.39 (0.90 – 2.16)		1.51 (0.93 – 2.45)	
Mom is an argeela smoker?						
No	Reference		Reference		Reference	
Yes	**4.29 (2.03 – 9.05)***		**2.59 (1.44 – 4.66)***		**3.00 (1.64 – 5.48)***	
Siblings are argeela smokers?						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	**3.35 (2.30 – 4.88)***	**3.18 (1.95 – 5.18)***	**2.69 (1.82 – 3.99)***	**2.53 (1.53 –4.18)***	**2.88 (1.83 – 4.51)***	**2.90 (1.73 – 4.86)***
Close friends are argeela smokers?						
No	Reference	Reference	Reference	Reference	Reference	
Yes	**5.76 (3.71 – 8.95)***	**3.87 (2.25– 6.63)***	**5.05 (2.91 – 8.79)***	**2.74 (1.40 –5.36)***	**3.86 (2.04 – 7.31)***	

* p≤0.05.

a. OR: Odds Ratio

b. 95% CI: 95% Confidence Interval

DISCUSSION

The results of this study show a high percentage of waterpipe smoking in Jordanian adult sample with more than half of the 600 participants (52.84%) previously using a waterpipe to smoke tobacco, one in three having used it in the past 30 days, and one in five having used it in the past week. A study among university students in Jordan reported rates of waterpipe smoking of approximately 37% of 1454 participants [20]. Frequency of use among those who reported waterpipe use (n=552) [20] was 13% on a daily basis, 54% on a weekly basis, and the rest at a lesser frequency. Another study among Jordanian university students [21] showed that 43% of 548 participants reported past month waterpipe use and a 61% reported past ever use. A study among Lebanese university students (n=1964), also found males were more likely to engage in waterpipe smoking as compared to females but noted that the difference was not as prominent as with cigarette smoking [23]. Our study population was different as it included all adults and was not limited to students. We did not find gender to be significantly associated with waterpipe smoking after controlling for potential confounders in the multivariate model, although there was an initial association in the past 30-day use and past 7-day use in the unadjusted analyses. Cigarette smoking in Jordan is more common among males [20, 31], while waterpipe smoking seems to be preferred in females [20]. Indicating a social acceptability of waterpipe smoking among females compared to cigarettes as noted in studies in neighboring Middle Eastern countries [23, 32-33].

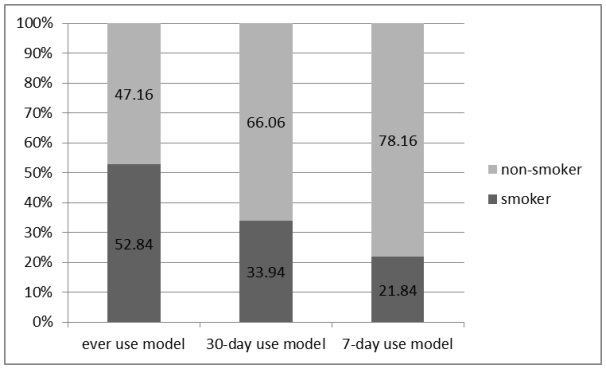

Fig. 1. Percentage of waterpipe use with the three outcomes

Age below 25 was also a significant predictor of waterpipe smoking in all 3 models compared to older age groups (over 40) indicating popularity of waterpipe smoking among students' age, consistent with previous reports [10, 21, 34]. Further research will be needed to assess age of starting the habit as prevention strategies should target such subpopulations before these individual begin. We still observed waterpipe smoking in other age groups with 37.18% of those aged 26-40 and 6.67% of those over 40 having used waterpipe in the past 30 days.

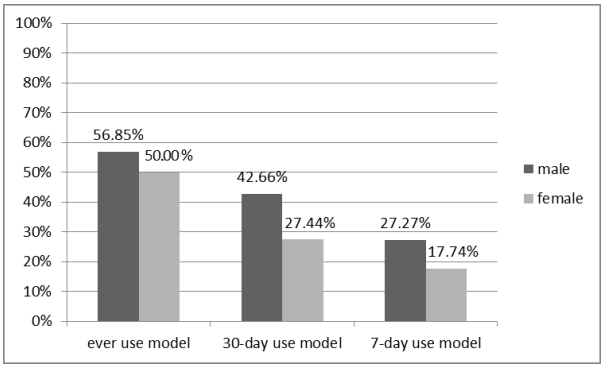

Fig. 2. Percentage of waterpipe use with the three outcomes by gender.

Past Cigarette use and past cigar use were also significant predictors of waterpipe smoking in the three models. Azab et al. [21] had noted that among 548 university students in Jordan, cigarette smoking and waterpipe smoking were associated but not correlated, thus not every waterpipe smoker was found to be a cigarette smoker. Other studies in Jordan did not assess past cigarette smoking as a predictor of waterpipe smoking in a multivariate model. Nonetheless, Essienberg et al. [34] conducted a study among 744 Virginia Commonwealth University Students in the US and found past 30 day cigar and past 30 cigarette use to be predictors of waterpipe smoking (past 30 day use). We also found those smoking a cigarette in the past 30 days were 2.69 times more likely to use a waterpipe in the past 30 days controlling for potential confounders. Past alcohol use was also associated with higher likelihood of ever using a waterpipe for tobacco but not in the past 7 day or 30 day model. This may indicate a tendency among some individuals to smoke several different tobacco forms as well as use other substances like alcohol. Other studies in Jordan [20-21] did not assess alcohol use, but Tamim et al. [23] found excessive alcohol use to be a predictor of waterpipe smoking among Lebanese university students. Our survey also asked about a number of other addictive substances including cocaine, ecstasy, marijuana, chewing tobacco, but these variables were all insignificant, so were not included in the final models.

Participants who used to achieve higher grades (As and Bs) in school were more likely to have smoked waterpipe compared to those that achieved lower grades. This suggests that the hardworking students are willing to try a waterpipe to smoke tobacco, and that the habit can be initiated by all types of students. This

association was not observed, however, in the past 7 or 30 day use models. Future research is needed to examine potential predictors that would promote continuing the habit among those who previously tried waterpipe smoking.

Comparing the harm of tobacco smoking using a waterpipe to that of cigarettes has been often done in previous literature [10, 21, 34-36]. In our sample, the majority of participants (85.57%) believed that waterpipe smoking was as harmful as or more harmful than cigarettes. Azab et al. [21] also found that 62% of the Jordanian students surveyed believed that waterpipe smoking was more harmful than cigarettes while 28% felt it was equally harmful. Despite this knowledge, we still found high rates of waterpipe smoking in our sample. This might be a result of the addictive nature of this form of tobacco use, as daily waterpipe use has been shown to cause nicotine absorption which is equivalent to 10 cigarettes [6, 9], a level that can cause dependence even in intermittent users [9], with smoking sessions lasting 60-80 minutes, and 50-200 puffs per session [16]. This underscores the importance of developing early interventions that can prevent individuals from starting the habit and becoming hooked. We still found that those who believed that waterpipe smoking was less harmful than cigarettes were more likely to have smoked in a waterpipe in past 7 or 30 days but not in the ever use model. This might indicate that the harm perception might affect whether someone will continue to engage in the habit, but may not prevent someone from trying it. These findings are consistent with studies among US university samples [10, 34, 37] as well as among Jordan university students for monthly use of a waterpipes [21] and highlight the importance of developing educational programs that explain the associated risks of waterpipe tobacco use.

Having a brother or sister who is a waterpipe smoker was a significant predictor in all 3 models as well. Having friends that smoke tobacco through a waterpipe was also a predictor in the past ever use and the past 30-day use. This suggests that smoking a waterpipe appears to be part of a social event with family and friends, and the development of any intervention strategy will have to take into consideration the social aspect. The waterpipe smoking environment often happens in social groups which play a prominent role promoting and spreading the habit. Primack et al. [10] found that among a US University students sample, peer acceptability and perceived popularity of the waterpipe smoking of tobacco were both predictors of smoking it.

Our analysis initially included other variables that showed significance in the unadjusted rates like mother or father using a waterpipe, graduating from a public or private high school, which is indicative of socioeconomic status in Jordan, level of education, and exhibiting symptom of shortness of breath. These variables were not significant after adjusting for potential confounders. Other variables included in the survey that were explored but were not significant were working or studying in a medical field vs. nonmedical field, suffering from dyspepsia, irritable bowel disease, inflammatory bowel disease, heart disease, total satisfaction with one's health, and feeling of usefulness (data not shown).

Several limitations to this study can be described. This research was based on a convenience sample, thus we were unable to describe nonparticipants and causality cannot be inferred from this study because of the cross-sectional design. The generalizability of the results is limited to similar subpopulations in the Middle East. Income was not included as a confounder and was reported to be associated with waterpipe smoking among students in Jordan [21]. We did however explore the type of high school that the participants graduated from (private or public), and that, to some extent, is affected by income and socioeconomic status in Jordan.

Despite these limitations, this is the first study, to our knowledge that examines predictors of waterpipe smoking among a sample of Jordanian adults. More than half of the 600 participants had previously used a waterpipe, one in three having used it in the past 30 days, and one in five having used it in the past week, even with a recognition of harm in most of the sample. This study underscores the magnitude of waterpipe smoking among Jordanian adults that is often combined with other forms of tobacco use like cigarettes and cigars. Future research should focus on developing intervention strategies to combat all forms of tobacco use in Jordan. Waterpipe smoking targeted interventions should incorporate the predictors identified above and address the social encouragement that spreads the use of this health hazard especially among younger adults.

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Declaration

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