



Waterpipe Use and Susceptibility to Cigarette Smoking Among Never-Smoking Youth

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Introduction: Susceptibility to cigarette smoking, defined as the lack of a firm decision against smoking, is a strong predictor of regular smoking and addiction. Several modifiable risk factors have been identified among never cigarette smokers, and one potential factor of interest is waterpipe use. The purpose of this study is to determine the association of waterpipe use with susceptibility to cigarette smoking among never-smoking youth.

Methods: In a pooled analysis of 17 Arab nations with nationally representative Global Youth Tobacco Surveys conducted during 2002–2011, tobacco-related information was obtained from 30,711 never-smoking adolescents representing 4,962,872 youth. Study outcome was susceptibility to cigarette smoking, and primary exposure was waterpipe use. Data were analyzed in 2014 using weighted logistic regression models, including stratified models by gender, to determine the odds of susceptibility to cigarette smoking with waterpipe use, adjusting for confounders.

Results: Overall, 20% of never-smoking youth were susceptible to cigarette smoking, ranging from 13.1% in Oman to 32.6% in Somalia; 5.2% currently used waterpipe, ranging from 0.3% in Morocco to 23.5% in Kuwait. The estimated odds of susceptibility to cigarette smoking were 2.5 (95% CI=1.9, 3.4) times higher for adolescents who used waterpipe in the past month compared with those who did not, controlling for confounders. Estimates were similar when stratified by gender.

Conclusions: Waterpipe use is associated with susceptibility to cigarette smoking. Study findings identify a novel risk factor for never smokers to initiate smoking and will help the public health community develop and implement policies around waterpipe use prevention.

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Introduction

Tobacco dependence typically begins during or prior to adolescence and develops quickly in youth.¹ Some youth develop addiction symptoms rapidly after their first exposure to nicotine,^{2,3} at low

levels of nicotine exposure,^{4,5} or well before they consume a lifetime total of 100 cigarettes or become daily smokers.^{6–8} Early onset of symptoms and the appearance of symptoms prior to escalation in cigarette use have been confirmed in earlier studies.^{3,4,6,7,9–11} Tobacco use continues to be the leading cause of preventable death,¹² and 90% of smokers initiate cigarette smoking during their adolescence.¹³ Therefore, it is important to identify risk factors that promote a never cigarette-smoking adolescent into smoking his or her first cigarette. Susceptibility to cigarette smoking, defined as the lack of a firm decision against cigarette smoking, is a strong predictor of regular or established smoking, with adolescents more likely to participate in tobacco industry activities and less likely to respond to tobacco prevention programs.^{14–16} Risk factors have been identified, including parental and peer smoking; stress; anxiety; exposure

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to secondhand smoke (SHS); smoking messages in media; tobacco industry promotions; and cigarette packing designs.^{17–21} Another potential risk factor of interest is waterpipe use, which may create dependence for nicotine,^{22,23} thereby encouraging an adolescent to smoke his or her first cigarette. In addition, waterpipe use is a social phenomenon, and a minimal gender gap exists because of its increased use and acceptability in social gatherings.²² Therefore, understanding its role in cigarette learning behavior of adolescents will help predict the magnitude of future regular smokers. Using data from multiple Arab nations, we aimed to determine the relationship between waterpipe use and susceptibility to cigarette smoking among never cigarette-smoking youth.

Waterpipe use (hookah, shisha, narghile, arghila, goza, and hubble-bubble) is an old tobacco smoking practice culturally predominant in Eastern Mediterranean countries, the Middle East, and parts of South Asia.²⁴ Recently, it has garnered significant attention by public health researchers and healthcare practitioners owing to its increasing consumption in Western countries.²⁵ Although it is predominantly smoked by men, the advent of flavoring agents, paraphernalia, accessibility, novelty, and the social atmosphere has made it more attractive for women and youth.^{22,24,26} Several chronic diseases have been attributed to waterpipe use, including respiratory tract infections, lung cancer, and periodontal infections.^{27,28} With widespread public perception that waterpipe use is less harmful and less toxic than traditional cigarettes, it has become a socially acceptable practice, resulting in increased consumption in youth.²⁹ However, studies^{30,31} have found that waterpipe smoke contains the same toxicants as cigarette smoke, including polycyclic aromatic hydrocarbons, tar, nicotine, and carbon monoxide. Studies have compared nicotine levels between waterpipe use and cigarette smoking and found higher plasma nicotine concentrations with either a single puff^{32,33} or one session^{23,32} per day of waterpipe use compared with that of a single puff or one session of cigarette smoking per day. Previous studies^{34–36} have reported that youth have become increasingly attracted to waterpipe use and might become regular smokers in the future. In addition, studies^{37–39} have reported the prevalence estimates and identified predictors of waterpipe smoking in different populations; however, no study has been conducted to estimate the odds of susceptibility to cigarette smoking among waterpipe users. With increasing evidence of a global waterpipe use pandemic and high level of nicotine dependence among waterpipe users,^{22,23} using a pooled analysis of multiple Global Youth Tobacco Surveys (GYTSs) conducted in the Arab nations where waterpipe use is more common,²⁵ we investigated the association of waterpipe use with susceptibility to

cigarette smoking among 30,711 adolescents representing 4.97 million youth who have never tried or experimented with cigarette smoking in their lifetime.

Methods

Study Population and Global Youth Tobacco Survey

The Global Youth Tobacco Surveys (GYTS) conducted during 2002–2011 were used to obtain information on youth tobacco use in 19 of 22 Arab nations (Table 1). Only surveys in which samples represented the youth nationwide in respective countries were included; therefore, those conducted in Algeria and Iraq were not included. Moreover, the survey was administered separately for Gaza Strip province of the Palestine, and hence was included separately, similar to other countries' national surveys. Consistent with earlier studies,^{17,40–42} data from the most recent survey were used for countries that had administered the survey more than once. The survey questionnaire, sampling frame, and design have been described in earlier studies.^{42,43} The GYTS employs a standard methodology in questionnaire preparation and administration and in collection and processing of data.^{42,44} The IRB at the East Tennessee State University provided study approval.

Measures

The outcome variable was susceptibility to cigarette smoking among never cigarette smokers. A never cigarette smoker was defined as a participant who responded *no* to the question *Have you ever tried or experimented with cigarette smoking, even one or two puffs?* Similar to earlier studies and using a validated definition for susceptibility to cigarette smoking developed by Pierce et al.,^{14,17} an adolescent was defined as being susceptible to cigarette smoking based on his or her response on a 5-point ordinal scale ranging from *definitely not* to *definitely yes* to the three following questions:

1. *If one of your friends offered you a cigarette, would you smoke it?*
2. *At any time during the next 12 months, do you think you will smoke a cigarette?*
3. *Do you think you will be smoking cigarettes 5 years from now?*

An adolescent who responded *definitely not* to all three questions was defined as not susceptible, and who reported any other response to the three questions was defined as being susceptible to cigarette smoking.

The main predictor variable was waterpipe use among never-smoking youth. Information on waterpipe use among youth was obtained by supplemental questions in the “core” questionnaires of the GYTS. We defined an adolescent currently using waterpipe when he or she responded *> 0 days* to the question *During the past 30 days (one month), on how many days did you smoke shisha, hookah, narghile, arghila, or waterpipe?* Waterpipe use-specific questions were not administered for Bahrain, Comoros, Mauritania, and Somalia, and hence were not included in the regression analysis.

Specific adolescent characteristics were included as covariates in the regression models based on the existing literature and plausible associations with both waterpipe use and susceptibility to smoking.^{17,37–39} Bandura's social cognitive theory⁴⁵ was employed as a theoretic framework to select the covariates, which included

Table 1. Study Measures, Survey Items With Responses, Global Youth Tobacco Survey (GYTS)

Study measure	GYTS survey items	GYTS item responses	Dichotomized measure
GYTS question used to obtain never-smoking youth			
Smoking status	Have you ever tried or experimented with cigarette smoking, even one or two puffs?	Yes No	Yes=Ever cigarette smoker No=Never cigarette smoker
Outcome			
Susceptibility to cigarette smoking	If one of your friends offered you a cigarette, would you smoke it? At any time during the next 12 months do you think you will smoke a cigarette? Do you think you will be smoking cigarettes 5 years from now?	Definitely not Probably not Probably yes Definitely yes	No="Definitely not" for all three items Yes=any other responses for any of the three items
Exposure			
Current waterpipe use	During the past 30 days (one month), on how many days did you smoke shisha, hookah, narghile, argghila, or waterpipe?	0 days 1 or 2 days 3 to 5 days 6 to 9 days 10 to 19 days 20 to 29 days All 30 days	No=0 days Yes=> 0 days
Covariates			
Exposure to secondhand smoke (SHS) inside home	During the past week, on how many days have people smoked in your home, in your presence?	0 1 to 2 3 to 4 5 to 6 7	No=0 days for both items Yes= ≥ 1 day for both items
Exposure to SHS outside home	During the past 7 days, on how many days have people smoked in your presence, in places other than in your home?	0 1 to 2 3 to 4 5 to 6 7	No=0 days for both items Yes= ≥ 1 day for both items
Parental smoking	Do your parents smoke?	None Both Father only Mother only	No=none Yes=any other response
Peer smoking	Do any of your closest friends smoke cigarettes?	None of them Some of them Most of them All of them	No=none of them Yes=any other response
Support for smoking ban	Are you in favor of banning smoking in public places (such as in restaurants, in buses, streetcars, and trains, in schools, on playgrounds, in gyms and sports arenas, in discos)?	No Yes	No Yes
Knowledge about harmful effects of smoking and SHS exposure	Do you think cigarette smoking is harmful to your health? Do you think the smoke from other people's cigarettes is harmful to you?	Definitely not Probably not Probably yes Definitely yes	No="Definitely not" for both items Yes=any other responses for either item

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Table 1. Study Measures, Survey Items With Responses, Global Youth Tobacco Survey (GYTS) (continued)

Study measure	GYTS survey items	GYTS item responses	Dichotomized measure
Exposure to anti-smoking messages in media	During the past 30 days (one month), how many anti-smoking media messages (e.g. television, radio, billboards, posters, newspapers, magazines, movies) have you seen? When you go to sports events, fairs, concerts, community events, or social gatherings, how often do you see anti-smoking messages?	None A few A lot	No="none/never" response for both items Yes=any other response for either item
Tobacco industry promotion	Do you have something (T-shirt, pen, backpack, etc.) with a cigarette brand logo on it? Has a (cigarette representative) ever offered you a free cigarette?	No Yes	No Yes
Anti-smoking education in schools	During this school year, were you taught in any of your classes about the dangers of smoking? During this school year, did you discuss in any of your classes the reasons why people your age smoke? During this school year, were you taught in any of your classes about the effects of smoking like it makes your teeth yellow, causes wrinkles, or makes you smell bad?	No Not sure Yes	No="No" for all three items Yes=Yes for any of the three items
Age	How old are you?	13 years 14 years 15 years	
Sex	What is your sex?	Female Male	No=Female Yes=Male

Note: Dichotomization of GYTS survey responses were conducted using previously described methods.^{17,38} "No" responses were coded as 0 and "Yes" responses as 1 for multivariable logistic regression model.

parental or peer smoking, exposure to SHS inside or outside the home, knowledge about harmful effects of smoking and SHS exposure, exposure to anti-smoking media messages or tobacco industry promotions, receptivity of anti-smoking education in schools, support for smoking ban in public places, age, sex, and year of GYTS administration. All variables were categorical in nature, and dichotomized using previously described methods.^{17,40–42} Information on GYTS questions, participant responses, and coding for data analysis is presented in Table 1.

Statistical Analysis

Data were analyzed for descriptive and inferential statistics. During assembly of data records, it was found that adolescents aged <13 and >15 years also participated in the surveys. The GYTS is a school-based survey designed to collect tobacco information among school-attending adolescents. Because all students in selected classes are eligible for participation, it is possible that adolescents aged <13 and >15 years might have participated in the survey. Therefore, to avoid data inconsistencies across multiple countries and to remain consistent with the sampling frame and previous literature,^{17,40,41} only adolescents aged 13–15 years were included. Descriptive characteristics were reported using unweighted sample counts and weighted population percentages. Bivariate analyses were conducted to assess differences in waterpipe use by adolescent characteristics using chi-square tests. To predict the population estimates, GYTS sample data were adjusted for sampling design effect, nonresponses, and post-stratification of the sample relative to grade and sex distribution of the population.^{40,43} A final adjustment summed the

weights by grade and sex to the population of schoolchildren in the selected grades in each sample site. A multivariable logistic regression model was conducted to estimate the odds of susceptibility to cigarette smoking with waterpipe use, adjusting for covariates including parental or peer smoking, SHS exposure inside or outside the home, knowledge about harmful effects of smoking and SHS, exposure to tobacco industry promotions, receptivity of anti-smoking education in schools, and country and year the GYTS was administered. Because earlier studies have reported significant differences in waterpipe use between female and male participants,^{46–48} weighted multivariable logistic regression models stratified by sex were conducted to estimate the relationships among male and female adolescents separately. As information on support for smoking bans in public places was not available in all surveys, it was not adjusted for in the regression models. Regression diagnostics were conducted and no correlations among covariates were observed to warrant omission of variables for multicollinearity issues. Hosmer–Lemeshow tests were performed to assess the goodness of fit for regression models, and identified *p*-values >0.05 indicating a good model fit. All parameter estimates with *p*-values <0.001 were considered significant for statistical inferences. Data were managed and analyzed in 2014 using SAS, version 9.2, with "survey" syntaxes to accommodate for final weights in the models.

Results

A total of 39,710 school-attending adolescents aged 13–15 years representing 6,270,302 youth participated in the survey. Among them, 30,711 representing 4,962,872

Table 2. Susceptibility to Cigarette Smoking Among Never-Cigarette Smoking Youth in Arab Nations

Arab nation	Year GYTS administered	GYTS participants aged 13–15 years		Never-smoking youth		Susceptibility to smoking (19.7%)
		Sample (n=39,710)	Population (N=6,270,302)	Unweighted count (n=30,711)	Weighted count (N=4,962,872)	Weighted percentage (%)
Bahrain	2002	1,445	25,264	1,078	18,757	24.8
Comoros	2007	811	11,469	573	8,057	14.7
Djibouti	2009	1,096	12,002	873	9,559	23.6
Egypt	2009	3,472	1,105,843	2,863	883,500	14.1
Gaza strip	2005	1,395	90,507	1,064	68,367	21.4
Jordan	2009	1,523	255,249	1,075	182,030	24.1
Kuwait	2009	2,213	52,736	1,588	37,442	26.2
Lebanon	2011	1,651	141,645	1,173	99,719	21.7
Libya	2010	1,361	234,029	1,155	199,143	27.9
Mauritania	2009	1,769	12,429	1,290	9,011	23.3
Morocco	2010	2,106	906,673	1,913	822,193	16.3
Oman	2010	905	80,168	798	70,443	13.1
Qatar	2007	943	8,111	722	6,217	17.0
Saudi Arabia	2010	1,797	816,926	1,336	604,102	21.1
Somalia	2007	897	7,513	758	6,317	32.6
Sudan	2009	950	505,265	827	439,188	18.9
Syria	2010	1,210	953,223	924	715,846	21.5
Tunisia	2010	1,294	356,822	1,034	284,644	24.0
United Arab Emirates	2005	10,821	111,719	8,416	85,243	17.5
West Bank	2009	1,401	149,739	744	80,730	26.4
Yemen	2008	650	432,970	507	332,363	24.1

GYTS, Global Youth Tobacco Survey.

youth had never smoked cigarettes, with prevalence estimates ranging from 54% in the West Bank to 91% in Morocco, and were included in the study (Table 2). Information on current waterpipe use was not available for Bahrain, Comoros, Mauritania, and Somalia, resulting in the final data of 27,012, representing 4,920,729 never-smoking youth. The majority of never-smoking youth was female (54.0%) and aged 14 years (37.1%). More than one third (33.7%) had parents who smoke, were exposed to SHS inside (34.5%) or outside the home (38.0%), and around one fourth (25.5%) had peers who smoke. Approximately 98% were knowledgeable about the harmful effects of smoking and SHS exposure, and 76% supported smoking bans in public places (Table 3).

Overall, 5.2% of never-smoking youth in Arab nations currently used waterpipe, with prevalence estimates ranging from 0.3% in Morocco to 23.5% in Kuwait. The prevalence estimate of waterpipe use was significantly higher among male (6.3%) compared with female (4.2%) adolescents ($p=0.03$). By contrast, there was no significant difference identified across the three age categories ($p=0.10$). When studying never-smoking adolescent characteristics by the waterpipe use groups, 8% and 10.6% of waterpipe users had smoking parents or peers, 9% and 8.7% were exposed to SHS inside or outside the home, respectively, and 8.6% of waterpipe users were exposed to tobacco industry promotions. By contrast, 5.2% and 5.5% of youth who were

Table 3. Bivariate Analysis of Factors Associated With Waterpipe Use Among Never Cigarette Smoking Youth in Arab Nations^a

Characteristics	Percentage yes ^a	Variable	Unweighted count		Weighted count		Percentage used waterpipe	p-value
			Used waterpipe	Did not use waterpipe	Used waterpipe	Did not use waterpipe		
Parental smoking	33.7	No	681	17,213	105,651	3,047,732	3.3	< 0.001
		Yes	737	7,664	132,280	1,510,235	8.0	
Peer smoking	25.5	No	657	18,833	118,221	3,500,502	3.3	< 0.001
		Yes	791	6,346	133,259	1,103,750	10.6	
Exposure to SHS inside home	34.5	No	569	17,320	94,887	3,070,286	3.0	< 0.001
		Yes	876	7,877	152,657	1,528,070	9.0	
Exposure to SHS outside home	38.0	No	560	16,200	83,951	2,889,641	2.8	< 0.001
		Yes	876	8,926	163,330	1,690,476	8.7	
Support for smoking ban	75.9	No	294	4,840	61,444	926,068	6.2	0.1
	36.8	Yes	799	17,422	158,462	3,550,528	4.2	
Age	37.1	13 years	491	9,610	77,988	1,719,746	4.3	0.1
	26.1	14 years	531	8,838	98,764	1,715,092	5.4	
	54.0	15 years	449	6,923	76,866	1,196,015	6.0	
Sex	44.2	Female	758	14,908	111,522	2,534,596	4.2	0.03
	1.7	Male	674	10,151	136,706	2,015,489	6.3	
Knowledge about the harmful effects of smoking and SHS exposure	97.9	No	37	691	2,063	81,202	2.5	0.02
		Yes	1,423	24,608	250,006	4,532,823	5.2	
Exposure to anti-smoking media messages	86.7	No	210	3,696	30,931	583,940	5.0	0.8
		Yes	1,239	21,501	220,866	4,013,773	5.2	
Exposure to tobacco industry promotions	15.3	No	1,026	20,699	177,290	3,735,569	4.5	< 0.001
		Yes	365	3,709	64,970	681,540	8.6	
Receptivity of anti-smoking education in school	56.3	No	287	5,627	50,134	1,261,228	3.8	0.003
		Yes	890	15,124	152,899	2,603,885	5.5	
Year GYTS was administered	3.1	2005	422	8,972	8,375	143,337	5.5	< 0.001
	0.1	2007	47	658	401	5,673	6.4	
	6.8	2008	6	465	4,704	302,435	1.4	
	33.2	2009	456	7,499	67,761	1,560,932	4.2	
	54.8	2010	267	6,880	148,960	2,542,556	5.5	
	2.0	2011	273	897	23,416	75,921	23.5	
Country GYTS was administered	0.2	Djibouti	34	839	386	9,173	4.0	< 0.001
	18.0	Egypt	61	2,796	14,478	867,737	1.6	
	1.4	Gaza strip	77	966	4,979	62,087	7.3	
	3.7	Jordan	133	936	21,799	159,141	12.0	
	0.8	Kuwait	69	1,519	1,680	35,762	4.5	
	2.0	Lebanon	273	897	23,416	75,921	23.5	
	4.0	Libya	24	1,131	3,981	195,162	2.0	
	16.7	Morocco	37	1,874	16,989	804,291	2.1	
	1.4	Oman	3	794	237	70,130	0.3	
	0.1	Qatar	47	658	401	5,673	6.4	
	12.3	Saudi Arabia	37	1,295	15,606	586,521	2.6	
	8.9	Sudan	27	798	14,876	423,056	3.4	
	14.5	Syria	136	787	103,653	611,652	14.5	
	5.8	Tunisia	30	999	8,494	274,800	3.0	
	1.7	United Arab Emirates	345	8,006	3,396	81,250	4.0	
	1.6	West Bank	132	611	14,542	66,063	18.0	
6.8	Yemen	6	465	4,704	302,435	1.4		

Note: Boldface indicates statistical significance ($p < 0.001$).

^aWaterpipe use information was not available for Bahrain, Comoros, Mauritania, and Somalia.

SHS, secondhand smoke; GYTS, Global Youth Tobacco Survey.

Table 4. Association of Waterpipe Use With Susceptibility to Cigarette Smoking Among Never-Cigarette Smoking Youth

Waterpipe use	Unweighted count	Weighted percentage	Susceptibility to cigarette smoking		
			Unweighted count	Weighted percentage	OR ^a (95% CI)
Total					
Yes	1,471	5.2	647	43.9	2.5 (1.9, 3.3)
No ^b	25,371	94.1	4,660	18.2	
Males					
Yes	674	6.3	310	43.8	2.4 (1.6, 3.3)
No ^b	10,151	92.7	2,226	21.1	
Females					
Yes	758	4.2	316	42.1	2.7 (1.8, 4.0)
No ^b	14,908	95.4	2,362	15.9	

Note: Boldface indicates statistical significance ($p < 0.001$).

^aOR is adjusted for parental or peer smoking, secondhand smoke exposure inside or outside home, knowledge about harmful effects of smoking and secondhand smoke, exposure to tobacco industry promotions, receptivity of anti-smoking education in schools, country, year of survey administration.

^bNever-cigarette smoking youth who did not smoke waterpipe (referent group).

knowledgeable about harmful effects of smoking and SHS exposure or who received anti-smoking education in schools, respectively, used waterpipe. Overall, significant differences in waterpipe use were identified by most adolescent characteristics, except among those who supported smoking bans in public places ($p=0.10$) and those who were exposed to anti-smoking messages in the media ($p=0.80$) (Table 3).

Overall, 19.7% of never cigarette-smoking youth were susceptible to cigarette smoking, with prevalence estimates ranging from 13.1% in Oman to 32.6% in Somalia. In addition, never-smoking male adolescents (22.6%) were more susceptible to cigarette smoking than female adolescents (17.1%) ($p < 0.001$). Approximately 44% of youth who used waterpipe were susceptible to cigarette smoking, compared with 18% who did not ($p < 0.001$). Table 4 presents the odds of susceptibility to cigarette smoking with waterpipe use among never-smoking youth in the Arab nations. The estimated odds of being susceptible to cigarette smoking were 2.5 times (AOR=2.5, 95% CI=1.9, 3.3) higher for adolescents who used waterpipe compared with adolescents who did not, controlling for confounders. Sensitivity analysis that involved maximum likelihood estimation and multiple imputation methods for missing values had results consistent with our primary analysis. As it was planned a priori to assess the relationships among male and female adolescents separately, weighted logistic regression models stratified by sex were conducted, and similar estimates were identified for cigarette smoking

susceptibility among never-smoking male (AOR=2.4, 95% CI=1.6, 3.3) and female (AOR=2.7, 95% CI=1.8, 4.0) adolescents, respectively.

Discussion

In a pooled analysis of 30,711 never cigarette-smoking adolescents representing 4,962,872 youth, approximately 44% of youth who used waterpipe were found to be susceptible to cigarette smoking compared with 18% who did not. In addition, never-smoking youth who used waterpipe had 2.5 times increased odds of susceptibility to cigarette smoking. Similar point estimates were identified among male and female adolescents.

Tobacco use continues to be a global public health issue, with more than 1 billion smokers worldwide, a majority of whom reside in low- and middle-income countries (LMICs).⁴⁹ Several tobacco control interventions have been developed to address the issue, including smoke-free policies, cessation support, advertising bans, mass media campaigns, school- and community-based interventions, tobacco excise taxes, and restricting youth access to tobacco products⁵⁰⁻⁵²; however, it remains the leading cause of preventable death worldwide. Therefore, it is important to curb the global tobacco pandemic by developing interventions and policies that target the initiation of cigarette smoking. In order to develop such control efforts, it is important to identify factors that promote a never-smoking adolescent to initiate smoking his or her first cigarette. Such factors include parental and

peer smoking, media messages, and promotions and have been identified in early studies, but these have been conducted primarily in high-income countries,^{14,53} with only few studies in LMICs.^{17,18,20} A novel potential risk factor is waterpipe use, proposed but with scientific evidence yet to be established.

Given that waterpipe use is predominant in the Arab nations,²⁵ the GYTSs conducted in the Arab nations were used to determine the relationship between its use and cigarette smoking susceptibility. It was found that approximately 20% of never-smoking youth were susceptible to cigarette smoking, with prevalence estimates higher than those reported in previous studies.^{17,18,20} Compared with studies by Lim et al.¹⁸ and Aslam and colleagues²⁰ that investigated susceptibility to cigarette smoking in Malaysia and Pakistan, respectively, our study utilized data from multiple Arab nations to determine this relationship. Approximately 5% of never-smoking youth reported currently using waterpipe, similar to earlier studies.^{22,38} With the perception that waterpipe use is less harmful and less toxic than cigarette smoking,²⁹ it has been gaining importance as an alternate tobacco product in Western nations.^{54–57} However, it has been reported that the daily use of waterpipe produces high levels of urine cotinine levels with a nicotine absorption rate equivalent to smoking ten cigarettes per day.²³ In addition, studies have reported that motivation to engage in waterpipe use exceeded users' health-risk perception,⁵⁸ and that families encouraged children to use waterpipe at home in social gatherings.⁵⁹ These factors call for attention when designing tobacco control intervention efforts for youth and should reflect a holistic approach focusing on the family, youth social networks, cultural background, psychosocial aspects, and subsequent impacts of waterpipe smoking.

Although evidence that waterpipe smoking might be a gateway for initiating cigarettes is not yet established, it is plausible that waterpipe use creates high nicotine dependence,^{22,23} and its use could subsequently result in cigarette smoking initiation. Initial support for this theory is the present study finding that waterpipe use among never cigarette smoking youth is associated with increased odds of cigarette smoking susceptibility. Earlier studies have demonstrated the association between waterpipe use and cigarette smoking behaviors in LMICs,^{36,60} but this is the first study to estimate the relationship with cigarette smoking susceptibility among never cigarette smokers. Given that waterpipe use is unique in its characteristics and emergence as a new strain of global tobacco pandemic, it is important to develop policy initiatives and interventions to curb waterpipe use and prevent a never-smoking adolescent from initiating his or her first cigarette. Specific tobacco-cessation and education programs should be developed targeting

adolescents who are never cigarette smokers but are waterpipe users because of their misperception that waterpipe use is not harmful. Similarly, policies should be developed to prevent youth access to waterpipe coffee shops or social gatherings where it is used. Moreover, familial education and intervention programs should be implemented where parents should be informed about the possible gateway effect of waterpipe use for future cigarette smoking.

Limitations

The study has limitations to consider. The GYTS is a cross-sectional school-based survey and includes adolescents who attend school on the day the survey is administered. The study's cross-sectional design limits establishment of causal inferences; hence, longitudinal studies should be conducted to investigate the relationship between waterpipe use and subsequent initiation of cigarette smoking. Multiple country-level data sets across different populations were used and might be subject to measurement bias; however, these populations are culturally similar and share similar demographic characteristics. Previous studies^{61–63} have demonstrated the association of waterpipe use with religiosity or religious commitment; however, information on religious commitment was not collected from the GYTSs, and future studies should be conducted to include such information. Only individual-level characteristics were obtained from the GYTSs, and future studies should include country-level characteristics, including national tobacco control plans, policy, and intervention efforts. In addition, although the outcome variable was assessed using a validated measure,¹⁴ the primary exposure variable, self-reported waterpipe use, has not been previously validated and future studies should be conducted in this direction. Nevertheless, waterpipe use is a new strain of global tobacco pandemic and a potential gateway for cigarette smoking, and this study is the first investigation that demonstrates that waterpipe use among never cigarette-smoking youth is associated with increased susceptibility to cigarette smoking.

Conclusions

In a pooled analysis of 30,711 never cigarette-smoking adolescents representing 4.9 million youth in Arab nations, waterpipe use was associated with increased susceptibility to cigarette smoking. With increasing waterpipe use among youth and emergence of a new waterpipe strain of global tobacco pandemic, the study findings will help public health professionals, policy advocates, and healthcare practitioners develop policies and intervention efforts around waterpipe use prevention to prevent never smokers from initiating cigarette smoking.

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