Original investigation

Waterpipe Use and Cognitive Susceptibility to Cigarette Smoking Among Never-Cigarette Smoking Jordanian Youth: Analysis of the 2009 Global Youth Tobacco Survey

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Abstract

Introduction: Susceptibility to cigarette smoking, defined as lack of a firm decision to not initiate smoking, predicts youth smoking initiation and experimentation and is a first step in the transition to regular smoking. This study investigated whether waterpipe (WP) smoking, an increasingly prevalent form of tobacco use among Arab adolescents, was associated with increased susceptibility to cigarette smoking.

Methods: A secondary analysis of the 2009 Jordan Global Youth Tobacco Survey was conducted to assess the association between WP use and cigarette susceptibility, after adjusting for important confounders.

Results: A total of 1,476 youth aged 13–15 years old who had never smoked cigarettes were identified and represented 166,593 never-cigarette smoking Jordanian youth. We found 40% of boys and 29% of girls were susceptible to cigarette smoking, and both boys (adjusted odds ratio [AOR] = 1.49, 95% confidence interval [CI] = 1.41–1.54) and girls (AOR = 1.95, 95% CI = 1.83–2.04) who had ever smoked WP were more susceptible to cigarette smoking than those who never smoked WP.

Conclusion: This is the first study to report that WP use may increase youth's susceptibility to initiate cigarette smoking.

Introduction

Cognitive susceptibility to cigarette smoking, defined as the lack of a firm decision by a never-cigarette smoker to not initiate cigarette smoking, has been identified as a predictor of smoking initiation,¹ a marker for the transition to smoking experimentation,² and as a first step in the transition to regular smoking^{1–4} with between 32% and 55% of susceptible youth becoming established smokers.⁵

While several social and behavioral determinants of susceptibility have been investigated,^{2,6–8} little is known about the effect

of waterpipe (WP) use on susceptibility to cigarette smoking among youth.

WP smoking is a rapidly growing global epidemic⁹ and its use has increased dramatically among youth in the Eastern Mediterranean region during the last decade. WP smoking among Arab youth has been shown to typically precede cigarette use.^{10,11}

In Jordan, the Global Youth Tobacco Survey (GYTS) estimates that about 21% of 13–15-year olds regularly smoke WP, with higher prevalence among boys (27%) than girls (16%).¹² In a random sample of middle and high school students, obtained in 2011 from a major

governorate in Jordan, Alzyoud, Weglicki, Kheirallah, Haddad, and Alhawamde¹³ reported that WP use ranged from 30% for the past week, 34% for the past month, and 36% for the past year. An interesting finding was that while girls were equally likely as boys to currently use only cigarettes or WP, they were twice as likely to be dual (cigarette plus WP) smokers (34% vs. 17%, respectively), suggesting that WP use may increase susceptibility to cigarette smoking especially among girls.

Similar results were reported by Mzayek and colleagues¹⁴ who followed a sample of 7th and 9th grade Jordanian school students over 2 years to study their tobacco smoking trends in one of Jordan's northern governorates. Ever use of WP increased 1.8 times during the 2-year follow-up period (from 26% to 46%; $p < .01$), while current WP smoking increased 1.4 times during the same period (from 13% to 19%; $p < .01$) among the 1,702 seventh-grade students.¹¹ Further, at all points in time for both genders, WP prevalence was higher than that of cigarette ($p < .001$).¹⁴ The bridge between WP and cigarette smoking was suggested in this longitudinal study by the finding that WP-only smokers at baseline were twice as likely to become current cigarette smokers after 2 years compared with never smokers (Relative Risk [RR] = 2.1; 95% CI = 1.2–3.4).^{11,14}

Given the rapid spread of WP smoking among Jordanian youth, this study was designed to examine the relationship between WP smoking and cognitive susceptibility to cigarette smoking among never-cigarette smokers, using the 2009 Jordan GYTS. Understanding this association has important implications for implementing effective tobacco control strategies and prevention efforts.

Methods

Dataset

We analyzed Jordan's 2009 GYTS dataset for this study. The survey's design and methodology are described elsewhere.¹⁵ Briefly, it is a cross-sectional, school-based survey that employs a standardized sampling design to produce a nationally representative sample of youth (13–15 years) recruited using a two-stage cluster sample with a probability proportionate to size sampling technique. Each participating school's demographics were obtained from the Jordan Ministry of Education, from which a list of eligible schools was generated. The primary (first stage) sampling frame consisted of all public schools comprising grades 7 through 10. The list of eligible schools was used to draw the sample. In this stage, primary sampling units were randomly selected with a random start and with probability of being selected proportional to the school's enrollment size. The second sampling stage consisted of systematic random sampling of classes from each selected school. All students in the selected classes were eligible to participate in the survey. Data were collected using a self-administered questionnaire developed by the Centers for Disease Control and Prevention and the World Health Organization.

Outcome Variable

Subjects who answered "no" to the question "have you ever tried or experimented with cigarette smoking, even one or two puffs" were identified as never-cigarette smokers. Among these never smokers, susceptibility was defined according to response to three questions: "Do you think you will be smoking cigarettes 5 years from now?", "At any time during the next 12 months do you think you will smoke a cigarette?", and "If one of your best friends offered you a cigarette, would you smoke it?" Youth who answered "definitely not" to all three questions were defined as nonsusceptible to cigarette smoking (coded as "0"), and all others were defined as susceptible (coded as

"1"). This algorithm was developed and validated by Pierce et al.,¹ and used elsewhere.^{2,4,6–8}

Independent Variables

The main independent variable was ever having smoked WP, based on the question: "Did you smoke waterpipe?". Youth who answered "yes" or "yes, but I stopped now" were defined as ever WP smokers (coded as "1") and those who answered "No" as non-WP smokers. All other independent variables were categorical in nature, including gender, grade in school, and friends' and parents' cigarette and WP smoking status, and most responses were dichotomized. A weighting variable was applied to adjust for design effects, nonresponses, and poststratification of the sample relative to the grade and gender distribution in the population. The methodology used for weighing, analyzing, and reporting weighted measures has been previously used.^{8,16,17}

Statistical Analysis

Data analysis was performed by SPSS version 20 using complex module to accommodate for sampling weights. Frequencies and proportions were used to describe the variables. Two-sided chi-square (χ^2) tests were used to assess the relationships at the bivariate level. Multivariable logistic regression models were used to identify the adjusted effect of WP use on susceptibility. Given the significant role of gender in smoking behaviors,^{8,18} the interaction term of gender by WP use on susceptibility was tested and found to be statistically significant; as such, adjusted odds ratios (AORs) and 95% CI were reported separately for boys and girls. A significance level of 5% was used for all tests.

Results

A total of 1,476 youth who had never smoked cigarettes were identified among study participants, representing a total of 166,593 never-cigarette smoking Jordanian youth. Boys represented 43.1% of study participants. The sample was distributed fairly equally across grade. About 16% of youth reported having ever smoked WP, with the proportion being higher for boys (19.2%) than girls (11.5%) ($p < .01$, $\chi^2_{[df=1]} = 16.30$). While about half of youth reported paternal cigarette smoking (45.1%), only 6.4% reported maternal cigarette smoking. Cigarette smoking by friends was reported by 41.8% of youth. Paternal and maternal WP smoking was reported by 21.3% and 6.1% of youth, respectively (Table 1).

At the bivariate levels, significantly more boys ($n = 246$, 40%) than girls ($n = 235$, 29%) were judged to be susceptible to cigarette smoking ($p < .000$, $\chi^2_{[df=1]} = 19.65$). The distribution of participants' susceptibility to cigarette smoking and association with each independent variable are presented in Table 2. Ever WP smokers had higher overall susceptibility ($n = 115$, 51.5%) than never WP smokers ($n = 378$, 31.3%) ($p < .000$, $\chi^2_{[df=1]} = 34.02$). Among boys, ever WP smokers had significantly higher susceptibility to cigarette smoking than never WP smokers (53% vs. 37%, $p < .001$, $\chi^2_{[df=1]} = 6.89$, respectively). Among girls, ever WP smokers had significantly higher susceptibility to cigarette smoking than never WP smokers (50% vs. 27%, $p < .000$, $\chi^2_{[df=1]} = 25.18$, respectively).

Table 3 presents the independent associations of susceptibility to cigarette smoking regressed on WP smoking status and other variables. For both boys and girls, being susceptible was associated with being in a higher grade, having friends and parents who smoke WP, having a father who smoked cigarettes, and having friends who smoke cigarettes. Maternal cigarette smoking was associated with greater

Table 1. Sample Characteristics

		Frequencies		Weighted percent (%)
		Unweighted (<i>n</i>)	Weighted (<i>N</i>)	
Total		1,476	166,593	
Gender	Boys	479	69,988	43.1
	Girls	964	92,248	56.9
Grade	8th grade	553	60,017	36.5
	9th grade	410	57,975	35.3
	10th grade	495	46,457	28.3
Ever smoked waterpipe	No	1,235	137,089	84.1
	Yes	209	25,846	15.9
Friends cigarette smoking status	None	864	96,018	58.2
	Some	422	49,669	30.1
	most/all	176	19,347	11.7
Friends smoke waterpipe	No	864	95,332	58.3
	Yes	587	68,246	41.7
Paternal cigarette smoking	No	802	91,517	54.9
	Yes	674	75,076	45.1
Maternal cigarette smoking	No	1,376	155,996	93.6
	Yes	100	10,597	6.4
Paternal waterpipe smoking	No	1,147	129,286	78.7
	Yes	310	35,028	21.3
Maternal waterpipe smoking	No	1,369	154,239	93.9
	Yes	88	10,075	6.1

Table 2. Chi-Square Analyses of Factors Associated With Susceptibility to Smoking Among Never-Cigarette Smoking Youth

	Susceptibility to cigarette smoking								
	Total (<i>N</i> = 1,476)			Boys (<i>N</i> = 609)			Girls (<i>N</i> = 803)		
	<i>n</i> ^a	% ^b	<i>p</i> ^c	<i>n</i> ^a	% ^b	<i>p</i> ^c	<i>n</i> ^a	% ^b	<i>p</i> ^c
Grade									
8th grade	146	27.9	.000	71	32.6	.000	73	24.5	.000
9th grade	184	36.4		101	46.1		74	27.9	
10th grade	157	38.8		67	41.4		87	36.7	
Ever smoked waterpipe	115	51.5	.000	61	53.3	.001	45	50.0	.000
Friends' cigarette smoking status									
None	219	26.2	.000	92	31.1	.000	120	23.1	.000
Some	193	44.6		111	47.0		75	40.5	
Most/all	81	47.9		39	54.9		38	41.8	
Friends smoke waterpipe	271	45.6	.000	155	49.5	.000	112	41.5	.000
Paternal cigarette smoking	251	38.4	.000	122	47.3	.000	123	32.0	.01
Maternal cigarette smoking	46	50.0	.01	14	45.2	.000	30	52.6	.01
Paternal waterpipe smoking	129	42.3	.000	65	53.7	.000	61	35.1	.000
Maternal waterpipe smoking	44	49.4	.01	21	61.8	.000	23	46.9	.01
Total	498	34.4	NA ^d	246	40.4	NA ^d	235	29.3	NA ^d

^aUnweighted frequency of susceptible youth.^bWeighted percent of susceptible youth.^cTwo-sided chi-square test.^dChi-square test not applicable.

susceptibility among girls but lower susceptibility among boys. Visual inspection of the AORs indicate that, for both boys and girls, the strength of association between WP smoking and susceptibility was generally similar to that of parental and friends cigarette and WP use.

Discussion

The re-emergence of WP as a tobacco use method, and its frequent co-use with cigarettes, points to the need to understand its role in

the pre-experimentation stages of cigarette smoking among vulnerable groups, such as youth. Indeed, focusing on this vulnerable group before tobacco use has begun is an essential element of tobacco control strategies given the high persistence rates among established smokers¹⁹ and the fact that WP smoking now often precedes cigarette use among Arab youth.^{10,11}

The current analysis found a substantial percentage of never-cigarette smoking Jordanian youth susceptible to initiate cigarette smoking (34.4% or 1 in 3). WP smoking was associated with

Table 3. Results From Multivariable Logistic Regression Analyses Showing Fully Adjusted Effects of Study Variables on Cigarette Smoking Susceptibility for the Total Sample and Stratified by Gender

	Susceptibility to cigarette smoking					
	Total		Boys		Girls	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Grade						
8th grade	Ref	–	Ref	–	Ref	–
9th grade	1.46	1.42–1.50	1.84	1.76–1.91	1.29	1.16–1.36
10th grade	1.53	1.43–1.58	1.38	1.32–1.45	1.64	1.57–1.70
Ever smoked waterpipe	1.67	1.61–1.71	1.49	1.41–1.54	1.95	1.83–2.04
Friends' cigarette smoking status						
None	Ref	–	Ref	–	Ref	–
Some	1.82	1.77–1.87	1.72	1.66–1.79	1.80	1.73–1.87
Most/all	1.95	1.88–2.02	1.92	1.81–2.04	1.92	1.83–2.01
Friends smoke waterpipe	1.72	1.68–1.77	1.72	1.67–1.78	1.68	1.62–1.73
Paternal cigarette smoking	1.26	1.23–1.29	1.41	1.36–1.47	1.14	1.04–1.18
Maternal cigarette smoking	1.29	1.23–1.36	0.62	0.57–0.67	1.90	1.78–2.02
Paternal waterpipe smoking	1.21	1.17–1.25	1.34	1.27–1.41	1.14	1.10–1.19
Maternal waterpipe smoking	1.50	1.43–1.59	1.50	1.37–1.63	1.35	1.25–1.49
Gender (girls)	1.30	1.27–1.33	–	–	–	–

AOR = adjusted odds ratio; CI = confidence interval.

susceptibility, especially among girls. These findings are alarming as it involves a tobacco use method that barely existed a decade ago.²⁰ Still, the results hold potential to inform initiatives for early tobacco intervention efforts targeted at never-cigarette smoking youth.

Our findings suggest that WP smoking is a gateway for introducing youth to cigarettes smoking through increasing cognitive susceptibility. Given the social acceptability of WP, more youth seem to have their first experience with tobacco through WP smoking. Because WP delivers large boluses of nicotine,²¹ tobacco dependence is possible.²² At a later stage, WP smokers may supplement their use with cigarette smoking in an attempt to avoid withdrawal symptoms or cravings.^{14,23} If these hypotheses hold true, then the emergence of WP smoking may have changed the dynamics of the tobacco epidemic.

It can be speculated that the association of WP smoking with susceptibility to cigarette smoking may reflect an early indicator of developing nicotine dependence. As dependence increases, more dosing may be required, portending a transition to cigarette smoking. This worrisome bridge between WP and cigarette smoking has been suggested before,²³ but not through susceptibility, indicating that the high prevalence of WP use will lead to an increase in the cigarette smoking prevalence.

Even though boys were more likely to be susceptible to cigarette smoking than girls, gender-wise analyses indicated that WP smoking was more influential among girls than boys. This discrepancy may have more than one explanation. First, the tobacco epidemic seems to act differently in boys than girls, with the former showing higher susceptibility to cigarette experimentation. The gender role associated with smoking initiation among youth was supported by others.¹⁸ Second, girls seem more prone to early signs of nicotine dependence than boys.^{24,25} While a number of studies suggested that initial symptoms of nicotine dependence for youth can appear soon after smoking initiation,^{26–28} some studies reported that adolescent smokers may show signs of nicotine dependence even when their smoking rates are low and intermittent,²⁵ with girls developing signs of nicotine dependence more quickly after initiating tobacco use than boys.²⁴ Therefore, once WP experimentation and initiation has started, never-cigarette

smoking girls may develop a cognitive susceptibility faster than their boys' counterparts. Third, boys tend to have more freedom in experimenting with cigarettes, and thus have more opportunity than girls to become susceptible.^{10,29} Regardless of the explanation, our results show that the predominance of WP in this age group is alarming as it indicates an increased likelihood of cigarette smoking initiation.

Another concern is that smoking one kind of tobacco is associated with higher odds of smoking the other, and being dependent on one kind of tobacco increases the risk of dependence on other kinds.³⁰ A recent study conducted among Jordanian youth indicated a high prevalence of dual tobacco smoking particularly among girls.¹³ This may indicate that once WP smoking is initiated, youth become more likely to use other forms of tobacco, in this case cigarettes, as a substitute nicotine source to avoid withdrawal symptoms.

The primary limitation of the current cross-sectional design is the lack of temporality and causality in the relationship between WP smoking and susceptibility. An alternate explanation of our findings is that higher susceptibility leads to WP use, rather than vice versa. A cohort design is needed to establish temporality of the association. As well, the study is based on self-reported responses which may lead to recall bias. On the other hand, if WP smoking increases susceptibility to initiate cigarette smoking, as our findings suggested, then some youth may have already been cigarette-smokers. This would have biased the association between WP smoking and susceptibility towards the null as ever-cigarette smokers were, by definition of susceptibility, excluded from the analysis. While we were able to adjust our models for several potential confounders, the GYTS had no indicator of socioeconomic status (SES). Thus, we are unable to determine whether the observed WP/cigarette susceptibility associations are substantially influenced by SES. This should be a focus of future research.

From a public health perspective, tobacco control may require a broader focus on multiple forms of tobacco use rather than focusing only on cigarette smoking. Tailoring prevention programs by youths' susceptibility may increase the efficacy of prevention efforts. Gender differences in susceptibility to cigarette smoking also argue for caution against relying only on "one size fits all" intervention strategies.

Declaration of Interests

None declared.

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