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Predictors of waterpipe smoking progression among youth in Irbid, Jordan: A Longitudinal Study (2008-2011)

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Abstract

BACKGROUND—The predictors of waterpipe smoking progression are yet to be examined using a longitudinal study that is guided by a theoretical model of behavioral change. This study identifies the gender-specific predictors of waterpipe smoking progression among adolescents in Irbid, Jordan.

METHODS—This study uses data from a school longitudinal study of smoking behavior in Irbid, Jordan. A random sample of 19 schools was selected by probability proportionate to size. A total of 1781 seventh graders were enrolled at baseline, and completed a questionnaire annually from 2008 through 2011. Students who reported ever smoking waterpipe (N = 864) at any time point were assessed for progression (escalation in the frequency of waterpipe smoking) in the subsequent follow-up. Grouped-time survival analysis was used to identify the risk of progression.

RESULTS—During the three years of follow-up, 29.6% of students progressed in waterpipe smoking. Predictors of waterpipe smoking progression were higher mother's education, enrollment in public school, frequent physical activity, and low refusal self-efficacy among boys, having ever smoked cigarettes, and having friends and siblings who smoke waterpipe among girls. Awareness

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Contributor's statement

Rana Jaber and Wasim Maziak conceptualized the study. Jaber designed and conducted the study analysis and wrote the first draft of the study. Maziak designed the large cohort study and supervised all work on it. Yousef Khader, Fawaz Mzayek collected the study data and conducted data management and cleaning. Maziak edited the manuscript and all authors edited and approved the final draft of the study.

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Conflict of interest

The Authors have no conflicts of interest or financial relationships relevant to this article to disclose.

of harms of waterpipe was protective among boys and seeing warning labels on the tobacco packs was protective among girls.

CONCLUSIONS—Even at this early stage, about a third of waterpipe smokers progressed in their habit during the 3 year follow up. Factors predicting progression of use differed by gender, which calls for gender-specific approaches to waterpipe interventions among Jordanian youth.

Keywords

Adolescents; Jordan; longitudinal; predictors; progression; waterpipe

1. INTRODUCTION

Based on the Global Youth Tobacco Survey (GYTS) that was conducted between 1999 and 2007, and involved more than 90,000 children (13-15 years) in the Eastern Mediterranean Region (EMR), the prevalence of waterpipe smoking has become higher than cigarette smoking among youth in this region (El-Awa et al., 2010; Warren et al., 2006; Maziak et al., 2014). Nevertheless, most national and international tobacco control strategies are not specifically addressing this method of tobacco use (Maziak, 2011). This may be partly attributed to the dearth of evidence on specific determinants of initiation and progression of waterpipe smoking.

Evidence from studying cigarette smoking trajectories showed that 25% of experimenters will continue smoking later in their life (Karp et al., 2005; Mayhew et al., 2000). Like cigarettes, it is necessary to know the percentage of waterpipe experimenters who will continue to smoke waterpipe. Additionally, understanding the factors that distinguish adolescents who progress in waterpipe smoking beyond the experimentation stage is crucial for early intervention before the development of nicotine dependence that is manifested by the increased frequency of waterpipe use (Salameh et al., 2008), or the onset of cigarette smoking (Jaber et al., 2015; Mckelvey et al., 2014).

Longitudinal studies in developed nations have identified the individual and social predictors that are associated with cigarette smoking trajectories (Mayhew et al., 2000). However, findings from these studies may not be applicable to waterpipe smoking that has unique social use patterns, cues, perceptions of harm, and societal/familial tolerance, particularly among girls (Amin et al., 2012; Maziak et al., 2005). Moreover, findings from studies among youth in developed nations may not be generalizable to youth in the EMR who have different knowledge, beliefs, and attitudes towards tobacco smoking (Asfar et al., 2005; Islam et al., 2005; Maziak et al., 2004).

Like cigarettes, waterpipe smoking requires longitudinal studies to identify the determinants of progression among youth. This is the first longitudinal study that is specifically addressing waterpipe smoking progression among youth in Jordan. Guided by a broad theoretical framework of behavioral change (attitude, social influence, and self-efficacy model [ASE; De Vries et al., 2003]), this study aimed to compare the hazard of progression in waterpipe smoking between levels of potential determinants, among a school-based

sample of adolescents (mean age = 12.8 years old at baseline) who reported ever smoking waterpipe in Irbid, Jordan.

2. METHODS

2.1 Study participants

This study used data from the Irbid longitudinal study of smoking behavior (ILS). Detailed methods were published elsewhere (Mzayek et al., 2011, 2012). Briefly, all schools in Irbid city (N= 60) were stratified by gender (male, female, and mixed) and type (public and private). A random sample of 19 schools was selected with probability proportional to size. All seventh grade students at the selected schools were invited to participate in the study. A total of 1781 (94.9%) students enrolled at baseline by turning in assent and their parents' consent forms. The students were surveyed annually from 2008 through 2011 (4 data collection waves including the baseline). For the purpose of this study, only students who reported ever smoking waterpipe at any point of data collection were included in the analysis. Non-smokers who reported smoking waterpipe daily the first time they reported waterpipe smoking were considered progressed, and therefore were excluded from the analysis. The final sample included 864 students with at least two consecutive waves (see Figure 1 for details about participants' selection).

2.2 Procedures

Data were collected using a pilot-tested questionnaire developed in accordance with international guidelines (WHO, 1998), using instruments that were tested and validated in Arabic such as the Global Youth Tobacco Survey (GYTS, 2002). The questionnaire was composed of four sections: socio-demographic status, cigarette smoking, waterpipe smoking, and other factors such as students' beliefs and exposure to tobacco advertisements.

Using the same items, the self-administered questionnaire was completed annually in the classrooms and facilitated by well-trained study personnel who explained the purpose of the study and responded to the students' questions. To improve the validity of the students' responses, no parents or school personnel were allowed in the classroom during data collection. This study was approved by the Institutional Review Boards (IRBs) of Jordan University for Science and Technology, University of Memphis, Syrian Society against Cancer, and Florida International University.

2.3 Measures

At each wave, students were asked, "How many times did you smoke waterpipe in the past month (30 days)." The responses were as follows: 0=not at all, 1=once weekly, 2=more than once weekly but not daily, and 3=daily. The participant was coded as having progressed if he/she reported a higher frequency of waterpipe smoking compared with that reported at baseline, or from that reported for the first time among never smokers who initiated waterpipe smoking subsequently. Guided by the ASE model (De Vries et al., 2003), we included a wide range of individual and social factors as potential predictors of waterpipe smoking progression.

2.4 Statistical analysis

Life tables were used to estimate the hazard probabilities of waterpipe smoking progression associated with each time interval by gender. The hazard of waterpipe smoking progression was estimated for each potential predictor using dichotomous grouped-time survival analyses (Allison, 1995; D'Agostino et al., 1990; Hedeker et al., 2000; Singer and Willet, 1993). This analysis is a combination of grouped-Cox model (D'Agostino et al., 1990), discrete time-hazard model (Singer and Willet, 1993), and the dichotomous approach (Hedeker et al., 2000). Items measured from wave 1 through wave 4 were used for time-dependent covariates linking the predictors to the risk of waterpipe smoking progression at the subsequent student's interview (e.g., measures at wave 2 predict smoking progression at wave 3). This analysis allowed for maximum data use, inclusion of the time-dependent covariates, and relaxing of the proportional hazards assumption.

In the last step, multivariate grouped-time survival analyses were performed by including all potential predictors that demonstrated an association with the outcome in the bivariate analyses at a significance level < 0.20 simultaneously in a single model (Mickey and Greenland, 1989). Multicollinearity and interaction were examined for factors that were not associated with the outcome in the bivariate analyses and demonstrated association in the multivariate ones (Lo et al., 1995). Akaike Information Criterion [AIC] was used to test the goodness of fit. All the analyses were performed for boys and girls separately. Population-averaged (marginal) model via robust variance estimation was used to account for an unobserved heterogeneity (random effect due to clustering and repeated measures). The significance level was set at $\alpha = 0.05$. All analyses were conducted using SAS V. 9.3 (SAS Institute Inc., NC; USA).

3. RESULTS

3.1 Descriptive findings

A total of 864 participants (57.1% boys at baseline) reported ever-smoking waterpipe during waves 1 through 3). The ages (mean \pm standard deviation) at baseline were 12.9 ± 0.63 for boys, and 12.7 ± 0.55 for girls. During the study period, 29.6% of the study participants had progressed in waterpipe smoking. However, this estimate is a bit conservative because it did not take into consideration the progression among those who lost to follow-up. Findings from the survival analysis that took into consideration the missing values showed that 40% of initiators may progress in waterpipe smoking within the three years of follow-up. The annual hazard probabilities and cumulative hazard probability by gender are shown in Table 1.

3.2 Results from multivariate analyses

In the multivariate analysis that included gender as an independent variable, boys were less likely to progress in waterpipe smoking than girls and this difference approached significance (HR boys: girls 0.76 [95% CI: 0.58-1.00]; $P = 0.050$).” On the other hand, gender-stratified analysis showed different patterns of predictors.

The independent predictors among boys were higher mother education, attending public school, seeing actors smoke in the movies, frequent physical activity and accepting offers to smoke from friends who smoke waterpipe (Table 2). Some factors were associated with waterpipe smoking progression in the multivariate analyses, but not in the bivariate analyses. These were related to the beliefs that waterpipe smokers are attractive and have more friends. After conducting a series of interactions between the variables, and constructing the correlation matrix for all potential predictors, both waterpipe smokers look attractive, and 'waterpipe smokers have more friends beliefs were correlated (Spearman rho = 0.42; $P < 0.001$). Hence, each variable was included separately in the multivariate analysis. The model that included attractiveness belief was selected because it had higher goodness-of-fit; i.e., lower *AIC*. However, similar findings were obtained from both models.

The independent predictors of waterpipe smoking progression among girls were older age, having ever smoked cigarettes, and having siblings or friends who smoke waterpipe, while having seen warning labels on waterpipe tobacco packs was protective amongst them (Table 2). In addition, there was a statistically significant interaction between having discussed the dangers of waterpipe smoking with family and refusal self-efficacy. This interaction was decomposed by examining the effect of discussing the dangers of waterpipe smoking with family at 2 levels of refusal self-efficacy, using a binary split (low v/s high self-efficacy). For students with lower refusal self-efficacy, having had discussed the dangers of waterpipe smoking with family was not protective against, but rather associated with progression of waterpipe use (HR: 1.43 [95% CI: 1.03 –1.97]; $P = 0.032$). On the other hand, for students with higher refusal self-efficacy, discussing the dangers of waterpipe use did not influence progression (HR: 0.79 [95% CI: 0.94-1.27]; $P = 0.329$).

4. DISCUSSION

This is the first longitudinal study to examine the determinants of waterpipe smoking progression among youth in Jordan. Predictors of waterpipe smoking progression were different between boys and girls. The independent predictors among boys were higher mother's education, attending public school, higher physical activity, and accepting offers to smoke waterpipe from friends who also smoke it. The predictors among girls were older age, ever smoking cigarettes, friends smoking, and siblings' smoking. On the other hand, belief that waterpipe smoking is harmful was protective among boys and reading the warning label on waterpipe tobacco packs was protective among girls.

Unlike cigarette smoking, which is inversely related to socioeconomic status (Conrad et al., 1992), waterpipe smoking was shown to be associated with a higher socioeconomic status (Palamar et al., 2014). Although how socioeconomic factors influence waterpipe smoking behavior is still not fully understood, findings from this study regarding the association between waterpipe smoking progression and some socioeconomic measures were similar to those known for cigarette smoking progression among youth. For instance higher mother's education predicted waterpipe smoking progression among boys. This association may not be unexpected within the social context of the EMR where mothers may grant implicit approval to their sons to smoke waterpipe, but explicit strong disapproval to smoke cigarettes. Furthermore, educated mothers who also work may provide financial support to

their sons, but not daughters, to be able to afford the costly waterpipe smoking in public places where waterpipe smoking is more acceptable for boys than girls (Afifi et al., 2013; Hammal et al., 2008; Khalil et al., 2013). Developing negative norms and encouraging parental strict rules against waterpipe are highly recommended to prevent the escalation in waterpipe smoking among boys.

This study shows the importance of social and cultural norms in delineating gender differences in waterpipe smoking. For example, we found that attending public schools predicted waterpipe smoking progression in boys and girls (although not significant in girls). One possible explanation is that parents who enroll their children in private school are more concerned about the future of their children's behavior (Distefan et al., 1998), and therefore, apply stricter rules to prevent waterpipe smoking equally in both genders (Kim et al., 2009). Additionally, private schools may enforce stricter tobacco control policies that prevent smoking among their students and staff than the public schools in Jordan. On the other hand, private schools are for-profit institutions. They attract customers (parents) by maintaining their reputation in both educational and behavioral aspects that make them less tolerant to smoking. Consistent with this perspective, being a smoking-tolerant school has been previously shown to be associated with cigarette smoking onset (O'Loughlin et al., 2009).

Friends' smoking and family members' smoking have been frequently reported as important predictors of adolescents' cigarette (Distefan et al., 1998; Kim et al., 2009) as well as waterpipe smoking (Amin et al., 2012). Based on social learning theory, adolescents copy their friends and close family members' behavior either directly by observing them, or indirectly through acquiring positive norms about the behavior. In line with this theory, waterpipe smoking progression is independently predicted by friends' and siblings' smoking among girls and by friends' smoking in boys who have low refusal self-efficacy.

One of the interesting findings of this study is that discussing the dangers of waterpipe smoking with a family member was associated with progression among girls with low refusal self-efficacy (i.e., accepting waterpipe offered by a friend). An explanation for this can be due to a prohibitionist context of such discussion within this local culture that is highly strict towards girls' behavior, which can create a parent-adolescent conflict (Robin and Foster, 1989). Evidence suggests that negative parent-adolescent communication of disciplinary nature, for instance, may predict negative behavioral outcomes such as smoking escalation (Ennett et al., 2001).

Within the prevalent gender roles in the EMR, smoking with friends appears to be more accessible for boys who have more flexible rules regarding outing with friends compared with girls (Mahdi, 2003). For example we found that the tendency to accept a waterpipe if offered by friends who also smoke a waterpipe was a strong predictor of waterpipe smoking progression among boys. These findings suggest that boys smoke waterpipe to seek pleasure in a social context and consider waterpipe smoking a leisure activity with friends (Akl et al., 2013). On the other hand, gender roles and social acceptability of waterpipe smoking, but not cigarette, for girls seem to drive different progression dynamics compared to boys. So while becoming hooked on nicotine through the waterpipe may push boys towards the more accessible cigarettes (Jaber et al., 2015), it will perhaps drive girls towards more waterpipe

use and progression. For example, in the present study, girls who ever smoked cigarettes, but not boys, were at higher risk of waterpipe smoking progression than those who reported never experimenting with cigarettes. Generally, our data shows that boys experimenting with cigarette smoking are more likely to progress in their habit compared with girls (data not shown), which is consistent with our perspective on how societal pressure can shape the smoking experiences between boys and girls.

The popularity of waterpipe smoking among adolescents, and even among adults, may be attributed to the myths associated with its use. One of these myths is that smoke passes through water (erroneously believed as filtered) and thus waterpipe smoking is less harmful and less addictive than cigarette smoking (Maziak et al., 2014). For example, a recent study in Jordan found that waterpipe smoking is less prevalent among adolescents who perceive waterpipe smoking to be as harmful as cigarette (Alzyoud et al., 2013). Consistent with these findings, our study shows that perceiving waterpipe as harmful as cigarettes, was associated with a lower risk of waterpipe smoking progression among boys. On the other hand, awareness of harm that results from reading the warning label on waterpipe tobacco packs was associated with a lower risk of progression among girls. Some studies showed that girls are more likely to read warning labels and comply with them than boys (e.g., LaRue and Cohen, 1987). Choices available, societal norms, and personal factors seem to influence tobacco use behaviors differentially for boys and girls in the Jordanian society.

Jordan adopted the Framework Convention on Tobacco Control (FCTC) in 2003. In response to the obligations that this entails, much has been done such as anti-smoking legislation and banning advertisements that promote smoking and smoking in public places (Ma'ayeh, 2003). However, these strategies have focused on cigarettes but not waterpipe. This may explain why we did not find any influence of policy-related factors except the protective effect of seeing warning label among girls. It appears that many challenges hinder the continuity of tobacco control efforts and the seriousness in their enforcement in the EMR, and particularly in Jordan.

This study has few limitations. First, all measures assessed were self-reported, which could result in underreporting of smoking, especially among girls because of social undesirability of girls' smoking in this region (Khalil et al., 2013). However, self-reported smoking has been strongly correlated with biomarkers of smoking in cohort studies of adolescents (Murray et al., 2002). Previous experience studying smoking habits of youth in the EMR showed that adolescents are willing to share openly their smoking experiences provided that confidentiality and anonymity are assured (Maziak and Mzayek, 2000). Similar studies in different social contexts are recommended to examine whether the current study findings can be generalized to all youth worldwide.

This is the first longitudinal study to investigate the predictors of waterpipe smoking progression among youth in Jordan. This study shows the importance of social and cultural norms as well as the prevalent beliefs regarding the harm of waterpipe smoking in shaping the gender differences in waterpipe smoking. Such understanding can be of great help in carving gender-sensitive, and tobacco use-specific strategies to address tobacco use among youth in Jordan and EMR.

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Highlights

- We identified the predictors of waterpipe smoking progression among youth in Irbid
- 40% of waterpipe experimenters are expected to progress in smoking within 3 years.
- Predictors of progression in boys were peer influence, attending public schools and exercise.
- Predictors of waterpipe smoking progression in girls were friends and sibling smoking.

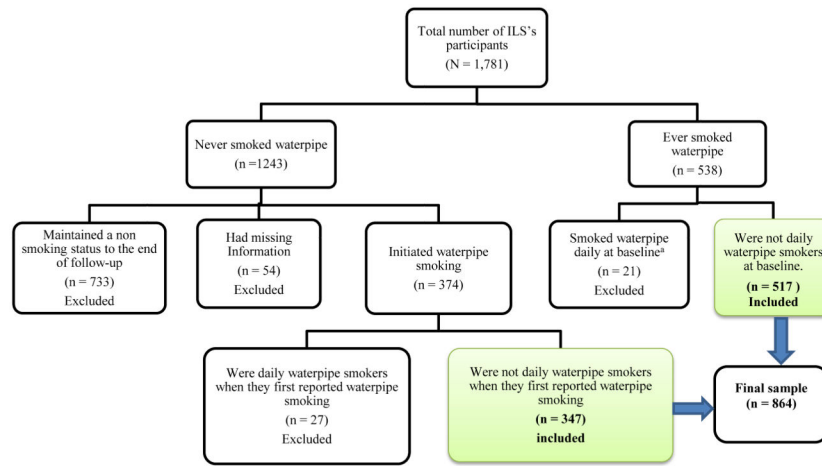


Figure 1. Participants' selection from Irbid longitudinal study of smoking behavior (ILS) to examine the predictors of waterpipe smoking progression among school adolescents in Jordan (2008-2011).

Table 1

Progression of waterpipe smoking by gender and time interval among school based sample of adolescents in Irbid, Jordan, 2008-2011. (N=864)

Boys (N=518)						
Time interval	Entered (N)	Progressed N (%)^a	Censored N (%)^a	Didn't progress N (%)^a	Probability of progression (%)	Cumulative probability (%)
Baseline-year1	337	42 (9.3)	25 (12)	270 (78.7)	9.3	9.3
year1-year2	355	56 (14.1) ^b	8 (1.7)	291 (84.2)	14.1	22.1
Year2-year3	387	79 (19.3) ^b	23 (6.7)	285 (74.0)	19.3	37.1
Girls (N = 346)						
Baseline-year1	180	21 (11.2)	9 (4.9)	150 (83.9)	11.2	11.2
year1-year2	226	37 (17.2) ^b	7 (3.2)	182 (79.6)	17.2	26.5
Year2-year3	272	43 (13.8) ^b	10 (4.9)	219 (81.3)	13.8	36.7

^a All proportions are weighted.

^b New students initiated waterpipe smoking among never smokers.

Table 2

Gender-specific adjusted hazard ratio of waterpipe (WP) smoking progression among school based sample of adolescents in Irbid, Jordan 2008-2011^a

Potential predictors	Boys	Girls
	AHR (95% CI) ^b	AHR (95% CI) ^b
Socio-demographic		
Age (Years)	0.97 (0.81-1.15)	1.19 (1.02-1.38)*
Father's education (>High school)	1.27 (0.94-1.70)	(-)
Mother's education (>High school)	1.39 (1.04-1.85)*	0.91 (0.70-1.19)
Daily allowance (Piaster/day) ^c	1.26 (0.96-1.65)	0.80 (0.58-1.10)
School type (public)	3.19 (2.01-5.05)**	1.23 (0.85-1.79)
Individual factors		
Ever smoked cigarettes	(-)	1.51 (1.12-2.04)**
Higher physical activity	1.24 (1.08-1.41)**	(-)
Belief WP smoker has more friends ^d	0.84 (0.64-1.12)	(-)
Belief WP smoker is attractive ^d	1.20 (0.90-1.60)	(-)
Belief WP decreases body weight	1.28 (0.97-1.69)	(-)
Belief it is easy to quit WP after smoking a year	(-)	1.29 (0.97-1.73)
Belief WP is harmful to health	0.65 (0.47-0.88)**	0.83 (0.58-1.20)
Refusal self-efficacy	1.08 (0.60-1.94)	1.21 (0.68-2.14)
Social factors		
Dangers of smoking discussed by family	0.95 (0.71-1.27)	0.76 (0.41-1.41)
At least one parent knows you smoke	(-)	1.01 (0.75-1.36)
Has at least one parent smokes WP	0.78 (0.58-1.04)	1.01 (0.75-1.36)
Has siblings smoke WP	0.97 (0.72-1.29)	1.39 (1.03-1.89)*
Has friends smoke WP	0.60 (0.36-1.01)	1.86 (1.33-2.60)**
Good relation with siblings	(-)	0.88 (0.55-1.40)
Good relation with classmates	1.26 (0.71-2.23)	(-)
Good relation with teachers	0.70 (0.44-1.11)	0.97 (0.63-1.49)
Saw advertisement warn from smoking	1.07 (0.80-1.44)	(-)
Teachers smoke in front of the students	0.95 (0.69-1.31)	0.98 (0.78-1.34)
Warning labels seen WP tobacco packs	0.92 (0.69-1.21)	0.54 (0.40-0.73)**
Seeing actors smoking in the movies	0.58 (0.41-0.80)**	1.54 (0.76-3.11)
Friends smoking * Low refusal self-efficacy	3.25 (1.54-6.88)**	(-)
Dangers discussed * low refusal self-efficacy	(-)	2.24 (1.12-4.51)*

^a Analysis is weighted by the inverse probability of school chosen.

^b Adjusted hazard ratio and its 95% confidence interval.

^c Jordanian currency (\$1=70 Piaster).

^d Were correlated (correlation coefficient = 0.42) and thus they were entered to the model separately and the model that have the higher fit was reported here [lower Akaike Information Criterion (AIC)].

* P-value less than 0.05

** P-value less than 0.01

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