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Time Trends and Predictors of Initiation for Cigarette and Waterpipe Smoking Among Jordanian School Children: Irbid, 2008-2011

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TIME TRENDS AND PREDICTORS OF INITIATION FOR CIGARETTE AND WATERPIPE

SMOKING AMONG JORDANIAN SCHOOL CHILDREN: IRBID, 2008-2011

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

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by

Karma McKelvey

2014

To: Dean Michele Ciccazzo
        Robert Stempel College of Public Health and Social Work

This dissertation, written by Karma McKelvey, and titled Time Trends and Predictors of Initiation for Cigarette and Waterpipe Smoking among Jordanian School Children: Irbid, 2008-2011, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Date of Defense: June 23, 2014

The dissertation of Karma McKelvey is approved.

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Robert Stempel College of Public Health and Social Work

_____
Dean Lakshmi N. Reddi
University Graduate School

Florida International University, 2014

DEDICATION

To my family, friends, mentors, committee members, coauthors, and the Universe at large. Thank you for conspiring to help me achieve my lifelong dream.

ACKNOWLEDGMENTS

ABSTRACT OF THE DISSERTATION

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Smoking prevalence among adolescents in the Middle East remains high while rates of

smoking have been declining among adolescents elsewhere. The aims of this research were to (1)

describe patterns of cigarette and waterpipe (WP) smoking, (2) identify determinants of WP

smoking initiation, and (3) identify determinants of cigarette smoking initiation in a cohort of

Jordanian school children.

Among this cohort of school children in Irbid, Jordan, (age ≈ 12.6 at baseline) the first

aim (N=1,781) described time trends in smoking behavior, age at initiation, and changes in

frequency of smoking from 2008-2011 (grades 7 – 10). The second aim (N=1,243) identified

determinants of WP initiation among WP-naïve students; and the third aim (N=1,454) identified

determinants of cigarette smoking initiation among cigarette naïve participants. Determinants of

initiation were assessed with generalized mixed models. All analyses were stratified by gender.

Baseline prevalence of current smoking (cigarettes or WP) for boys and girls was 22.9%

and 8.7% respectively. Prevalence of ever- and current- any smoking, cigarette smoking, WP

smoking, and dual cigarette/WP smoking was higher in boys than girls each year (p<0.001). At

all time points, prevalence of WP smoking was higher than that of cigarette smoking (p<0.001)

for both boys and girls. WP initiation was documented in 39% of boys and 28% of girls.

Cigarette initiation was documented in 37% of boys and 24% of girls. Determinants of WP

initiation included ever-cigarette smoking, low WP refusal self-efficacy, intention to smoke, and having teachers and friends who smoke WP. Determinants of cigarette smoking initiation included ever-WP smoking, low cigarette refusal self-efficacy, intention to start smoking cigarettes, and having friends and family who smoke.

These studies reveal intensive smoking patterns at early ages among Jordanian youth in Irbid, characterized by a predominance of WP smoking. WP may be a vehicle for tobacco dependence and subsequent cigarette uptake. The sizeable incidence of WP and cigarette initiation among students of both sexes points to a need for culturally relevant smoking prevention interventions. Gender-specific factors, refusal skills, and smoking cessation of both WP and cigarettes for youth and their parents/teachers would be important components of such initiatives.

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Introduction

Smoking prevalence among adolescents in the Middle East remains high while rates of smoking have been declining among adolescents in other areas of the world.[1,2] Decreasing rates of smoking initiation among adolescents have been achieved in the US and other industrialized countries as a result of policies and interventions that were implemented over time.[3] These interventions and policies were evidence-based and typically founded on results from longitudinal studies.[4]

Success in preventing smoking initiation among adolescents has not been observed in the Middle East, where effective smoking prevention programs are lacking and few tobacco control policies have been successfully implemented. This is due in part to the dearth of information regarding predictors of smoking initiation and progression among adolescents in this region.[5] While the findings from developed countries can be useful in guiding intervention and policy planning, longitudinal studies of adolescent smoking from the same region are needed to establish causal relationships between predictive factors and smoking initiation/continuation in the Middle East. The findings can then be used to develop appropriate, culturally sensitive smoking prevention programs and tobacco control policies.[6-8]

Most studies on youth smoking in the Middle East have collected data at a single time point[9-12] and have revealed a high prevalence of smoking ranging from 35% among Jordanian university students to 52.8% among Lebanese university students. These studies have also consistently reported similar factors associated with smoking such as male gender, older age, peer influence, and higher socio-economic status. However, due to the cross-sectional nature of these studies, causal relationships between these predictors and smoking initiation cannot be determined.

Additionally, few studies measure waterpipe (WP) smoking, which has proven to be of higher prevalence than cigarette smoking among youth in the Middle East, as reported by the Global Youth Tobacco Survey,[13] and several other studies.[14-16] WP smoking is sometimes collapsed with cigarette smoking when reporting overall smoking prevalence[11,12] and other studies do not report whether WP smoking was measured[9] or focus solely on cigarette smoking.[10] In the one report from a longitudinal study conducted in the region, which contains preliminary findings from the parent study of this dissertation research, WP smoking was found to be an important means of initiating and continuing smoking among Jordanian youth. This research also indicated that WP may influence cigarette-smoking behaviors, and vice-versa, in ways not yet fully understood.[16] These findings point to the importance of concurrently measuring behaviors and beliefs related to smoking both cigarettes and WP, especially in the Middle East. By developing a thorough understanding of region- and country-specific predictors of smoking initiation, effective interventions tailored to the needs of specific subgroups of smokers can be developed.

Parent study

The data were collected from a school-based longitudinal study of adolescent smoking from 2008-2011 conducted in Irbid, Jordan. The source population was all students who were enrolled in the seventh grade (age 12-13 years) during the fall of 2008, in Irbid, Jordan (population ~300,000). There were 60 schools in Irbid, with a total of 5287 seventh graders. Stratified, cluster random sampling was used to obtain the study sample: a list of city school names and number of students was obtained from the Jordanian Department of Education. The schools were stratified by gender (male schools, female schools and mixed-gender schools) and by type (private or public) to ensure representative numbers of boys and girls from public and private schools in the study sample. A random sample of schools with probability proportional to size was selected from the roster of school names. Nineteen schools were selected (8 male, 9

female, 2 mixed and 6 private). All seventh grade students in the selected schools were invited to

enroll in the study and out of a total of 1877 students in these 19 schools, parental consents and

student assents were provided by 1781 (95%), all of whom were enrolled into the study.

Theory

The Attitude-Social influence-self-Efficacy (ASE) model was used to guide the choice of

variables included on the survey instrument. This model has been successful in predicting

smoking and other unhealthy behaviors.[17] The ASE Model combines aspects of several well-

known and widely accepted theories (i.e. Bandura's Social Cognitive Theory,[18] the Theory of

Planned Behavior,[19] the Health Belief Model,[20] and the Transtheoretical Model).[21]   The ASE

model states that behaviors are determined by a person's motivation or intention to carry out a

particular type of behavior. Behavior is the result of a person's intentions plus abilities. Intentions

can range from not contemplating behavioral change to contemplating changing the behavior very

rapidly. A person's abilities, such as being able to plan specific actions to reach the goal behavior

and intentions to implement these actions as well as actual skills, increase the chances of

changing intentions into actions, while barriers can lower these chances. Potential risk factors

from the modeled categories have been measured at each time point in the parent study. An

additional advantage of this approach is that it allows for testing predictors of initiation vs. those

of later stages of transition to regular smoking.[8,22] By accurately determining the extent to which

each factor and/or groups of factors predict (or protect against) cigarette smoking initiation,

progression, and/or cessation, these analyses will provide precise information useful in

developing targeted smoking prevention and cessation interventions.

Value of Dissertation Research

This dissertation research was the first to analyze and report on the full dataset from the Irbid

Longitudinal Smoking Study, which was the first longitudinal survey of tobacco use in

adolescents conducted in the Middle East (Jordan), and the first longitudinal study that measured

cigarette *and* WP smoking behaviors and related beliefs. The analyses provide critical

information regarding the patterns of cigarette and WP use, as well as determinants of cigarette

and WP smoking initiation in this population. Findings from this research can be used to help

plan targeted prevention and cessation interventions, as well as to provide insight on the

effectiveness of tobacco control policies. Ultimately, this knowledge could contribute to the

development of a sustainable tobacco control infrastructure for the Middle East.

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Article 1

Abstract

Background: Coordinated, high-impact interventions and community-level changes in smoking behavior norms effectively reduced prevalence of smoking among youth in many developed countries. Smoking trends among Jordanian adolescents are likely different than their western counterparts and must be understood in the context of their daily lives to tailor interventions specifically for adolescents in this setting.

Methods: Between 2008 and 2011, a school-based longitudinal study was conducted in Irbid, Jordan. All seventh-grade students in 19 randomly selected schools (out of 60) were surveyed annually for four years. Outcomes of interest were time trends in smoking behavior, age at initiation, and change in frequency of smoking.

Results: Among 1,781 participants, baseline prevalence of current smoking (cigarettes or waterpipe) for boys was 22.9% and 8.7% for girls. Prevalence of ever- and current any smoking, cigarette smoking, waterpipe smoking, and dual cigarette/waterpipe smoking was significantly higher in boys than girls each year (p<0.001). Smoking prevalence increased every year after year 2 for current smoking (p<0.05) across all methods (any, cigarette, waterpipe, and dual). At all time points for both boys and girls, prevalence of waterpipe smoking was higher than that of cigarette smoking (p<0.001).

Conclusion: This study shows intensive smoking patterns at early ages among Jordanian youth in Irbid, characterized by predominance of waterpipe smoking and steeper age-related increase in cigarette smoking. It also points to waterpipe being the favorite method for introducing youth to tobacco, as well as being a vehicle for tobacco dependence and cigarette smoking.

Keywords: adolescent, cohort, smoking, trends, waterpipe

Introduction

In the developed world, huge successes in curbing the tobacco epidemic were achieved over the past 40 years due to a mixture of policies and interventions that led to the de-normalization of smoking within the society. Much of the developing world, however, has not shared this success story, but witnessed an escalation in tobacco use instead.[1,2] This was mostly due to the tobacco industry's effort to compensate for the loss of markets in countries with strong tobacco control regulations, and in many regions the emergence of new tobacco use methods - most notably the waterpipe (WP) (a.k.a. *hookah, shisha, narghile*).[3] In the Middle East, for example, where the WP has been known for centuries, recent years have witnessed a dramatic increase in its popularity, particularly among youth. In Middle Eastern countries where WP is popular, such as Lebanon, Jordan, and Syria, smoking prevalence among youth has reached staggering levels (e.g. 66% among boys and 54% among girls aged 13-15 years in Lebanon).[4]

To curb the tobacco epidemic among youth, it is crucial to understand the patterns and determinants of tobacco use in this population.[5] Yet, the local evidence-base needed to guide policy and interventions to curb smoking among youth in the Middle East is either lacking or arises from cross-sectional studies, which are limited in their usefulness for the identification of important determinants contributing to future smoking behaviors. An understanding of the dynamics of smoking behavior at the early stages of smoking acquisition among youth is necessary. Such an understanding can only be achieved through longitudinal studies with an adequate follow up period to allow monitoring of important trends in the smoking behavior of youth, and to study the influence of a wider variety of proximal and distal factors on youth smoking behavior.[6,7] This study is the first longitudinal study of tobacco use behaviors among youth in the Middle East, with detailed information about cigarette and WP smoking, and with 4 data points, collected annually. The aim of this study is to describe the dynamics of tobacco use behavior among school children in Irbid (Jordan), in order to understand time-trends of tobacco

use, cigarette and WP acquisition, and progression of tobacco use behavior among youth in Irbid. Such information will help guide interventions to curb tobacco use among youth in light of their early tobacco use trajectory, as well as according to age, gender, and tobacco use method. This may benefit tobacco control for youth not only in Irbid, but also in the rest of Jordan and in other countries in the Middle East that share many of the same tobacco use patterns.[8]

Methods

Participants

Detailed methodology of this study is published elsewhere.[8,9] Briefly, from 2008 to 2011, we conducted a school-based longitudinal study among students who we followed from 7th through 10th grades in the city of Irbid, Jordan (population ≈330,000). The cohort was surveyed annually. The 60 schools in the city were stratified by gender (boys, girls, mixed) and type of school attended (public and private). A cluster random sample of 19 schools (8 male, 9 female, 2 mixed and 6 private) was selected with probability proportional to size (PPS) to ensure representativeness of the sample. In 2008, all 7th grade students (1,877) in the selected schools were invited to participate and 1,781 students (95%) were enrolled in the study after obtaining parental consent and student assent.

Participants were followed prospectively by matching identification numbers each year. Follow-up rates each year were at least 89% (Y2=90%; Y3=95%; Y4=89%) and over the study period, 83% of the participants completed all four surveys. At each time point, participants lost to follow-up were more likely to be male and baseline smokers (current, cigarette and/or WP). Differential participation within these groups may have weakened some results of this study. For example, the gap in current smoking prevalence between boys and girls may appear narrower since boys, who are more likely to be current smokers, were disproportionately lost to follow-up.

This study was reviewed and approved by the IRBs of Jordan University for Science and Technology, University of Memphis, Syrian Society Against Cancer, and Florida International University.

Survey Instrument

Development of the questionnaire was guided by international guidelines[10] and other instruments that have been used and validated in Arabic.[10,11] The questionnaire was composed of 6 sections pertaining to sociodemographics; tobacco use behavior (cigarette and WP); tobacco advertisement and warning labels; family and school environment; peer influences; and students' attitudes and beliefs regarding quitting smoking. Prior to the study, the questionnaire and study protocol were piloted among 86 boys and 67 girls from 4 schools in Irbid and modifications were introduced accordingly.

Definitions

A student was defined as an "*ever smoker*" if he/she reported ever experimenting with smoking. A student was defined as a "*current smoker*" if he/she reported smoking at least once within the past 30 days. *"Age at initiation"* was the reported age at which a student experimented with cigarette (or WP) for the first time. *"Smoking frequency"* among current smokers was dichotomized as "daily" vs. "less than daily" for cigarette use and "weekly" vs. "less than weekly" for WP use. Parental education was dichotomized into "less than high school" (ranging from illiterate to high school graduate) and "more than high school" education (at least some college).

Data analysis

Statistical analyses were performed using SPSS v21 (SPSS Inc., Chicago, IL) and Epi Info 7.0.9.34 (CDC, Atlanta, Georgia). All analyses were restricted to baseline participants (n=1,781).

The data were described using frequency and percent of total for categorical variables, and mean and standard deviation (SD) for continuous variables. The prevalence at each time point was stratified by gender (boys/girls), smoking method (cigarette/WP) and smoking status (ever/current). Students who reported ever-smoking (cigarettes or WP) were counted as ever smokers at all subsequent time points. Chi-square test (or Fisher-exact test when appropriate) was used to compare prevalence by gender and smoking method. The chi-square test for trend (extended Mantel-Haenszel) was used to test linear trends in prevalence of smoking and smoking frequency among current smokers. We established a 2-tailed statistical significance level of ($p<0.05$). To account for the complex sampling design, all analyses were weighted by the school weight using 'Weight Cases' in SPSS v21. School weights were calculated by multiplying number of schools selected from each stratum with the probability of selecting a particular school and taking the inverse of the result.

Results

Description of sample

Of the 1,781 participants enrolled at baseline, a minimum of 89% were measured at each time point, with 1,482 (83%) being measured at all time points. The mean age of the sample was 12.73 (±0.61) years at baseline. The sample was approximately half boys at each time point. At baseline, roughly half the participants' parents (55.1% of fathers and 49.1% of mothers) had at least some college education. (Table 1)

Table 1.1 Sociodemographic characteristics of school based sample of adolescents in
Irbid, Jordan 2008-2011

	N=1781 Year 1 n (%)*	N=1597 Year 2 n (%)*	N=1687 Year 3 n (%)*	N=1587 Year 4 n (%)*
Age (mean ± SD)	12.73 ± 0.61	13.31 ± 0.65	14.72 ± 0.60	15.72 ± 0.61
Boys	915 (50.4)	797 (47.4)	857 (48.7)	795 (47.5)
Girls	866 (49.6)	800 (52.6)	830 (51.3)	792 (52.5)
Father's education				
≤ high school	864 (44.9)	783 (45.7)	820 (45.4)	757 (44.6)
> high school	916 (55.1)	813 (54.3)	865 (54.6)	814 (55.4)
Mother's education				
≤ high school	942 (50.9)	844 (51.1)	893 (51.4)	871 (53.6)
> high school	838 (49.1)	752 (48.9)	794 (48.6)	704 (46.4)
Household size				
<8	1276 (71.8)	1037 (67.3)	1160 (69.5)	1081 (69.7)
≥8	504 (28.2)	560 (32.7)	522 (30.5)	480 (30.3)

*Weighted proportions are reported

Smoking behavior at year 1 (baseline)

Year 1 prevalence of ever- and current any smoking (cigarettes or WP) for boys was

47.1% and 22.9%, respectively, and 26.4% and 8.7% for girls. Prevalence of ever- and current-

any smoking was 36.8% and 15.9% within the entire sample. For ever- and current cigarette

smoking, the prevalence for boys was 26.9% and 8.0%, respectively, and 10.6% and 2.3% for

girls (18.8% and 5.2% overall). For ever- and current- WP smoking, the prevalence for boys was

39.2% and 20.6%, respectively, and 24.1% and 7.7% for girls respectively (31.7% and 14.2%

overall). Ever- and current dual smoking of both cigarettes and WP was 19.0% and 5.7%,

respectively, for boys and 8.3% and 1.3% for girls (13.7% and 3.5% overall). Baseline smoking

prevalence of ever- and current smoking (any, cigarette, WP, and dual smoking) was significantly

higher among boys than girls (p<0.001 for all).

Time trends

Prevalence of ever- and current any smoking, cigarette smoking, WP smoking, and dual

cigarette/WP smoking was significantly higher in boys than girls at all follow-ups (p<0.001).

Smoking prevalence increased every year for ever smoking (p<0.001) and every year after year 2 for current smoking (p<0.05) across all methods (any, cigarette, WP, and dual). At all time points, the prevalence of WP smoking was significantly higher than that of cigarette smoking for both boys and girls (p<0.001). (Table 2)

Over the study period, the prevalence of ever smoking either cigarettes or WP increased overall by 80% and 67% among boys and 105% among girls. Prevalence of ever smoking cigarettes increased 130% among boys, 220% for girls, and 153% overall, while ever WP smoking increased by 79% among boys, 98% for girls, and 86% overall, and ever smoking dual cigarette/WP increased by 177% among boys, 230% for girls, and 189% overall.

Similarly, current any smoking (cigarettes or WP) increased 80% among boys, 136% for girls, and 91% overall. Current cigarette smoking increased 218% for boys, 226% for girls, and 208% overall, while current WP smoking increased by 72% for boys, 136% for girls, and 86% overall, and current smoking of both cigarettes and WP rose by 247% for boys, 300% for girls, 246% overall. All these trends were significant using chi-square test for trend (p<0.001 for all).

Age at initiation
The majority of participants reported initiating cigarettes (54% boys; 52% girls) and WP (58%, 63%) between the ages of 11 and 14 while smoking initiation for both cigarette and WP steadily increased until ages 13-14. For cigarette smoking among girls, the prevalence dropped slightly from ages 11-12 to age ≥ 15, while for boys, the decrease between ages 13-14 and ≥15 was much greater. However, the decline in WP initiation between ages 11-12, 13-14, and ≥15 was similar for boys and girls. It is notable that the largest drop in prevalence of initiation was evidenced at ≥15 years old (see Figure 1 for details).

Table 1.2 Prevalence of smoking at each time point by gender and smoking method in a school based sample of adolescents in Irbid, Jordan 2008-2011

	BOYS				
Smoking status	Year 1 N=915*	Year 2 N=1014*	Year 3 N=1068*	Year 4 N=988*	X^2 Trend p-value
	n (%)**	n (%)**	n (%)**	n (%)**	
Ever any	421 (47.1)	529 (61.8)	637 (69.4)	688 (78.6)	<0.001
Ever cigarettes	245 (26.9)	343 (39.7)	471 (50.6)	537 (61.8)	<0.001
Ever waterpipe	354 (39.2)	454 (53.4)	558 (61.2)	609 (70.2)	<0.001
Ever both	178 (19.0)	267 (30.7)	392 (42)	457 (52.7)	<0.001
Current any	213 (22.9)	212 (24.1)	294 (32.9)	339 (41.1)	<0.001
Current cigarettes	82 (8.0)	103 (10.6)	197 (20.1)	215 (25.4)	<0.001
Current waterpipe	185 (20.6)	177 (20.9)	209 (23.8)	284 (35.5)	<0.001
Current both	54 (5.7)	68 (7.3)	112 (12.2)	160 (19.8)	<0.001
	GIRLS				
Smoking status	Year 1 N=866*	Year 2 N=976*	Year 3 N=988*	Year 4 N=937*	Trend p-value
	n (%)**	n (%)**	n (%)**	n (%)**	
Ever any	204 (26.4)	293 (37.8)	391 (47.3)	443 (54.0)	<0.001
Ever cigarettes	82 (10.6)	153 (19.3)	225 (26.6)	285 (33.9)	<0.001
Ever waterpipe	184 (24.1)	264 (34.4)	354 (43.2)	386 (47.8)	<0.001
Ever both	62 (8.3)	124 (15.9)	188 (22.4)	226 (27.4)	<0.001
Current any	74 (8.7)	85 (10.4)	132 (16.8)	172 (20.5)	<0.001
Current cigarettes	20 (2.3)	30 (3.5)	53 (5.7)	67 (7.5)	<0.001
Current waterpipe	65 (7.7)	69 (8.5)	106 (13.9)	152 (18.2)	<0.001
Current both	11 (1.3)	14 (1.6)	27 (3.2)	47 (5.2)	<0.001

* Weighted proportions are reported.
** Participants who report ever smoking are counted as ever-smokers at all subsequent time points.

Smoking progression

Among current smokers, we analyzed the time trend of daily and weekly use of cigarettes and WP, respectively. All trends were significant (p<0.001 for all except girls daily cigarette smoking p<0.05); however, the sole *increasing* trend in smoking frequency was for daily cigarette smoking in boys. Boys in particular reported more intensive smoking patterns compared to girls, with a larger proportion of boys reporting daily cigarette smoking at years 2 through 4 (p<0.001) and weekly WP smoking at years 3 and 4 (p<0.001). (See details in Figure 2)

Discussion

This is the first cohort study exploring the evolution of smoking behavior among youth (13-16 years) in a Middle Eastern country, and with detailed information about cigarette and WP smoking with 4 years of follow up. It shows that even at the early age of 13, 16% of these youth in Irbid were already current smokers and more than one-third (37%) of the sample had at least experimented with smoking by age 13. While WP smoking was more prevalent at every time point of this study and in both sexes, cigarette smoking showed a bigger increase during the 4 years of observation. Generally, girls showed the same predominance of WP smoking at every time point of the study, but generally at lower levels of smoking than boys for both cigarettes and WP. The time dynamics of smoking acquisition among girls seems in general about 2 years delayed compared to that of boys. Most youth smokers in this population initiated smoking before the age of 15, with the age group 11-12 showing the most intense smoking initiation for both boys and girls. Cigarette initiation among girls moreover, showed a delayed pattern compared to WP. Such information provides valuable insights about early tobacco use trajectories among youth in Irbid according to age, gender, and tobacco use method. These insights can guide interventions to curb tobacco use among youth in Irbid and perhaps Jordan overall, as well as other countries in the Middle East that share many of the same tobacco use patterns.[18]

Figure 1.1: Age of smoking initiation by smoking method and by gender among a school based sample of adolescents in Irbid, Jordan 2008-2011

Cigarette
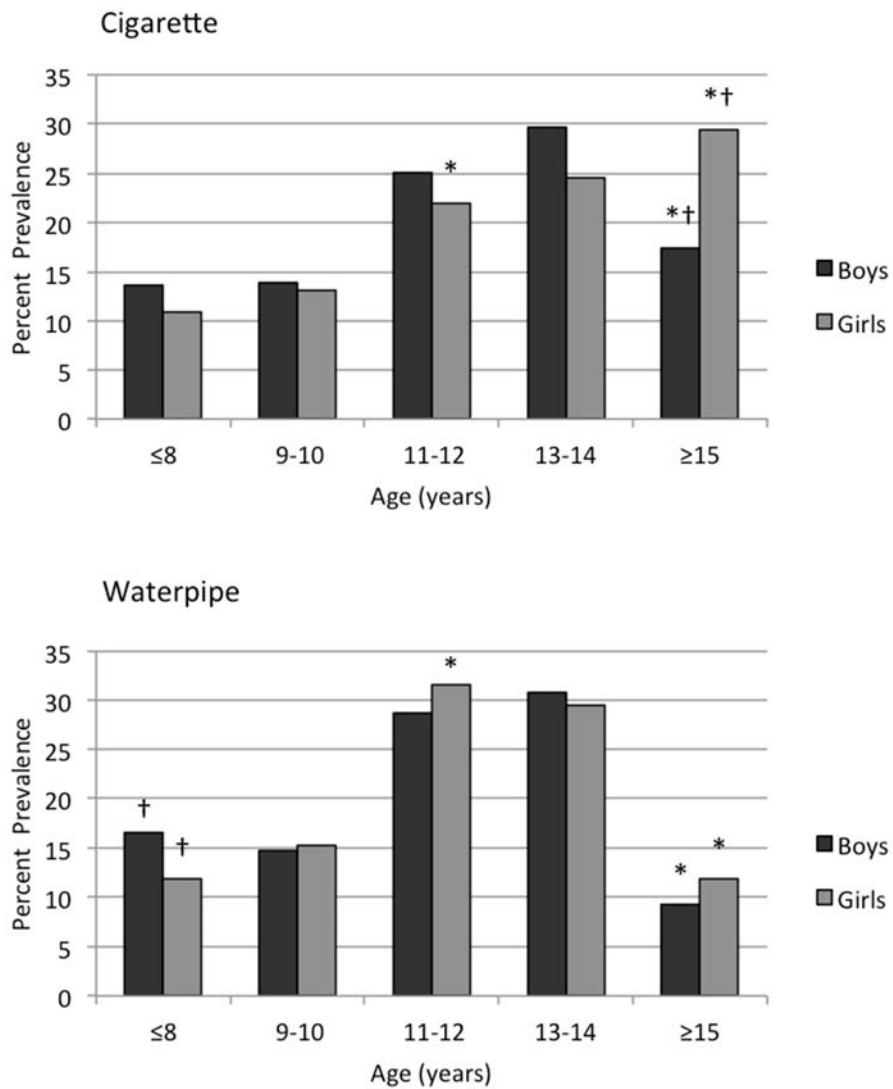
Waterpipe

* Significant difference in smoking method within gender (p<0.05).
† Significant difference by gender within smoking method (p<0.05).

Figure 1.2: Frequency of daily smoking of cigarettes and weekly smoking of waterpipe by gender among current smokers in a school based sample of adolescents in Irbid, Jordan 2008-2011
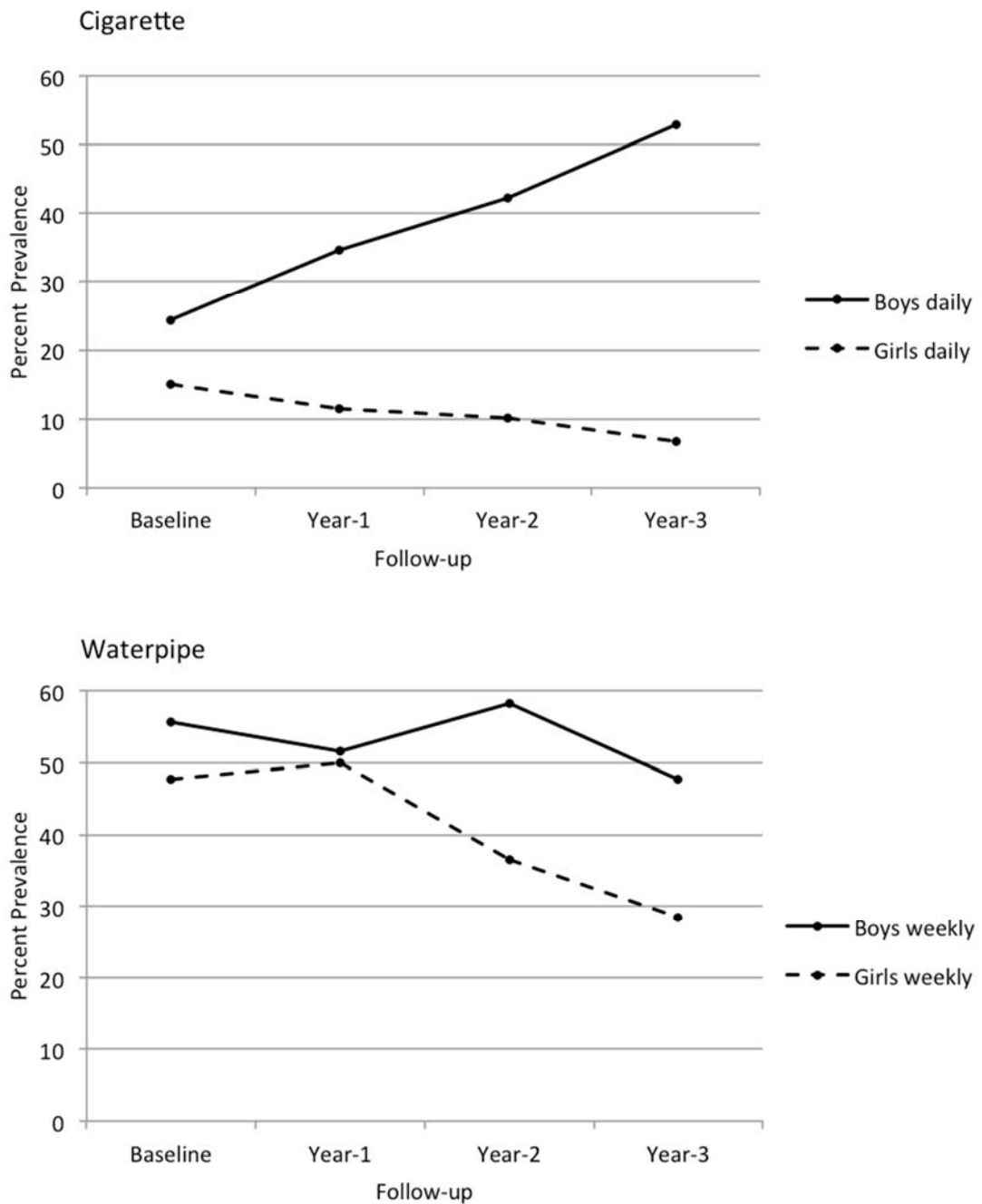
*Significant linear trend (p < .05)

The predominance of WP smoking at early stages and the faster rise of cigarette smoking suggest that more youth are having their first experience with tobacco through the WP. Our results show generally that WP initiation is occurring at earlier stages compared to cigarettes. Whether this reflects more interest in experimenting with the exotic WP,[12] societal tolerance for the culturally acceptable WP (especially for girls),[13,14] a belief in WP's reduced harm and addictiveness,[15] or earlier exposure to the WP by family and peers remains to be seen.[16] Most likely, it is a combination of all these and other factors, but a more systematic study of the predictors of WP initiation is needed to understand this phenomenon.

WP early predominance and steeper cigarette time trends also suggest that the WP can potentiate cigarette smoking among youth. In fact, an earlier study from the same cohort with a shorter follow-up showed that WP smokers at baseline were twice as likely as never-smokers to be current cigarette smokers two years later.[9] One suggested mechanism for this could be the recently illustrated dependence-inducing properties of WP smoking in youth and its limited accessibility compared to cigarettes.[17]Accordingly, once WP smokers become hooked on nicotine in a way that requires frequent dosing, cigarettes become a more practical way to obtain the "fix" compared to the WP, which requires time and arrangement for smoking.[18]

The gender difference in tobacco use method and time dynamics also suggest some interesting patterns. Generally, smoking among women/girls is less tolerated by traditional societies in the Middle East compared to men's smoking.[13,18] As this and other studies suggest however, this gender-based intolerance to girls' smoking is less pronounced for the traditional/indigenous WP compared to the "Western" cigarettes.[13,16,18,19] So while girls in this study smoked mostly less than boys, the gender-based predominance of WP smoking (over cigarettes) was more pronounced for girls compared to boys. For example, at each time point of the study, current WP smoking was more than double that of cigarettes among girls, but the difference between the two tobacco use methods was less pronounced for boys. This is also

supported by the later cigarette initiation by girls compared to boys shown in this study. These observations perhaps illustrate that experimenting with WP is a more culturally acceptable act for girls in traditional Middle Eastern societies compared to smoking cigarettes.[4]

This unfavorable environment for smoking by girls is likely influencing not only initiation/preference of WP vs. cigarettes, but also their smoking progression. Interestingly, while the frequency of daily smoking increased for boys, reflecting perhaps progression to dependence, the observed trend for girls was one of diminishing daily smoking. A decline in frequent users was also seen for girls' WP smoking -evidenced by the decrease in weekly smokers - despite the general increase in WP smoking among them. So while more girls seem to be experimenting with smoking as they grow up, their use patterns do not intensify as seen in boys. Another related interesting pattern is that in contrast to age-related increase in frequent cigarette smokers (daily smokers) among boys, the same was not noticed for the frequency of (weekly) WP smoking (which decreased). This is likely related to the earlier point suggesting switching to the more accessible cigarettes among the more nicotine dependent WP smokers among boys, but the traditional barrier for girls is somehow prohibiting such switch.

Limitations and strengths

One of the main limitations of this study is that all measures assessed were self-reported, which could result in underreporting of smoking, especially among girls, because of the social undesirability of girls' smoking in this region of the world. However, self-reported smoking has been strongly correlated with biomarkers of smoking in cohort studies of adolescents.[20] Moreover, our previous experience studying smoking habits of youth in the Middle East shows that adolescents will share openly their smoking experiences provided that confidentiality and anonymity are assured.[21]

On the other hand, this is the first cohort study to investigate this top priority public health problem among youth in the region. This study analyzes time trends of smoking assessed

cross-sectionally at each time point; i.e. not the development of smoking for each study participant across time. This is intentional, because we wanted to draw a general picture of group behavior change across time rather than the progression of the smoking habit among individuals. While both types of information are important, they reflect different aspects of the problem with different implications for tobacco control in this population.

The presented information provides unique insights on time-related patterns that are gender- and tobacco-use- method specific among youth in Irbid, Jordan. The length and completeness of follow-up, combined with the detailed information of both smoking methods relevant to this population and region (cigarettes, and WP) add to the strength of this study.

Conclusions

This study shows intensive smoking patterns at early ages among youth in Irbid, characterized by early predominance of WP smoking and a steeper increase in cigarette smoking. It points at the possibility of WP being the favorite method for introducing youth to tobacco, as well as being a vehicle for tobacco dependence and cigarette smoking. Such information necessitates more attention to WP at early ages for any tobacco control strategy among youth in Irbid. The reasons behind this early predominance of WP and factors influencing the gender and tobacco use method-specific time-trends noticed in this study provide very valuable research questions for further studies aimed at understanding tobacco use and addiction among youth in Irbid, Jordan, and the Middle East. Going forward, risk and protective factors for initiation of cigarette and WP and the potential interaction of these smoking behaviors, together with further investigation of WP as a gateway to cigarettes are all viable avenues of investigation and could provide clear direction for smoking prevention interventions.

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Manuscript 2

Determinants of waterpipe initiation in school children: A 4-year longitudinal analysis

Abstract

Objective: Guided by the Attitude-Social influence-self Efficacy (ASE) theory, this study identified predictors of waterpipe (WP) smoking initiation in a WP naïve cohort of Jordanian school children.

Methods: A school-based cohort of all 7th grade students (N=1,781) in 19 of 60 schools in Irbid, Jordan, was followed from 2008 to 2011. Generalized linear mixed modeling was used to examine predictors of WP initiation among WP-naïve students (N=1,243).

Results: During the 3-year study, WP initiation was documented in 39% of boys and 28% of girls. Prior cigarette smoking (boys: Odds Ratio 5.72; 95% Confidence Interval 3.57- 9.17 & girls: 6.62; 3.81-11.52) and low WP refusal self-efficacy (boys: 9.01; 5.19-15.66 & girls: 11.75; 7.14, 19.34) were strongly predictive of initiating WP. Boys were also more likely to initiate WP smoking if they had siblings (2.44; 1.35- 4.41) or teachers (1.84; 1.09-3.09) who smoked and girls if they had a friend (2.73; 1.67, 4.46) or parents (1.92; 1.18, 3.13) who smoked.

Conclusion: There is a sizeable incidence of WP initiation among students of both sexes. These findings will help in designing culturally responsive prevention interventions against WP smoking. Gender-specific factors, refusal skills, and cigarette smoking need to be important components of such initiatives.

Keywords: cohort, gender, initiation, Jordan, school children, waterpipe

Introduction

The global spread of waterpipe (WP) smoking among adolescents is widely documented. [1-16] While the evidence is still preliminary, it suggests that WP smoking is as addictive and detrimental to health as cigarette smoking. [17-24] Prevalence of WP smoking is high among school children in other parts of the world and is increasing among adolescents in the US. [2,6-8,14,25-34] A recent 2011 review by Akl *et al.* reported prevalence for current WP smoking among school students in Estonia and Lebanon to be 21% and 25% respectively; with estimates ranging from 12% -15% for Arab-Americans. In the US, a recent national survey of WP use among adolescents revealed ever-WP smoking prevalence of 7.3% and of large survey involving more than 100,000 students in 152 colleges found the prevalence of WP smoking to be 8.4%, second only to cigarettes at 16.8%. [35] WP popularity is partly fueled by the widespread misperception that it is safer alternative to cigarettes. [7,36-38] Evidence however, shows that WP smoking is likely to be associated with many of the health risks of cigarette smoking. [4,13,24,29]

Despite the adverse public health implications of this resurging smoking method, there are no effective prevention or intervention strategies to curb its spread. [23,39] One of the reasons that such efforts are delayed lies in the lack of knowledge about early stages of WP adoption and important factors influencing initiation. Most of the work about WP initiation has been based on cross-sectional studies and/or lacked guidance of an appropriate theoretical model of behavioral change. Recently, two longitudinal studies assessing predictors of WP initiation were conducted among college students in the US. [26,40] While both studies reported high rates of initiation; they also reported high prevalence of ever-WP smoking at baseline, which emphasizes the need to study WP initiation dynamics at an earlier age. This evidence is in line with studies worldwide that suggest much of WP initiation occurs at younger ages. [6,8,15,16,25,27,30,33,34,41,42]

To address this knowledge gap, we employed the Attitude–Social influence–self-Efficacy (ASE) model as a framework for variable selection and interpretation. [43,44] The ASE model

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incorporates insights from other tested and validated social cognitive theories, and suggests that behavior is the result of intentions and abilities, whereby motivational factors, such as various attitudes, social influences and self-efficacy, determine intention, while abilities and environmental barriers (e.g., availability, restrictions) determine whether intentions will be realized. [45,46] Guided by the ASE model, this longitudinal study examined predictors of WP initiation among WP naïve school children in Jordan.

Methods

Detailed description of the methodology from this study is published elsewhere. [3,29,33] Briefly, from 2008 to 2011, school-based cohort of 7th graders (at baseline) were surveyed annually through 10th grade in the city of Irbid, Jordan. The 60 schools in the city of Irbid (Jordan) were stratified by gender (boys, girls, mixed) and type of school attended (public and private). A cluster random sample of 19 schools (8 male, 9 female, 2 mixed and 6 private) was selected with probability proportional to size (PPS). All 7th grade students (age ≈ 13 at baseline) in the selected schools were invited to participate. All selected schools and 95% of the students approached (N=1,781) agreed to participate in the study.

This study was reviewed and approved by the institutional review boards of Jordan University for Science and Technology, University of Memphis, Syrian Society Against Cancer and Florida International University.

<u>Survey Instrument</u>

Development of the study questionnaire was guided by the international guidelines of the World Health Organization (WHO) [47], other previously used and validated instruments in Arabic and it was subsequently pilot-tested. [42,48] The questionnaire included four modules: sociodemographics; cigarette smoking; WP smoking; and media and tobacco control.

<u>Measures</u>

Initiation of WP was the main outcome. Initiation was defined as the change from "never smoker" (of WP) at baseline to "ever smoker" or "current smoker" (of WP) at any subsequent follow-up survey(s). A student was considered an "ever smoker" if he/she reported ever experimenting with smoking and a "current smoker" if he/she reported having smoked in the last 30 days. Assessed theoretical domains and corresponding survey questions are shown in Table 1. Variables were selected by choosing questions on our questionnaire that corresponded to domains in the ASE model as described in previous studies. [43,49-52] Density Index (DI) is the number of persons living in a dwelling divided by the number rooms in a home (minus kitchen and bathrooms), which is a proxy for economic status that was used and tested previously in the Middle East. [11,53]

<u>Statistical analysis</u>

All statistical analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC, 2011). The cohort for this analysis was derived from WP-naïve participants at baseline (N=1,243). The cohort was stratified by gender prior to analysis. SAS proc GLIMMIX was used for the analyses, which accounted for clustering of schools and the repeated measures during the follow-up in students. Questions with more than two possible response categories were analyzed in two ways: once as they were originally obtained, and the second time as binary. The variables were dichotomized by combining responses such as "maybe" and "sometimes" with "yes." "I don't know" answers were excluded from the analysis. We also combined "mother" and "father" into "parents" and "brother" and "sister" into "siblings." The results were robust, whether we used multiple categories or binary categories; binary categories were used for clarity of reporting. [54]

Baseline characteristics were compared between WP initiators and non-WP initiators using chi-square test for categorical variables and t-test for continuous variables. Bivariate correlations for all predictor variables revealed no multicollinearity problems. This was inspected

further by checking for extraordinary estimated coefficients and standard errors, which would have suggested the existence of colinearity. A "full(er)" model as described by Flom and colleagues (2007), [55] that included all potential predictor variables, was then fitted using SAS proc GLIMMIX to find adjusted effects of each variable on initiation.

Odds ratios (OR) and 95% confidence intervals (CI) were reported. P-values of <0.05 were considered significant. Weighted proportions to adjust for complex sampling design were reported throughout.

Results

Characteristics of sample

Baseline characteristics of 1,243 WP initiating and non-WP initiating participants are shown in Table 1. The participants who initiated WP were less likely to have fathers with more than a high school education; to have attended a public school; and to have reported they would accept WP from a friend.

Table 2.1 Survey questions with corresponding Attitude-Self efficacy-Social influence theoretical model domains and baseline characteristics of school based cohort (N=1,243) of Jordanian school children age ≈13 at baseline, Irbid, Jordan, 2008-2011 (waterpipe initiators versus waterpipe non-initiators)

Theoretical Domain	*Survey Questions*	*Initiators (n=458)*	*Non-initiators (n=785)*
		n (%)*	**n (%)***
	What is your gender? (Male)	**256 (53.0)**	**305 (40.8)**
	Have you ever smoked a cigarette, even a puff or two?	**47 (10.4)**	**40 (6.0)**
	Do you attend public school?	**412 (85.2)**	**641 (67.2)**
Predisposing/	How old are you? Mean (SD)	12.7 (0.6)	12.6 (0.6)
Demographics	Density Index,[b] Mean (SD)	1.6 (0.9)	1.7 (1.1)
	How many years of education father has (>High School)	**145 (33.1)**	**273 (40.4)**
	How many years of education mother has (>High School)	104 (25.3)	190 (27.7)
	How much is your daily allowance? (≥0.50 JOD)[c]	73 (18.6)	120 (19.3)
Awareness	Do you think smoking WP is harmful for your health?	421 (92.1)	710 (90.8)
	Have you seen pro smoking ads in the media in the past month?	215 (47.0)	343 (43.6)
Information	Have you seen ads warning about dangers of smoking on health in the media in the past month?	361 (79.8)	633 (82.3)
	Have you seen warnings on WP tobacco packaging in the past month?	**196 (42.4)**	**302 (35.6)**
	Has a family member warned you about dangers of WP smoking?	298 (66.8)	510 (65.8)
Motivation			
Social	Does your family know you smoke cigarettes[a]?	10 (23.8)	10 (29.8)
Influence	Do your parent(s) smoke waterpipe?	**116 (28.6)**	**164 (20.3)**
	Do your sibling(s) smoke waterpipe?	52 (11.0)	69 (9.3)
	Do you have close friends who smoke waterpipe?	108 (22.3)	133 (18.7)
	Have you seen actors on TV smoking?	396 (87.8)	679 (88.0)
	Do your teachers smoke in front of students?	**198 (42.0)**	**212 (23.3)**
Self Efficacy	Would you accept WP from friends if offered?	**52 (12.4)**	**39 (6.2)**
Attitude	Do you think students who smoke WP have more friends?	114 (23.5)	197 (25.4)
	Do you think student who smoke WP are more attractive?	141 (46.2)	203 (41.4)
	Do you think smoking WP affects body weight? (lose weight)	222 (49.0)	397 (51.1)
	Do you think it is easy to stop smoking WP after smoking for year or two?	151 (35.1)	244 (32.7)
Intention	Do you think that you may start to smoke WP next year?	42 (9.3)	61 (8.3)

*Weighted proportions reported to account for complex sampling design. p<0.05 indicated in **bold.** [a]n=47 for initiators and n=40 for non-initiators for ever smokers of cigarette at baseline. [b] Density Index was calculated by dividing the number of people living in each participant's home by the number of rooms (minus kitchen and

bathroom) in the home. [c] In Jordanian Dinars (JOD) (1JOD=1.41USD)

Smoking initiation incidence

      Over the study period of 4 years, 36.8% of participants initiated WP (39.2% of boys and

28.3% of girls). The largest proportion of participants initiated WP smoking at age ≈14, in the 8th

grade (Figure 1).

Figure 2.1: Number of students initiating waterpipe by gender and year of follow up (2008-2011), Irbid, Jordan
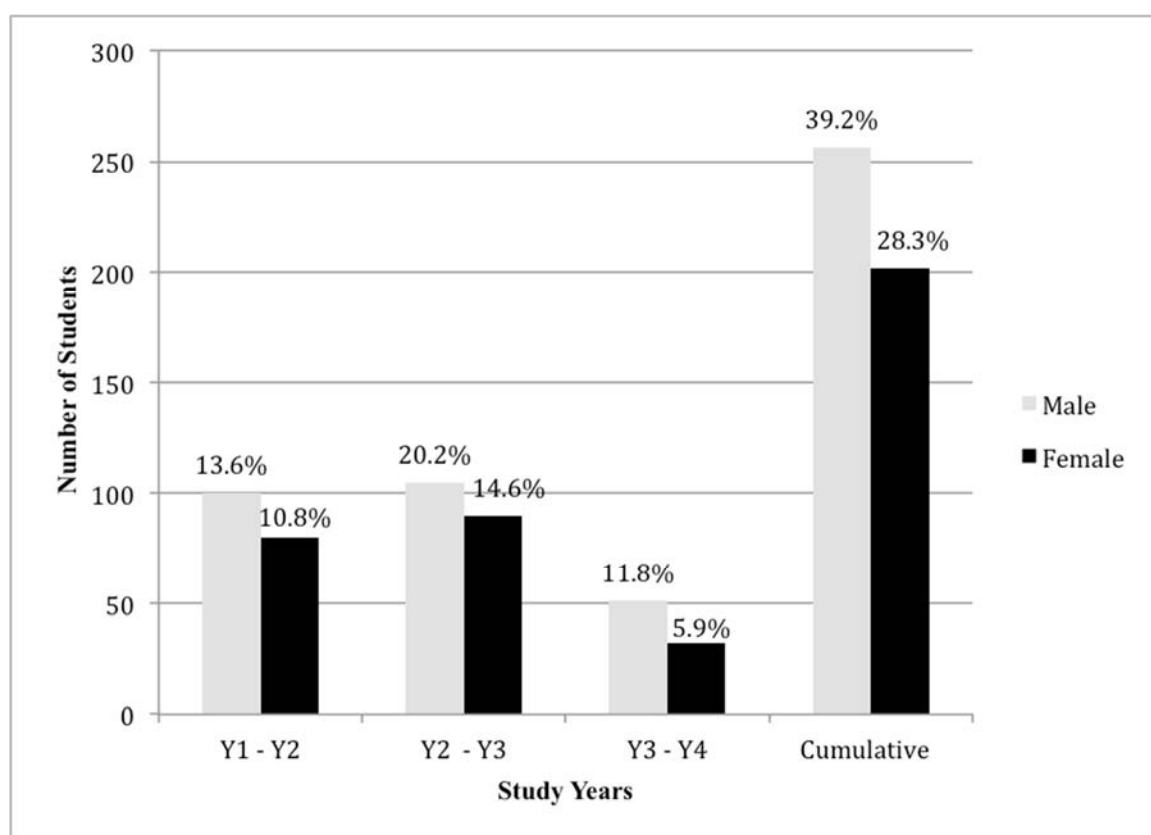
Weighted proportions are reported.

Association of ASE variables and WP smoking initiation by tenth grade

      The results of the longitudinal analyses assessing the relationship between WP initiation

by 10th grade and potential predictor variables, stratified by gender, are summarized in Table 2.

Socio-economic status was not associated with WP smoking initiation in this sample. Previous cigarette smoking and low refusal self-efficacy were strongly associated with WP initiation. Teacher and sibling smoking were associated with initiation among boys while having friends who smoke was associated with initiation among girls. Awareness that WP smoking is harmful for health was protective against initiation (details in Table 2).

Initial analysis indicated significant effects of quit belief ("Is it easy to quit smoking WP after smoking for a year or two?") on WP initiation among girls [OR 0.47; (0.24, 0.94)], these results were not interpretable due to a suppression effect concerning quit belief.[56] Quit belief was not correlated with the outcome (Spearman's 0.078; p <0.150). However, quit belief was significantly related to self-efficacy ("If a friend offers you a WP would you smoke it?") (Spearman's = 0.154; p < 0.01), and further analyses showed suppression to take place when self-efficacy and/or intention and quit belief enter the model simultaneously. Self-efficacy was strongly related with intention ("Do you believe you will start smoking WP in the next year?") (Spearman's = 0.546; p < 0.01) and both self-efficacy (0.451; p<0.01) and intention (437; p< 0.01) were associated with the outcome. Therefore, we estimated models with each of these variables adjusted for all predictor variables, except the other two (e.g. self-efficacy was not adjusted for intention or quit belief). When quit belief was entered into the model without self-efficacy and intention, its association with the outcome was no longer significant.

Table 2.2 Predictors of waterpipe smoking initiation, by gender, among school based cohort of school children aged 13 at baseline, Irbid, Jordan, 2008-2011: longitudinal analysis (N=1,243)

Theoretical Domain	Potential Predictor Variables[a]	Boys (n=561)		Girls (n=682)	
		OR (95%CI)	AOR* (95%CI)	OR (95%CI)	AOR* (95%CI)
Predisposing	Smoke cigarettes	7.17 (5.03, 10.20)	**7.41 (4.05, 12.92)**	9.93 (6.55, 15.05)	**8.48 (4.34, 16.56)**
	Density Index[b] (continuous)**	0.89 (0.74, 1.07)	1.07 (0.80, 1.43)	0.91 (0.74, 1.11)	1.02 (0.72, 1.45)
	Mother's education (> High School)	1.09 (0.76, 1.56)	1.95 (0.93, 4.07)	0.69 (0.46, 1.04)	0.56 (0.24, 1.28)
	Father's education (> High School)	0.85 (0.59, 1.22)	0.53 (0.25, 1.12)	0.61 (0.41, 0.91)	1.28 (0.58, 2.81)
	Daily allowance (≥0 .50 JOD)[c]	1.67 (1.21, 2.30)	1.45 (0.76, 2.78)	1.06 (0.76, 1.47)	0.56 (0.24, 1.28)
	Age in years (continuous)	1.19 (1.03, 1.37)	0.80 (0.60, 1.06)	1.06 (0.92, 1.24)	0.84 (0.60, 1.16)
	Participation in sports	3.43 (1.94, 6.07)	**4.28 (1.60, 11.43)**	1.29 (0.82, 2.02)	0.68 (0.31, 1.49)
Information	Propaganda encouraging smoking	1.28 (0.92, 1.78)	1.11 (0.62, 2.00)	1.20 (0.87, 1.66)	1.50 (0.84, 2.69)
	Propaganda warning about smoking	0.89 (0.62, 1.28)	0.88 (0.46, 1.67)	0.72 (0.48, 1.06)	2.15 (0.96, 4.82)
	Warning labels on WP tobacco packages	1.82 (1.31, 2.52)	1.46 (0.81, 2.62)	1.80 (1.30, 2.50)	1.22 (0.68, 2.22)
	Warning of WP dangers from family	0.89 (0.62, 1.28)	1.87 (0.92, 3.81)	0.66 (0.47, 0.93)	0.82 (0.44, 1.50)
Awareness	Believe WP is bad for health	0.38 (0.24, 0.59)	**0.39 (0.17, 0.88)**	0.34 (0.20, 0.59)	**0.36 (0.13, 0.98)**
Motivation	Parent(s) smoke WP	2.10 (1.44, 3.06)	1.06 (0.56, 2.03)	3.53 (2.53, 4.94)	1.79 (0.97, 3.33)
	Sibling(s) smoke WP	2.42 (1.55, 3.78)	**2.30 (1.14, 4.64)**	3.14 (2.14, 4.62)	1.37 (0.71, 2.63)
	Friends smoke WP	3.37 (2.35, 4.84)	0.68 (0.36, 1.29)	5.82 (4.09, 8.29)	**2.96 (1.59, 5.54)**
	Seen TV actors smoke in past 30 days	1.01 (0.64, 1.58)	**0.47 (0.23, 0.99)**	0.86 (0.50, 1.51)	0.47 (0.18, 1.23)
	Teachers smoke around students	1.01 (0.64, 1.58)	**2.07 (1.12, 3.84)**	1.53 (1.02, 2.29)	1.44 (0.73, 2.85)

	Accept WP from friends[d]	22.05 (14.78, 32.90)	**26.67 (13.80, 51.53)**	20.52 (13.80, 30.52)	**11.49 (6.42, 20.55)**
	Believe have more friends if smoke WP	1.10 (0.75, 1.60)	0.89 (0.46, 1.75)	0.84 (0.53, 1.33)	0.46 (0.19, 1.11)
	Believe more attractive if smoke WP	1.35 (0.93, 1.97)	1.24 (0.61, 2.54)	1.79 (1.22, 2.62)	1.31 (0.61, 2.81)
	WP weight belief = lose weight	0.93 (0.67, 1.30)	1.05 (0.59, 1.85)	0.80 (0.58, 1.10)	0.88 (0.49, 1.58)
	Easy to quit after smoking WP year or two[d]	2.00 (1.44, 2.78)	1.35 (0.86, 2.14)	1.31 (0.92, 1.85)	0.76 (0.45, 1.27)
Intention	Intend to start smoking WP next year[d]	17.52 (11.87, 25.84)	**8.83 (5.08, 15.35)**	11.05 (7.40, 16.51)	**4.43 (2.39, 8.21)**

OR = Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval

*AOR for each variable is adjusted for all other variables in the model. Statistically significant adjusted odds ratios (*P*-value < 0.05) are in **bold**.

**For continuous variables, the OR approximates the risk change for every one-unit increase in the DI or one year increase in age.

[a]No is the referent category [b] Density Index was calculated by dividing the number of people living in each participant's home by the number of rooms (minus kitchen and bathroom) in the home. [c]In Jordanian Dinars (JOD) (1JOD=1.41USD) [d]Due to suppression effect, AOR for quit belief was not adjusted for intention or self-efficacy. Likewise, intention was not adjusted for quit belief or self-efficacy; nor was self-efficacy was adjusted for quit belief or intention. See text for detailed explanation.

Discussion

Results of this study reveal annual incidence rates of WP initiation ranging from 6% -
20% in school children followed from the 7th to the 10th grade. Over a third of youth initiated WP
during the study period. More boys than girls initiated WP during this time and most participants
initiated it around age 14. Those who took up WP smoking were more likely to attend a public
(vs. private) school and have parents with less than a high school education. Outcomes lend some
support for use of ASE-based variables in predicting WP smoking behaviors among youth in our
study. Among predisposing variables, current cigarette smoking was associated with increased
risk of WP initiation for boys and girls, and current involvement with sports was associated with
increased risk for boys. Awareness about dangers of smoking was associated with decreased
odds of initiation for boys and girls. Social influences to smoke were motivational risk factors for
both boys and girls; however, effects differed by gender: for boys, social influences were sibling
and teachers smoking and for girls it was friends smoking. Low refusal self-efficacy was another
motivational factor that was strongly associated with initiation across both genders. Finally the
odds of WP initiation were greater among those with an intention to smoke WP within the next
year. These findings suggest that interventions should begin early, and target youth who attend
public schools, and have not yet smoked. Effective interventions could include skill building to
enhance children's refusal self-efficacy and resistance to social cues to smoke.

Although research on risk factors for WP initiation among adolescents is nonexistent, the
temporal precedence of many predictors identified here fit with earlier longitudinal studies on
adolescent cigarette smoking initiation.[51,52,57-69] Research has frequently shown that predisposing
factors such as use of other tobacco products is predictive of cigarette initiation.[4,29,57] Some
research has also shown that the peer influence common in team sports is associated with
smoking behavior and that involvement in certain sports may be related to risk-taking,
impulsivity, and consequently tobacco and other substance use.[67,68] It is possible that youth who

are attracted to the social nature of team sports may also be attracted to the social nature of WP, an activity usually shared in a group. [16,28,70] Although the evidence is cross-sectional, an association between participation in organized sports and increased odds of WP smoking has been found among American collegiate athletes as well. [5] The importance of the social environment - such as siblings', friends', and peer smoking behaviors, as well as role-model (e.g. teachers) smoking on cigarette smoking initiation has been underscored repeatedly in the literature. [51,57,60-62,66] Alternately, certain personal factors we found to predict (low refusal self-efficacy) or protect against (health concerns) WP initiation have also been similarly associated with cigarette smoking initiation. [51,52,57,60-62,66,69,71] Finally, in line with our findings, studies measuring smoking intention found this domain to be a strong predictor of cigarette initiation. [63-65]

Some cigarette research has provided outcomes counter to the findings in this WP initiation study. First, seeing actors smoke has been associated with cigarette initiation. [59] It is likely our participants saw actors smoking cigarettes and not WP and that these modeled behaviors were interpreted by youth as very distinct. Finally, longitudinal research of cigarette initiation among youth that employed models similar to ASE identified strengths of some ASE domains to predict smoking that were not supported in our study. For example, motivational factors—such as positive attitudes and beliefs about smoking, like believing adolescents who smoke have more friends—have also been shown to influence cigarette-smoking uptake. [58] Two cohort studies employing ASE (Denmark [51]) and social cognitive theory (Taiwan [66]) reported an association between adolescent cigarette smoking initiation and positive attitudes toward smoking. Our divergent findings may be due in part to our having stratified the sample by gender. Also, it is likely that attitudes regarding WP smoking in our sample are less pronounced, as the habit is ubiquitous in Jordan, eliciting weak; if any perceived attitudes compared to those which cigarette smoking does around the world.

A potential weakness of this study was that all responses were self-reported and there may be a higher level of underreporting of smoking by girls due to the social undesirability of smoking among females in this area of the world. However, research among adolescents has shown strong agreement between self-reported smoking rates and those verified with biochemical measures. 72 Furthermore, our previous research among adolescents in the Middle East has also shown that youth are willing to share honestly about their smoking experience when confidentiality is assured. 28 Another potential limitation is that the ASE model may not sufficiently translate relevant cultural differences. One study examined the application of the ASE model to predict smoking among youth of different countries. [73] The study found that the association between country of residence and intention to smoke was only partially mediated by ASE factors and that country also moderated cognitive factors associated with smoking intention. Despite these limitations, our study has several strengths that are important to note. This was the first longitudinal study of tobacco use in the Middle East and while the data were collected in one city, the sample was drawn from the entire population of 7th graders in 2008. Our study also collected smoking information simultaneously for both cigarette and WP. The high response and retention rates across four years also add to the strengths of this study.

Conclusions

Our study found that adolescents' efficacy to resist invitations to smoke is an important factor in actual WP smoking initiation. The influence of smoking by siblings, teachers, and friends were also predictive of WP initiation among youth in this study. Together these findings provide support for the development and implementation of "social influence" smoking prevention type interventions [74,75] focused on enhancing the skills needed to resist social pressure to begin smoking WP. The influence of prior cigarette smoking on actual WP initiation, along with the mean initiation age (14 years) of this cohort, suggests that interventions need to begin early and target youth who have not yet smoked. Successful and early WP smoking prevention

interventions that promote refusal efficacy will contribute to a sustainable foundation for regional

tobacco control.

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Manuscript 3

Determinants of cigarette smoking initiation in Jordanian school children: Longitudinal analysis

Abstract

Objective: To identify determinants of cigarette smoking initiation, by gender, among school children in Irbid, Jordan.

Methods: Between 2008 and 2011, data were collected using self-reported questionnaires annually over 4-years in a prospective cohort of 1,781 students recruited from all 7th grade classes in 19 secondary schools, selected out of a total 60, using probability-proportionate-to-size method. Independent predictors of smoking initiation were identified among the cigarette naïve participants (N=1,454) with mixed-effect multivariable logistic regression analysis using generalized mixed model.

Results: Participants were 12.6 years of age on average at baseline. 29.8% of the 1,454 students (37.2% of boys and 23.7% of girls) initiated cigarette smoking by 10th grade. Of those who initiated (n=498), 47.2% of boys and 37.2% of girls initiated smoking in the 8th grade. Determinants of cigarette smoking initiation included ever smoking a waterpipe, low cigarette refusal self-efficacy, intention to start smoking cigarettes, and having friends who smoked. For girls, familial smoking was also predictive of cigarette initiation.

Conclusion: This study shows that many Jordanian youth have an intention to initiate cigarette smoking and are susceptible to cigarette smoking modeled by peers and that girls are influenced as well by familial cigarette smoking. Prevention efforts should be tailored to address culturally relevant gender norms, help strengthen adolescents' self-efficacy to refuse cigarettes, and foster strong non-smoking social norms.

Keywords: adolescent, cigarette, gender, initiation, Jordan, longitudinal, waterpipe

Introduction

Smoking has been characterized as the most important public health issue of our time. [1] Most of the hazards of cigarette smoking are greatest for middle-aged smokers who began smoking as adolescents, but the short-term health consequences for adolescent smokers are serious as well. [2] These include upper respiratory tract infections, reduced lung growth, reduction in maximum lung function, and poorer self-reported overall health. [3-5] Still, in many countries, especially those in the developing world, the prevalence of smoking continues to increase among youth. [6,7] While developed countries have the knowledge base and resources to try and reverse these trends, many developing countries like those found in the Eastern Mediterranean Region (EMR), still lack critical information about factors influencing early stages of the smoking habit. [8]

Both short-term and long-term health effects of smoking can be influenced by measures to prevent smoking initiation and progression during early stages of the smoking habit. [9] Such work using a mixture of tobacco control policies and interventions is employed in many developed countries with considerable success. [2,10,11] Generally, the establishment of the smoking habit among youth includes shared factors (e.g. addictive nature of nicotine), as well as more specific ones related to the cultural and contextual setting of the environment (e.g. local policy, societal attitude towards smoking). [12-14] Therefore, understanding and highlighting some of the salient factors influencing cigarettes smoking initiation among youth is of paramount importance to start planning prevention and intervention strategies to reduce smoking amongst them. [13-17] For instance, over the past decade, waterpipe (WP) smoking has become the most widespread tobacco use method among youth in the EMR. [18] Even though WP smoking among adolescents has been shown to be associated with adolescent cigarette smoking in cross-sectional studies, longitudinal evaluation of its importance as a risk factor for youth cigarette uptake in the EMR and elsewhere is very limited. [19-23] Additionally, the greater social tolerance of WP smoking for girls in the

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EMR, as compared to cigarette smoking, may heighten their risk for delayed cigarette initiation, which could pose a unique challenge to prevention efforts in the EMR. [20, 24-26]

Integrative models applied to study adolescent smoking have positioned potential influences in terms of distance from the individual behavior—i.e. smoking—ranging from contextual (cultural norms and policies) to immediate social/normative (interpersonal interactions and relationships) to individual (preexisting behaviors, individuals' characteristics, beliefs and perceptions). [9,27-29] Some of these integrative theories suggest that factors more "distant" from the individual may nonetheless be as powerful, if not more powerful, than individual factors in predicting youth smoking initiation. [30,31] Contextual risk factors and those associated with social norms are important in the process of identifying potentially modifiable environmental factors for smoking initiation that are unique to different communities. [8,9,13,16,32-41] Guided by these models, we followed a cohort of cigarette naïve school children in Irbid, Jordan for four years to examine gender-specific predictors of cigarette smoking initiation among Jordanian youth.

Methods

Detailed descriptions of the methodology for this study are published elsewhere. [20,22,42] Briefly, data were drawn from a prospective cohort of 1,781 students (age ≈ 13 at baseline) recruited in 2008 from all 7th grade classes in a stratified cluster random sample with probability proportional to size of 19 (6 private, 8 all-male, 9 all-female, and 2 mixed) of the 60 schools in the city of Irbid, Jordan. All selected schools and 95% of the students agreed to participate in the study. Self-report questionnaires were administered at school by trained study personnel and collected once each school year through 10th grade, for a total of 4 survey cycles.

This study was reviewed and approved by the institutional review boards of Jordan University for Science and Technology, University of Memphis, Syrian Society Against Cancer and Florida International University.

<u>Survey Instrument</u>

Development of the questionnaire was guided by the international guidelines of the

World Health Organization (WHO) [43] and other previously used and validated instruments in

Arabic. [44]

<u>Measures</u>

The outcome measure, initiation of cigarette smoking, was defined as the change from

"never smoker" (of cigarettes) at baseline to "ever smoker" or "current smoker" (of cigarettes) at

any subsequent follow-up surveys. A student was considered a "never smoker" if he/she had

never smoked a cigarette, not even a puff or two; an "ever smoker" if he/she reported ever

experimenting with smoking; and a "current smoker" if he/she reported smoking within the last

30 days.

Sociodemographic covariates included age, gender, father's and mother's education,

school type (public/private), daily pocket money, and density index (DI). The DI is calculated by

dividing the number of people residing in the house by the number of its rooms (minus kitchen

and bathrooms). Income was assessed indirectly using the DI, which is a proxy measure

previously used and tested in the Middle East. [45,46] Measures of social influences to smoke

included mother, father, sibling, friend, teacher, and movie stars smoking. Attitudes favorable

toward cigarette initiation were measured with questions regarding beliefs that smoking is

associated with attractiveness and having more friends; perceived ease of quitting smoking;

intention to start smoking. Attitudes considered unfavorable towards cigarette initiation were

measured by asking whether smoking is bad for health. Self-efficacy to resist cigarettes was

measured by asking whether the participant would smoke a cigarette if offered one by a friend.

Finally, to assess the perceived relationships participants had with their parent/s, sibling/s,

classmates, and teachers, we asked them to rate each relationship as "good," "normal," or "not

good."

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The cohort for this analysis was derived from cigarette-naïve participants at baseline (N=1,454). Since differences in smoking behavior and societal perceptions and attitudes towards smoking were shown to be markedly different for males and females in the EMR, we stratified our sample by gender for the analysis of determinants of initiation. [2,8,15,24,45,47-53]

SAS proc GLIMMIX was used for the analysis to account for clustering of schools and the repeated measurements during the follow-up. To account for the complex sampling design, weights for each school were calculated by multiplying the number of schools selected from each stratum with the probability of selecting a particular school and taking the inverse of the result. A weight statement was used in the analysis where weight was calculated by dividing the original weight by the mean of the original weight (2.9540314). Proportions reported throughout were weighted in this manner.

Questions with more than two possible response categories were analyzed first in their original form, and then they were analyzed as binary. For example, multiple levels of education were collapsed from: Cannot read or write, <6 years, 6-12 years, University into ≤high school vs. >high school. We found the associations did not change whether we used multiple categories or binary categories; hence, we used binary categories in this paper for clarity of reporting. [54]

Baseline characteristics of those students who initiated cigarettes and those who did not were compared using chi-square tests for categorical variables and t-test for continuous variables. For all variables measured during the follow-up period, SAS proc GLIMMIX was used for the mixed logistic modeling, stratified by gender (boys & girls). All predictors found to be significant at the p-value <0.20 level in the bivariate analysis were included in the multivariable analysis. [55]To assess multicollinearity, correlations among independent variables were examined, as well as extraordinary estimated coefficients and standard errors were checked. Odds ratios (OR) and 95%

confidence intervals (CI) are reported. All statistical analyses were performed using SAS version 9.3 (SAS Institute Inc., SAS/STAT 9.3 User's Guide, Cary, NC: SAS Institute Inc., 2011).

Results

Trends

        Of the entire sample (N=1,781), 327 participants (18.8%) were ever-smokers of cigarettes at baseline. Of the remaining cohort of cigarette naïve students (N=1,454) the cumulative incidence of cigarette smoking initiation over 3 years was 37.2% for boys and 23.7% for girls. At all times, significantly more boys than girls initiated cigarette smoking. Between the 8th and 9th grades the greatest number of boys (n=128; 47.2%) and girls (n=72; 37.2%) initiated smoking cigarettes (Figure 1).

Baseline characteristics

        Bivariate analysis showed initiators differed from non-initiators on several sociodemographic variables. Initiators were more likely to be males (OR 1.92; 95% CI: 1.52-2.38), have parents with less than a high school education (fathers: 1.39; 1.10-1.75; mothers: 1.30; 1.01-1.69), and attend public (vs. private) schools (2.74; 2.05-3.66). Initiators and non-initiators did not differ by age, or economic status. Initiators had 1.92 (1.48-2.49) times increased odds to report ever smoking WP, having at least one parent (1.66; 1.32-2.09), siblings (1.55; 1.15-2.08), friends (1.57; 1.18-2.09), or teachers (1.99; 1.56-2.52) who smoke. Initiators also had 2.12 (1.17-3.84) times increased odds to report low cigarette smoking refusal self-efficacy (Table 2).

Determinants of Cigarette Smoking Initiation

        After controlling for sociodemographic covariates (gender, type of school [public/private] age, DI, father/mother education, daily pocket money), WP smoking, low refusal self-efficacy, intention to smoke cigarettes next year, and having friends who smoked cigarettes were independently predictive of cigarette smoking initiation for both boys and girls. Additionally, parental and sibling smoking were predictive of initiation of cigarette smoking (Table 3) among
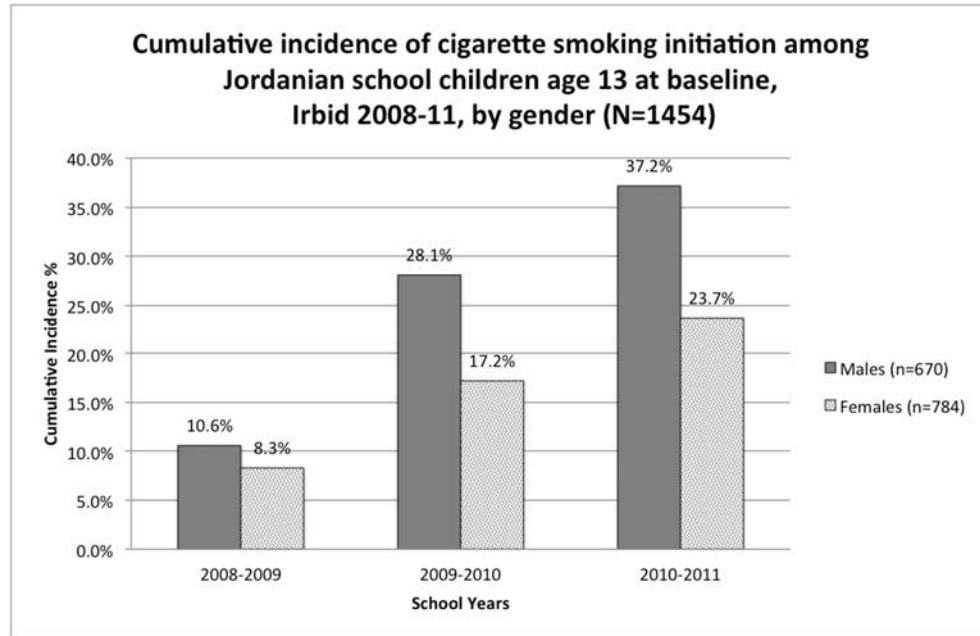
girls only. While not having good relationships with family and teachers, as well as having positive attitudes towards cigarette smoking, were risk factors for initiation in the bivariate analysis, these associations were not significant in the multivariable model.

Discussion

This is the first longitudinal study of smoking among adolescents in the EMR, and one of the very few to be conducted in the developing world. In this prospective cohort of 1,781 Jordanian school children, we found that nearly one-fifth were already smoking cigarettes at baseline (mean age 12.7 years). Of the cigarette naïve students, almost one-third began smoking cigarettes by 10th grade (mean age 14.6 years); with boys just slightly more likely to initiate cigarette smoking compared to girls. For all participants, we found that a mixture of individual (e.g. ever smoked WP, poor refusal skills, intention to smoke) and social (e.g. friends smoking) factors were the most important determinants of smoking initiation. Additionally, solely for girls, familial (e.g. parents/siblings) smoking was a strong predictor of cigarette smoking initiation. These results provide valuable insights to understand smoking initiation among youth, as well as modifiable targets for efforts to reduce smoking among youth in Jordan and the EMR.

One of the unique features related to cigarette initiation in Jordan and the EMR, is its relation to WP smoking, which is even more popular than cigarettes. For example, ever WP smoking was a risk factor for cigarette initiation in our study, more so for girls than boys. Interestingly, WP smoking by girls does not face the same social taboo as cigarette smoking in the EMR. Our results therefore, can signify WP smoking as being a "gateway" to cigarettes, especially among girls. The WP delivers adequate amounts of nicotine to smokers, but it is considerably less accessible than cigarettes (e.g. requires a long time to setup and smoke and is much less portable). Those who become dependent on nicotine through the WP may resort to easily accessible cigarettes to satisfy their urge. [56-61] Additionally, many cafés and restaurants in

Figure 3.1.

Cumulative incidence of cigarette smoking initiation among Jordanian school children age 13 at baseline, Irbid 2008-11, by gender (N=1454)

Weighted proportions are reported.

Table 3.1 Characteristics of school children (N=1,454) aged 13 at baseline, Irbid, Jordan, 2008-2011; cigarette-smoking initiators versus non-initiators

	Potential Determinants of Initiation	Total N(%)	Initiators (n=495) n(%)*	Non-initiators (n=959) n(%)*	p-value**
Sociodemographics	Males (vs. females)	670 (45.3)	292 (37.2)	378 (62.8)	**0.00**
	Public school (vs. private)	1216 (71.7)	445 (84.4)	771 (66.4)	**0.00**
	Age, mean (SD)[a]	12.7 (0.6)	12.8 (0.5)	12.7 (0.6)	0.22
	Density Index, mean (SD)	1.7 (1.0)	1.7 (1.0)	1.6 (1.0)	0.77
	Father's education (> High School)	520 (39.9)	160 (34.5)	360 (42.2)	**0.01**
	Mother's education (>High School)	356 (26.9)	105 (23.3)	251 (28.4)	**0.05**
	Daily pocket money (≥0.50 JOD)[b]	261 (21.1)	83 (19.9)	178 (21.5)	0.48
Social Influences	Ever-smoke waterpipe	298 (22.2)	142 (30.6)	156 (18.6)	**0.00**
	Participate in sports	1038 (75.0)	371 (78.9)	667 (73.2)	**0.03**
	Seen ads promoting smoking last 30 days	670 (45.4)	249 (51.5)	421 (42.9)	**0.01**
	Seen ads against smoking last 30 days	1141 (79.7)	383 (77.8)	758 (80.5)	0.23
	Seen cigarette package warnings	1275 (87.4)	442 (88.8)	833 (86.8)	0.30
	Family warned about dangers of cigarettes	1121 (76.5)	374 (76.6)	747 (76.4)	0.91
	Family knows smoke waterpipe	166 (57.2)	77 (55.0)	89 (58.8)	0.50
	Father and/or mother smoke cigarettes	733 (49.7)	281 (58.6)	452 (46.0)	**0.00**
	Sibling(s) smoke cigarettes	237 (16.1)	103 (20.4)	134 (14.2)	**0.01**
	Friends smoke cigarettes	247 (17.1)	114 (21.9)	133 (15.1)	**0.01**
	Seen actors smoking in media	1245 (87.1)	418 (85.2)	827 (87.9)	0.17
	Teachers smoke around students	492 (30.0)	209 (40.6)	283 (25.6)	**0.00**
Attitudes	Believe cigarettes are bad for health	1351 (93.6)	456 (92.2)	895 (94.2)	0.16
	Believe students who smoke cigarettes have more friends	318 (39.8)	120 (39.7)	198 (39.8)	0.98
	Believe students who smoke cigarettes are more attractive	503 (48.3)	191 (54.7)	312 (45.3)	**0.01**
	Believe cigarettes affect weight (lose weight)	840 (57.5)	283 (56.4)	557 (58.0)	0.56
	Believe it is easy to stop smoking cigarettes after year or so	425 (29.8)	149 (29.3)	276 (30.1)	0.77

Relations	Relationship with parents (not good)	39 (2.8)	14 (2.8)	25 (2.8)	0.95
	Relationship with siblings (not good)	47 (3.1)	15 (3.3)	32 (3.0)	0.70
	Relationship with classmates (not good)	56 (3.9)	17 (3.7)	39 (4.0)	0.08
	Relationship with teachers (not good)	75 (5.49)	31 (7.2)	44 (4.8)	0.06
	Would accept cigarette from friends	41 (3.5)	23 (5.5)	18 (2.7)	**0.01**
	Intention to start smoking cigarettes next year	120 (9.5)	48 (11.0)	72 (8.8)	0.25

Statistically significant p-values for chi-square for difference test are in **bold**.

*Standardized proportions are reported to account for complex sampling design.

** Chi-square test for equality of proportions p-value reported.

Table 3.2 Determinants* of cigarette smoking initiation, by gender, among a cohort of school children aged 13 at baseline, Irbid, Jordan, 2008-2011 (N=1,454)

Determinants	Boys (n=670)		Girls (n=784)	
	OR (95%CI)	aOR** (95%CI)	OR (95%CI)	aOR** (95%CI)
Smoke waterpipe	6.12 (4.30, 8.70)	**3.43 (2.06, 5.69)**	9.13 (6.28, 13.27)	**5.38 (3.43, 8.42)**
Parents smoke cigarettes	1.33 (0.99, 1.79)	1.15 (0.71, 1.85)	2.48 (1.73, 3.55)	**1.90 (1.20, 3.00)**
Sibling(s) smoke cigarettes	1.55 (1.11, 2.18)	0.91 (0.53, 1.55)	2.48 (1.75, 3.51)	**1.75 (1.11, 2.75)**
Friends smoke cigarettes	5.29 (3.71, 7.54)	**2.34 (1.40, 3.91)**	5.00 (3.53, 7.07)	**2.00(1.22, 3.28)**
Accept cigarettes from friend	23.32 (15.91, 34.17)	**10.67 (6.14, 18.56)**	12.74 (8.48, 19.14)	**4.95 (2.70, 9.08)**
Intend to start smoking cigarettes next year	7.15 (5.14, 9.94)	**3.07 (1.77, 5.32)**	4.43 (2.90, 6.78)	**2.07 (1.09, 3.94)**

OR = Odds Ratio (unadjusted); aOR = Adjusted Odds Ratio; CI = Confidence Interval

*Only determinants whose aOR did not include one, for either one or both genders are reported

Odds ratios adjusted for all variables with p<0.20 in bivariate analysis (see Supplemental Table). Statistically significant adjusted odds ratios p<0.05 are in **bold.

the EMR cater to WP smokers, providing an environment where pro-smoking norms are pervasive, and perhaps conducive to tobacco use by adolescents. [62-64] Intervention planning in Jordan and other places where WP is commonplace therefore, would need to address the WP and its harmful and addictive properties, as well as its potential to hook youth on nicotine and lead to cigarette smoking. [65,66] Additionally, stronger anti-smoking policies that include WP smoking should be implemented and enforced to help avert cigarette uptake among adolescents in the EMR.

Poor refusal self-efficacy and intention to smoke have frequently been identified as strong predictors of adolescent cigarette initiation in developed countries. [67-69] They have also been found to be indicative of "late-stage" smoking acquisition, where the adolescent has a clear intention to begin smoking. [70] These factors were also strong predictors of cigarette smoking initiation in our population. This shows that patterns of initiation in different parts of the world and cultures share some aspects as well as have specific ones such as the WP in this case. Therefore, successful interventions focusing on strengthening refusal skills and self-efficacy in other societies are likely to be adaptable to the EMR. [71,72]

The influence of friends' smoking on both boys and girls in our sample is in line with theories emphasizing the power of peer modeling in the development of health behaviors among youth. [32,40,45,52,73-79] One of the interesting findings in our study was that family smoking was strongly predictive of cigarette initiation for girls but not for boys. One interpretation could be that in the EMR, where there is greater societal disapproval and less tolerance for girls' cigarette smoking, smoking among family members may signify more tolerance towards the habit, and perhaps provide girls with more private access to experimentation with it. [15,51] Boys on the other hand, would not be subjected to the same social taboo or "bad publicity," which seem to define a different contextual environment for initiation that is dominated by friends' smoking. [45,52] As peer/family influence can be a risk for smoking initiation; they can be part of the solution as well.

For example, the Truth Campaign of the American Legacy Foundation has utilized peers to promote healthy behaviors among adolescents, and helped reduce adolescent cigarette uptake. [80]

Tobacco control policies, such as banning advertisement and enforcing graphic warning labels have been shown to influence adolescents' cigarette uptake in developed countries. [81-84] In Jordan, and perhaps other EMR countries, the situation seems to be different. For example, Jordan has graphic warning policy in place that requires covering 30% of the front and rear sides of the cigarette package. In our study, noticing such warnings was widespread among our students, yet it was not associated with smoking initiation. It is possible that in the absence of comprehensive tobacco control policy environment, single measures will not lead to changing the social norms, and thus will have lesser impact on smoking. [31,84-86]

Strengths and limitations

A weakness of this study could be that all responses were self-reported and due to the social undesirability of cigarette smoking among females in Jordan, there may be a higher level of underreporting of smoking by girls. However, research has shown strong agreement between self-reported smoking rates among adolescents and those verified with biochemical measures. [87] Additionally, our previous research among adolescents in the Middle East has found them willing to share honestly about their smoking experience when confidentiality is assured. [88]

Conclusions

Our results suggest that multiple levels of influences are involved in the onset of cigarette smoking among adolescents in Jordan, and that both individual level and social (family-friend) level factors are important in this regard. Some of these risk factors have also been identified among adolescents in developed countries and have been successfully addressed with multiple strategies including public health policy, clean indoor air laws, supportive school environment, and personal skills development. [86] Components of these interventions therefore, can be adopted for use among youth in Jordan and perhaps the EMR, but they are unlikely to be effective unless

they are dealt with within a comprehensive tobacco control package. Other factors, such as the

effect of WP smoking on cigarette initiation, especially among girls, need to be addressed based

on local evidence. Taken together, these findings could help form the basis for effective tobacco

control interventions and policies in Jordan and provide a starting point for other similarly

situated countries in their fight against youth tobacco use.

Supplemental Table 3.3 Potential determinants of cigarette smoking initiation, by gender, among school based cohort of school children aged 13 at baseline, Irbid, Jordan, 2008-2011: longitudinal analysis (N=1,454)

Predictor Variables	Boys (n=670)		Girls (n=784)	
	OR (95%CI)	aOR* (95%CI)	OR (95%CI)	aOR* (95%CI)
Age, mean (SD)	1.23 (1.08, 1.40)	1.24 (0.97, 1.58)	1.16 (1.00, 1.35)	1.03 (0.82, 1.29)
Density Index (DI), mean (SD)[a]	0.83 (0.70, 0.99)	0.85 (0.64, 1.13)	0.95 (0.79, 1.15)	0.95 (0.74, 1.23)
Public school (vs. private)	4.82 (2.73, 8.52)	**2.89 (1.43, 5.84)**	2.10 (0.87, 5.06)	**2.87 (1.30, 6.34)**
Father's education (> High School)	0.83 (0.60, 1.15)	0.90 (0.51, 1.59)	0.83 (0.57, 1.21)	1.03 (0.60, 1.77)
Mother's education (>High School)	0.80 (0.57, 1.12)	0.85 (0.47, 1.55)	0.72 (0.48, 1.07)	0.73 (0.41, 1.31)
Daily pocket money (≥0.50 JD)[b]	1.57 (1.16, 2.11)	0.79 (0.45, 1.38)	1.48 (1.07, 2.04)	1.01 (0.61, 1.68)
Smoke waterpipe	6.12 (4.30, 8.70)	**3.43 (2.06, 5.69)**	9.13 (6.28, 13.27)	**5.38 (3.43, 8.42)**
Participated in sports	3.14 (1.95, 5.07)	2.05 (0.93, 4.53)	1.07 (0.70, 1.63)	[c]
Parents smoke cigarettes	1.33 (0.99, 1.79)	1.15 (0.71, 1.85)	2.48 (1.73, 3.55)	**1.90 (1.20, 3.00)**
Sibling(s) smoke cigarettes	1.55 (1.11, 2.18)	0.91 (0.53, 1.55)	2.48 (1.75, 3.51)	**1.75 (1.11, 2.75)**
Friends smoke cigarettes	5.29 (3.71, 7.54)	**2.34 (1.40, 3.91)**	5.00 (3.53, 7.07)	**2.00(1.22, 3.28)**
Would accept cigarettes from friend	23.32 (15.91, 34.17)	**10.67 (6.14, 18.56)**	12.74 (8.48, 19.14)	**4.95 (2.70, 9.08)**
Teachers smoke around students	3.45 (2.44, 4.89)	1.60 (0.95, 2.70)	1.84 (1.26, 2.69)	1.21 (0.74, 1.99)
Seen pro-smoking ads in last 30 days	1.46 (1.08, 1.96)	1.22 (0.73, 1.89)	1.07 (0.78, 1.47)	[c]
Family warned about dangers of cigarette smoking	0.65 (0.45, 0.95)	0.88 (0.47, 1.63)	0.66 (0.45, 0.96)	1.32 (0.73, 2.39)
Seen warning labels on cigarette pack in last 30 days	1.07 (0.71, 1.61)	[c]	1.54 (0.86, 2.77)	0.96 (0.47, 1.97)
Believe students who smoke cigarettes are more attractive	1.32 (0.95, 1.83)	0.63 (0.35, 1.11)	1.41 (0.99, 2.00)	0.88 (0.55, 1.42)
Believe students who smoke have more friends	1.44 (1.05, 1.98)	1.15 (0.68, 1.96)	1.12 (0.75, 1.67)	[c]
Believe easy to stop smoking cigarettes after year or so	1.60 (1.19, 2.15)	1.49 (0.93, 2.39)	1.14 (0.80, 1.63)	[c]
Intend to start smoking cigarettes next year	7.15 (5.14, 9.94)	**3.07 (1.77, 5.32)**	4.43 (2.90, 6.78)	**2.07 (1.09, 3.94)**
Relationship with parents (not good)	1.70 (0.89, 3.27)	1.13 (0.36, 3.57)	1.64 (0.72, 3.76)	[c]
Relationship with siblings (not good)	1.74 (0.85, 3.60)	0.89 (0.22, 3.56)	1.86 (0.84, 4.11)	1.00 (0.30, 3.27)
Relationship with teachers (not good)	2.80 (1.77, 4.42)	1.55 (0.69, 3.48)	2.11 (1.18, 3.77)	1.30 (0.55, 3.04)

OR = Odds Ratio (unadjusted); aOR = Adjusted Odds Ratio; CI = Confidence Interval;
*Odds ratios adjusted for all variables in the listed model. Variables with p>0.20 in bivariate analysis were excluded from the final model. Statistically significant adjusted odds ratios p<0.05 are in **bold**.
[a]Density Index is calculated by dividing the number of people reported living in each participant's home by the number of people rooms in the dwelling (minus kitchen and bathrooms). [b]In Jordanian Dinars (JOD) (1JOD=1.41USD) [c]Association at p<0.20 in bivariate analysis for one gender and thereby included in final model for that gender, but not the other

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Conclusion

Smoking continues to be major preventable cause of death worldwide. As smoking rates are decreasing in developed countries, they are increasing in other parts of the world including Jordan and other countries in the EMR. In the EMR, the growing epidemic of tobacco use is partly related to a resurgence of WP use. As the first longitudinal survey of tobacco use in adolescents conducted in the EMR, this research provides critical information regarding the patterns of cigarette and WP use as well as determinants of initiation in this population. This information can be used to plan prevention and cessation interventions, as well as monitor the effectiveness of tobacco control policies. Thus, this research is important scientifically in terms of understanding youth smoking behavior, building regional capacity in longitudinal studies, and helping to curb the ongoing smoking epidemic in Jordan and the EMR.

Across the three analyses, we found intensive smoking patterns at early ages, characterized by a predominance of WP smoking and a steeper age-related increase in cigarette smoking over the four-year period. There was a sizeable incidence of cigarette and WP initiation among students of both sexes. WP was found to be an important method of introducing youth to tobacco, as well as a vehicle for tobacco dependence and cigarette smoking. While any form of tobacco use is potentially addictive and may result in dangerous health consequences, cigarette smoking may be the most harmful due to its portability and accessibility, leading to more frequent use. In addition, the powerful influence of smoking by other important people in youths' lives was observed to significantly impact WP and cigarette initiation in these studies.

The first study showed intensive smoking patterns at early ages, characterized by a predominance of WP smoking but a steeper increase in cigarette smoking. These findings suggest that more attention should be paid to WP smoking at early ages as part of an overall tobacco control strategy among youth in Irbid. The time-trends noticed in this study lead to very valuable research questions aimed at understanding gender- and administration method- specific tobacco

use and addiction research among youth in Irbid, Jordan, and the Middle East. Outcomes of this study also indicate a need for tobacco prevention programming designed to reach children as young as age 8.

The investigation into determinants of WP initiation found that adolescents' efficacy to resist invitations to smoke and clear intention to start smoking were important factors associated with beginning to smoke WP. The influence of smoking by siblings, teachers, and friends were also predictive of WP initiation among youth in this study. Together these findings provide support for the development and implementation of "social influence" smoking prevention type interventions focused on enhancing the skills needed to resist social pressure to begin smoking WP. The influence of prior cigarette smoking on actual WP initiation, along with the mean initiation age (14 years) of this cohort, suggests that interventions need to begin early, ideally target youth who have not yet smoked, and address both forms of tobacco use.

Results from the study on determinants of cigarette smoking initiation suggest that multiple levels of influence are involved in cigarette initiation and that individual and social level variables are important in contributing to the onset of smoking among Jordanian adolescents. Girls were more strongly influenced by family members' smoking, indicating that prevention efforts geared toward girls should encourage smoking cessation for families and help parents communicate strong antismoking norms to their children. Further, as also found in the WP initiation study, the role of WP smoking in the initiation of cigarettes is evident. Again, it is important to include information about the harmful effects of WP and WP cessation counseling in future tobacco control programs.

Overall, these results provide new insights into potentially modifiable risk factors for cigarette intiation among adolescents in Jordan that can be used to explore smoking initiation in other developing countries. Going forward continued monitoring of youth smoking trends and further evaluation of gender-specific risk and protective factors for initiation of cigarette and WP

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are suggested avenues of investigation and could provide clear direction for smoking prevention interventions. Early cigarette and WP smoking prevention interventions should exploit the power of modeling by peers and family members and should help to build smoking refusal skills. Finally, strong anti-smoking policies must be implemented and enforced to reduce the amount of exposure to smoking behavior modeled by adults and to reduce access to tobacco by children. Changing community norms from pro- to anti-smoking requires time, resources, and a sound evidence base. We hope that the dissemination of our research findings and outcomes from future smoking studies in the EMR will help to move anti-smoking efforts forward in this region of the world.

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