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Factors associated with tobacco use among adolescents in the Kingdom of Saudi Arabia in 2010

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2010

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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2013

Abstract

Factors associated with tobacco use among adolescents in the Kingdom of Saudi Arabia in 2010
By Jessica Lyn Silvaggio

Background: Smoking behaviors are primarily initiated and established during adolescence. Also, among every three young smokers, only one will quit while one of the remaining two will die from tobacco-related causes. Most young people do not consider the long-term health consequences associated with tobacco use nor are they aware that nicotine is highly addictive. Little is known about these aspects of adolescent tobacco use in Saudi Arabia.
Objective: The purpose of this study is to identify specific factors associated with various types of current tobacco use including cigarette, waterpipe, and or any tobacco use among adolescents in the Kingdom of Saudi Arabia in 2010.
Methods: Using a two-stage cluster sample design, a representative sample of 13 to 15 year old school-going children was surveyed using standardized Global Youth Tobacco Survey (GYTS) questionnaires. Current smoking was defined as smoking cigarettes or waterpipe at least one day in the past 30 days. Analyses were conducted using three separate logistic regression equations for currently smoking cigarettes, waterpipe, and either. All independent variables were either dichotomous or categorical as presented in the questionnaire. We categorized exposures as they related to demographics, households, societal, access, and school-based influences.
Results: In 2010, 10.6% of adolescents were current cigarette smokers and 11.0% were current waterpipe smokers. After adjusting for the effect of other exposures in the model, the strongest predictors for cigarette and waterpipe were peer smoking, parental smoking, and household member smoking. Concerns about weight and seeing or hearing anti-smoking and anti-waterpipe media messages within the past month were protective of cigarette and waterpipe. .
Discussion: In designing interventions to prevent tobacco experimentation and use among adolescents, social context and cultural influences related to cigarette and waterpipe smoking should be considered. Other factors related to the household environment, school, and social circles of adolescents need to be considered. Using the Social Learning Theory as a foundation, school-based programs can teach students refusal skills and may have an important role in tobacco prevention in Saudi Arabia.

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CHAPTER 1: LITERATURE REVIEW

According to the World Health Organization (WHO), tobacco kills up to half of the people that are users. Each year, tobacco kills approximately six million people including 600,000 nonsmokers who will die from environmental tobacco smoke. By 2030, tobacco is expected to kill more than eight million people despite the preventability of the epidemic. The WHO cites tobacco use as a risk factor for six of the eight leading causes of deaths in the world. As the epidemic shifts toward developing parts of the world, more than 80 percent of tobacco-related deaths will occur within the coming decades.(1)

Since the 1950s, cigarette smoking has become widespread in Saudi Arabia.(2) In fact, between 1961 and 1987, tobacco imports have increased forty-fold.(3) Prevalence estimates of tobacco use have also increased among adolescents in Saudi Arabia. Both cigarette and waterpipe smoking are common in Saudi Arabia.

After reviewing the literature regarding youth tobacco use in the Middle East, we broadly identified nine categories of factors associated with tobacco use. This review gives readers an understanding of the global tobacco epidemic, discusses tobacco use (cigarettes and waterpipe) in Saudi Arabia and geographical and cultural practices specific to the region, and concludes with a categorized discussion of the risk factors associated with adolescent tobacco use. This review will lead to a manuscript written

about the factors that are associated with tobacco use among adolescents in Saudi Arabia using the most recent Global Youth Tobacco Survey of 2010.

Tobacco: Defining the Problem of Cigarette and Waterpipe Smoking

In 1964, the United States (U.S.) Surgeon General released a report on the health impacts and consequences of smoking, documenting the relationships between cigarette smoking and chronic bronchitis as well as lung and laryngeal cancer in men.(4, 5) Reports released later by the Surgeon General's office document that smoking is associated with other illnesses including coronary heart disease, atherosclerotic peripheral vascular disease, cerebrovascular disease, chronic obstructive pulmonary disease, intrauterine growth retardation, lung and laryngeal cancers in women, oral cancer, esophageal cancer, and cancer of the urinary bladder. Furthermore, cigarette smoking contributes to pancreatic cancer, renal cell carcinoma, and cervical cancer.(6) Despite this information, smoking continues to be a major preventable cause of death.(7) While the impacts of smoking are universally known, adult and adolescent smoking rates remain high.(8)

Each year, an estimated 6 million deaths worldwide are attributed to tobacco use. In 2004, approximately five million adults aged 30 years and over died from direct tobacco use (smoking and smokeless) worldwide, equating to one death approximately every six seconds.(9) According to the World Health Organization (WHO), 12 percent of deaths among men are attributed to tobacco use, two percent of deaths among women are attributed to tobacco use, and seven percent of deaths among all adults are attributed to tobacco use.(9) The global tobacco epidemic is predicted to kill 10 million people

annually in the next 20 to 30 years, with 80 percent of these deaths occurring in developing countries.(10) Research suggests that the increase in deaths may be an underestimate due to the increase in smoking among young girls in comparison to adult females, high susceptibility of smoking occurring among people who have never smoked before, high levels of exposure to secondhand smoke, and pro-tobacco advertising.(11) Estimates indicate that, on average, male smokers lose 13.2 years of their lives while females lose approximately 14.5 years.(12) As noted, tobacco use does not respect geographic borders. For the purposes of this analysis, we chose to focus on the tobacco epidemic in the context of Saudi Arabia.

Tobacco use in Saudi Arabia

The Kingdom of Saudi Arabia is one of the top ten cigarette importing countries in the world.(13) The United States exports 10,637 metric tons of cigarettes to Saudi Arabia, and estimates indicate that 160 million USD are spent each year on purchasing tobacco products in Saudi Arabia.(2) While current research and policy efforts focus primarily on cigarettes, many people in Asia, the Indian subcontinent, and Eastern Mediterranean regions smoke tobacco using waterpipes.(10)

Various small-scale studies show that prevalence of current smoking among the Saudi Arabian population ranges from 2.4 to 52.9 percent (median is 17.5 percent). The small-scale studies show a wide range in prevalence estimates due to sampling various populations, different regions, and different timeframes among various studies. Among adults, the prevalence of smoking ranges from 11.6 to 52.3 percent.(2) However, current

active smoker data from the national study on coronary artery disease risk factors in Saudi Arabia indicated that smoking prevalence among males is 19.1 percent, 8.3 percent among females, and 13.4 percent overall.(14) Among university students, the prevalence of current smoking ranges from 2.4 to 37.0 percent.(2) According to the 2004 nationwide STEPS surveys conducted in Saudi Arabia, 15.3 percent of males were current cigarette smokers while 0.7 percent of females were current cigarette smokers.(15)

Saudi Arabia has also conducted nationwide surveys focused on youths. The Global Youth Tobacco Survey (GYTS) has been conducted in 2001, 2007, and 2010. The regularity of these surveys serves to help monitor tobacco use among youth and to evaluate tobacco prevention and control programs. Based on the 2010 GYTS data, we are aware that 8.9 percent of students (aged 13 to 15 years) currently smoke cigarettes (13 percent among boys, 5 percent among girls), 9.5 percent of students currently smoke waterpipe (13.3 percent among boys, 6.1 percent among girls), and 11 percent of students currently use other tobacco products such as smokeless tobacco (15.3 percent among boys, 7.1 percent among girls). The findings also show that 21.2 percent of those that have never smoked are likely to initiate smoking the following year.(16) However, it does not explain factors that are strongly associated with being a current cigarette smoker or current waterpipe smoker. The secondary data analysis discussed in Chapter 2, however, explores potential influences using data from the 2010 Global Youth Tobacco Survey from Saudi Arabia.

The Middle East: Unique Geographical and Cultural Aspects Pertaining to Tobacco Use, Specifically Waterpipe Smoking

Cigarettes remain the primary form of tobacco used globally. However, many adolescents use other forms of tobacco. In particular, over the past decade, waterpipe smoking, also known as hookah, narghile, goza, argileh, shisha, and hubble-bubble, has become increasingly popular among adolescents in the Middle East.(17) The WHO reports the highest rates of waterpipe smoking for adults in 2008 in Jordan (61.7%), Tunisia (51%), and the Syrian Arab Republic (42%).(17) Waterpipe smoking is increasing not only among youth in the Eastern Mediterranean Region, but has become a global trend among adolescents and young adults living in other countries.(18)

Traditionally, waterpipe was found in the Middle East, North Africa, and Asia. Waterpipe smoking dates back approximately 500 years as an ostensibly less harmful method of tobacco use. Physician Hakim Abul Fath recommended that the "tobacco smoke be first passed through a small receptacle of water so that it would be rendered harmless."(19) The widespread belief among many waterpipe users that waterpipe smoking is safe is as antiquated as the waterpipe itself.(20) Contrary to traditional mythos, the smoke from waterpipe contains high levels of toxic compounds, including carbon monoxide, heavy metals, and carcinogens. One study of nicotine and cotinine in waterpipe smokers found high values of nicotine and cotinine after smoking. For example, after a 45-minute long waterpipe smoking session, saliva nicotine concentration rose from 1.05 to 624.74 ng/mL, and cotinine rose from 0.79 to 283.49 ng/mL.(21) In another study examining carboxyhemoglobin (COHb) concentrations (carbon monoxide

binds with hemoglobin in the red blood cells in the lungs; measures of COHb in the bloodstream gives the levels of exposure a person has had to carbon monoxide) in 1,832 Saudi Arabian male volunteers, there was a linear relationship between smoking intensity and carboxyhemoglobin concentrations. The mean carboxyhemglobin concentrations were higher among waterpipe smokers (10 percent) than among cigarette smokers (6.5 percent) or nonsmokers (1.6 percent).(22) Further, the commonly used heat sources to burn the tobacco include wood cinders or charcoal. These heat sources are likely to increase the health risks because as these fuels are combusted, they produce their own toxicants which include high levels of carbon monoxide, metal, and cancer-causing chemicals.(19) When comparing cigarette smoking to waterpipe smoking, a one-hour-long waterpipe smoking session involves 100 to 200 times the volume of smoke inhaled from one cigarette.(19)(4) The U.S. Centers for Disease Control and Prevention (CDC) has warned that waterpipe smoking is not a safe alternative to smoking cigarettes.(1)

In the Middle East, prevalence of waterpipe use among youth has surpassed that of cigarettes for most countries including Saudi Arabia. The prevalence has increased significantly in the past ten years.(23) Among Arab women, there seems to be less stigma associated with smoking waterpipe compared to smoking cigarettes, thus creating a smaller gender differential than that found for cigarette smoking between males and females. There are also beliefs that waterpipe smoking is less harmful than cigarette smoking or other forms of tobacco use.(24, 25) The nationally representative Global Youth Tobacco Survey from seven countries in the Middle East collected between 2001 and 2005 confirmed that boys are significantly more likely than girls to smoke cigarettes

or to use the waterpipe. For both genders, waterpipe smoking rates were higher than cigarette smoking rates in nearly all of the countries surveyed.(26)

It is not uncommon to share waterpipe with guests or children. Research shows that sharing waterpipe mouthpieces poses a serious risk of transmission of communicable diseases such as hepatitis and tuberculosis.(27) Waterpipe smoking is symbolic of cultural identity and social sharing in the Middle East. People of Arab origin view waterpipe as a representation of their history and traditions.(26) While smoking waterpipe represents a shared, communal environment for many Arabs, cigarette smoking represents the practical and stressful life of the West and sharing cigarettes with guests, sons, or daughters is viewed as atypical.(24)

Dating back to the 1990s, it was estimated that more than 100 million people worldwide smoked waterpipe daily.(28) There are socio-anthropological factors associated with waterpipe use. Anthropologists have identified three main characteristics that influence the conviviality found within this association. These include: the handling of the hose while smoking the waterpipe, the conversation among people smoking, and the quality of time and interactions with others in the created situation.(24) Essentially, smoking cigarettes and waterpipe are thought to be quite culturally different. Cigarettes smoking can be perceived as an act for busy people who are always on the move, whereas waterpipe is for people who want to get away from it all and have a ‘philosophical’ discussion in a seated forum.(29)

In the Middle East, limited research has documented waterpipe smoking as it is such a longstanding tradition that it has never been viewed as a health risk.(30) Given the millions of current waterpipe users, a more thorough understanding of waterpipe risks and health effects are needed. Therefore, global efforts to understand patterns of smoking across specific regions in Saudi Arabia will help researchers and public health practitioners to develop effective interventions. Further, increased efforts to explore national and global trends of waterpipe smoking and the relationship between waterpipe and other forms of tobacco would be helpful in developing cessation strategies to prevent risk factors among adolescents.

Risk Factors Affecting Tobacco Use in Adolescents

Evaluating the literature regarding risk factors that are associated with adolescent smoking conveys the complexity of risk factors that interact and affect decisions regarding smoking among adolescents. The literature identifies different categories of risk factors for tobacco use in adolescents: social, household, gender, school-based, religious, and psychological influences. Each of these categories will be described in further detail below. Overall, based on the available data, it appears that developing effective interventions and thoughtful prevention strategies will require targeting adolescents from a biological perspective as well as a psychosocial perspective so as to confront the variety of factors influencing tobacco use.

Social Influences and Adolescent Tobacco Use

Multiple studies support the notion that social influences, including peer and parental smoking, lower parental monitoring of behaviors, and relaxed parental attitudes towards adolescent smoking were associated with greater adolescent tobacco use. (31-41) Perceptions around societal norms are reflected in an adolescent's attitude and beliefs toward smoking. Also, peer perception of smoking prevalence among other peers is a part of adolescent perceptions of societal norms. Research suggests that adolescents may take into account their friend's attitudes and beliefs regarding smoking when making decisions about increasing amounts of tobacco consumption, continuing, or quitting.(42) Research also suggests that persistence of peers in encouraging and advising smoking to other peers is one of the most important risk factors that perpetuate adolescents to smoke. The results of one study show that adolescents who transitioned from nonsmokers or experimentors to current smokers were heavily influenced by friends that were current smokers both in a one-year period and in a seven-year period.(43) Also, in comparison to other age categories, younger people tend to be more influenced by persistence of fellow peers than adolescents in older age categories.(44) Thus, building effective refusal techniques in school-based programs may assist in giving adolescents the confidence to refuse a behavior that is commonly accepted among their peers.(45, 46)

Further, several studies have found that peer smoking is a more consistent risk factor for adolescent smoking in comparison to low socioeconomic status (SES) and childhood abuse.(7, 47-49) One study reported, as the proportion of friends who smoke increased, the risk for participating in smoking increased. In this same study, when adolescents had the majority of friends who smoke (e.g., in this particular case, 74

percent), the risk of them becoming a smoker increased 27 times. Among those captured in the study, findings indicated the risk was higher for girls.(50)

Peers are important in influencing tobacco experimentation and habitual use. As such, teaching young people and propagating resistance and refusal techniques amongst their peers may be instrumental components of successful smoking prevention programs for this audience. While peers play a major role in an adolescent's decision to smoke, parents also have an effect.

Household Influences and Adolescent Tobacco Use

Specific household-related factors have been found to be associated with smoking during adolescence. For example, findings from several studies indicate that adolescents who are in some conflict with their parents (51-54) and those who have low performance in school (51, 53) are at risk for experimenting and continuing to smoke during adolescence.

Additionally, adolescents who have smokers among them in the same environment regardless of whether they are parents, siblings, and or peers, puts the adolescent at an increased risk of becoming a smoker during adolescence, in addition to the second-hand smoke exposure which is harmful in and of itself.(7) Having a parent or sibling smoker is a precursor for smoking among many adolescents, primarily among younger adolescents or those that have not experimented with smoking before.(55) Other studies report that previous or current cigarette smoking among parents puts adolescents

at an increased risk for experimentation with cigarettes(47) and current smoking.(56) Specifically, maternal smoking was found to be a risk factor for experimentation with smoking and current smoking.(50, 56) Other studies reported that either paternal or maternal smoking was associated with more than double the risk for adolescent smoking.(57) Unlike the aforementioned studies, one study reported that indirect encouragement of smoking through parental behavior (e.g. lighting a parent's cigarette for them) had no increased risk for adolescent smoking, thus potentially removing one mechanism for the effect of parental influence on smoking among adolescents.(7)

Household factors found to be associated with adolescent smoking involve smoking among parents, as well as lack of support, restrictive, non-empathetic parents, and an environment where adolescents are not involved in decision-making. In essence, parents may play a critical role in preventing and educating their children about the dangers of tobacco use in early ages of life. Studies have shown that parental involvement in intervention programs usually results in higher reductions in prevalence rates for adolescents who smoke.(58)

Gender Differences in Attitudes Towards Tobacco Use

There is conflicting evidence regarding the role of gender on tobacco use. Males tended to be significantly more influenced by opinions of friends, teachers, and important persons. Males also had more teachers and friends as tobacco users than females. Males were also more susceptible to peer pressure than the females.(41) On the contrary, females seemed to have other influential female characters or models present in their

lives that were tobacco users, including their mothers and sisters. In this same study, females had a more a positive perception of tobacco consumption. There are similar findings published from middle and high school students in Saudi Arabia. In the latter study, female students reported also having a more positive perception of tobacco use than males. Female students indicated having at least one parent who was a smoker which resulted in them having a more positive attitude towards experimenting or using smoking compared to males. Fritz el al. reported findings contradictory to that previously discussed by Park el al.(59) Fritz et al. did not indicate significant differences between gender and perceptions of smoking among peer smokers. In regions where classrooms are segregated, including in Saudi Arabia, the intervention program may consider taking into account gender differences and the differences in influences between boys and girls.(59)

School-Based Influences and Adolescent Tobacco Use

According to one study conducted in Saudi Arabia among adolescents, students primarily established smoking beliefs based on social norms and perceptions. The results showed that students who had a teacher that used tobacco products or approved of using tobacco products still had negative perceptions of tobacco use. Further, students who had teachers that were morally supportive and promoted tobacco in a negative light also had negative attitudes towards tobacco use. From this study, it appears that attitudes toward smoking were not necessarily influenced by teachers, but instead by other social influences.(41)

Religion and Adolescent Tobacco Use

Having strong religious beliefs was found to be a negative predictor of intention to use tobacco.(41) Multiple studies have shown that religion is a protective factor in adolescents' active decisions not to smoke.(35, 60, 61) For example, one study indicated that students who are affiliated with Islamic secondary institutes had a lower prevalence of smoking compared to students who were enrolled in a non-religious school (i.e., general, commercial, or technical secondary school).(62) Similarly, studies conducted in Western societies support the protective role of religion in the decision to smoke.(32, 62) Researchers indicate that future studies are necessary to explore the degree of religiosity and its association with tobacco use among practicing Muslim adolescents. Moreover, given the current information around religion and tobacco use, it may be that religion could serve as an outlet to promoting tobacco awareness and prevention among adolescents. Thus, by framing smoking prevention programs through the lens of religion, it may be advantageous to keep youth from experimenting or becoming habitual smokers. Researchers Islam and Johnson suggest that Islamic messages condemn smoking; therefore, coupling that notion with the negative health risks associated with tobacco use could be used to reinforce the negative consequences of using tobacco while changing positive beliefs regarding the behavior.(63)

CHAPTER 2: MANUSCRIPT

Introduction

Tobacco consumption is currently the leading preventable cause of death worldwide. According to the World Health Organization (WHO), tobacco kills nearly six million people each year, of whom more than 5 million are users and ex users, and more than 600,000 are nonsmokers exposed to second-hand smoke.(1) The Centers for Disease Control and Prevention has identified reducing tobacco consumption as a Winnable Battle. As 63 percent of all deaths globally are caused by non-communicable diseases (NCDs), and tobacco use is one of the greatest risk factors, reducing tobacco use may have profound benefits in terms of lowering global morbidity and mortality.(1)

In Saudi Arabia, the number of tobacco users has exponentially increased over the past decade. Saudi Arabia is ranked 3rd worldwide in terms of the absolute number of children and youth smoking. The estimated social, economic, and health losses related to tobacco use were SR 5.2 billion (US $1.4 billion) in 2010 alone.(41) Additionally, waterpipe tobacco use (also known as shisha, hookah, nargile, or hubble bubble) is a common tradition practiced in Arab cultures, both those in the Middle East and the diasporas.(26) In Saudi Arabia, the prevalence of waterpipe smoking is higher than for cigarette smoking. The waterpipe has a long and distinguished history of approximately 500 years and can be traced back to ancient India. As a reflection of its social acceptance, Kandela explains in traditional Arab society, waterpipe signifies a social occasion in which everyone can participate including families and visitors.(29) In recent years, there has been a revival of waterpipe smoking most notably among adolescents.(64)

Previous literature has shown that multiple factors play a role and interact with each other in an individual's decision to start smoking. Such factors include personal, household, cultural, school-based, and societal influences. In fact, other studies have suggested that perceived social norms, attitudes toward smoking, and self-efficacy concerning smoking resistance may explain initiation of smoking.(41) Little is known about factors that influence youth and adolescents in the Middle East to smoke, and whether this differs for cigarette and waterpipe smokers.

The aims of this study were to identify the factors associated with cigarette, waterpipe, and any form of smoking among 13 to 15 year olds in Saudi Arabia. Furthermore, we sought to identify whether there were any sex differences in associations with cigarettes versus waterpipe smoking. Also, using additional 2007 data, we explore the cross-sectional differences between experimentation with the various types of tobacco use (e.g., cigarettes, waterpipe, any, and both) as well as estimates of current youth smoking during 2007 and 2010. Additionally, we determined the proportion of adolescents that transitioned from experimenting with smoking (per type of tobacco use) to becoming a current smoker.

Methodology

Introduction: The Global Youth Tobacco Survey

This research study utilized the Global Youth Tobacco Survey (GYTS), a school-based survey, to collect data regarding tobacco use in children and adolescents in the Kingdom of Saudi Arabia in 2007 and 2010. The school-based survey uses standardized

approaches to collect youth tobacco data on a global scale and to guide implementation and evaluation of tobacco prevention and control programs. The WHO and CDC jointly developed a Global Tobacco Surveillance System, of which the GYTS is one data collection mechanism. Between 1998 through 2008, the GYTS was conducted in 168 sites around the world, including 140 World Health Organization (WHO) member states, six territories (American Samo, British Virgin Islands, Guam, Montserrat, Puerto Rico, and the U.S. Virgin Islands), two geographic regions (Gaza Strip and West Bank), one United Nations administered province (Losovo), one special administrative region (Macau), and one Commonwealth nation (Northern Mariana Islands). In the Eastern Mediterranean region, there were 21 of 21 countries and two geographic regions that conducted the study. Specifically, the Kingdom of Saudi Arabia has collected GYTS countrywide data on three separate occasions: 2001, 2007, and 2010.

Using a standard methodology for constructing sampling frames, selecting schools and classes, developing questionnaires, and following protocols for consistency in the field, managing data, processing data, and analyzing data, the GYTS data can be used to compare across various countries that collect GYTS data. There is a standard set of core questions that are self-administered and completed by a representative school based sample of students between 13 and 15 years old.

Sample Selection

The standard sampling methodology of the GYTS uses a two-stage cluster sampling design. In an effort to capture the age group of interest, 13 to 15 year olds, schools within Saudi Arabia most likely to include that age group were selected, and then

specific classrooms (the primary sampling unit) were selected. All students in selected classes were eligible to participate. The GYTS sample design produces independent, cross-sectional estimates that are ideally representative of school-going children in the Kingdom of Saudi Arabia.

In Saudi Arabia, 50 schools were found to be eligible. Eligibility criteria for the list of schools country-wide included schools that exist and schools that may have merged with other schools since the previous GYTS study was conducted. Schools were selected with probability proportional to enrollment size. Among the 50 schools, 160 classrooms were sampled, of which all classes participated. Within the randomly selected classrooms, 2,564 of the 3,075 sampled students (83.4 percent) completed usable questionnaires. The 2010 Saudi Arabia GYTS had a school response rate of 100.0%, a class response rate of 100.0%, and a student response rate of 83.4%.

GYTS Questionnaire

The survey is an anonymous and confidential self-administered questionnaire that is proctored by trained Tobacco Control Program staff of the Ministry of Health. The questionnaire consisted of two sets of questions. The first set of questions includes 56 core questions used by all countries participating in GYTS. These questions not only allow comparison across countries, but also allows for comparisons among years for the same country. Depending on the country's priorities and interests, there may be a second set of questions that are relevant for that country's context. The questionnaire used in this

study includes several domains of data that were used as outcomes and exposures in our analysis:

- experimentation with cigarettes and waterpipe regular use of cigarettes and waterpipe (defined as having smoked either every day or some days in the past 30 days), never using cigarettes and or waterpipe (someone who has not ever experimented or currently uses tobacco products),
- tobacco branding preferences,
- perceptions and beliefs related to tobacco use,
- cessation and cessation attempts,
- access and availability,
- various types of exposure including environmental tobacco smoke exposure,
- education on tobacco use in school,
- perceptions related to banning smoking,
- intention to quit, and
- media and advertising.

The questionnaire in Saudi Arabia consisted of 66 multiple-choice questions which have been previously tested with other students of similar age in Saudi Arabia before the GYTS was officially administered.

Variable Definitions

Current smoking in previous surveys (including the Monitoring the Future Surveys) classified people who average one or more cigarettes per day during the

previous thirty days as daily smokers. Thus, daily smokers include persons who smoke every day, as well as person who smoke on some days, but who average one or more cigarettes per day (USDHHS, 1994). For the purposes of this study, current cigarette smoking was defined as having smoked at least one cigarette on one or more days during the last thirty days. Current waterpipe smoking was defined as having smoked waterpipe at least one day in the past thirty days. Any current smoking was defined as having smoked either one cigarette or waterpipe for at least one day or more in the past thirty days. Independent variables of interest were chosen based on biological significance, support from the tobacco literature, and taking into account cultural norms and how they might influence youth tobacco smoking. All independent variables were self-reported and can be categorized as follows:

- Demographics and background: reported age at the time of taking the survey and self-reported sex,
- Societal perceptions and influences (for each of these variables, cigarette and waterpipe smoking were assessed independently):
    - Beliefs pertaining to weight loss or weight gain as a result of smoking behaviors. This variable was a categorical variable that allowed participants to choose whether they thought cigarette and waterpipe smoking caused weight gain, weight loss, or indicating that there is no perceived difference in weight in comparison to non-smokers.
    - Perceptions regarding dangers of cigarette and waterpipe smoking. This variable allowed participants to indicate whether they viewed cigarette and waterpipe smoking as definitely not harmful to their

health, probably not harmful, probably harmful, and definitely harmful.

- Having close friends as cigarette and or waterpipe smokers. Categorically, students indicated whether they had no close friends as tobacco users, some close friends, most close friends, or all close friends that smoke either waterpipe or cigarettes.
- Perceptions regarding secondhand smoke from waterpipe and or cigarettes and its perceived harm. This variable allowed participants to indicate whether they viewed secondhand-waterpipe and secondhand-cigarette smoke as definitely not harmful to their health, probably not harmful, probably harmful, and definitely harmful.

- Household influences:
  - Knowledge of parental smoking status prompted students to indicate whether neither parent smokes, both parents smoke, father only smokes, mother only smokes, or whether they were uncertain about their parent's smoking status.
  - Having other household members aside from parents that smoke either cigarettes or waterpipe. This variable was dichotomous.
- School-based influences
  - Belief that cigarette or waterpipe smoking makes boys or girls look more or less attractive compared to no difference in attractiveness of non-tobacco users. There were separate questions for each sex and the

categories included perceiving males or females more attractive, less attractive, or no difference in attractiveness from non-smokers.

  - Indication of being taught about the dangers of smoking in class during the school year. Students reported whether they were, were not, or could not recall being taught about the dangers of smoking in one of their classes within the past year.

- Access and availability influences:
  - Age at experimentation prompted students to indicate their age when they first tried cigarettes and waterpipe. Students had the option to report that they had never tried either form of tobacco, experimentation at age 7 or younger, age 8 or 9, age 10 or 11, age 12 or 13, age 14 or 15, age 16 or older.
- Tobacco industry influences:
  - Owning paraphernalia with a cigarette logo. This variable was dichotomous.
  - Having ever been offered a cigarette by a cigarette representative. This variable was dichotomous.
  - Recollection of the number of anti-smoking and anti-waterpipe media messages within the past thirty days. This variable was categorized as having seen or heard a lot of messages, a few, or no messages.

Data Analysis

Data were analyzed using SAS version 9.3 (SAS Institute Inc., Cary, NC) and SUDAAN version x32 (Durham, NC) with adjustment for GYTS' two-stage cluster complex survey design. There were three separate dependent variables including current cigarette smoking, current waterpipe smoking, and current smoking of either cigarettes or waterpipe.

To each student record, a weighting factor was applied in order to adjust for complex sampling techniques and non-response by schools, classes, and students. The final weight is the product of two separate weights (one for the inverse of the probability of selecting the school and the other for the inverse of the probability of selecting the classroom within the school) as well as four adjustments. The weighted results can be used to make important inferences concerning tobacco use risk behaviors of students in Saudi Arabia in grades one through three.

$$W= W1*W2*f1*f2*f3*f4$$

W1= the inverse of the probability of selecting the school

W2= the inverse of the probability of selecting the classroom within the school

F1= a school-level non-response adjustment factor calculated by the school size category (small, medium, large)

F2= a class adjustment factor calculated by school

F3= a student-level non-response adjustment factor calculated by class

F4= a post stratification adjustment factor calculated by gender and grade

Following descriptive explorations of sample characteristics including age, sex, and school-grade, we calculated the proportion of current cigarette, current waterpipe, current any, and current both smokers for 2007 and 2010. Also, we calculated the proportion of adolescents who ever experimented with cigarettes, waterpipe, any, and both forms of tobacco. Next, univariate and bivariate analyses were performed to explore the relationships between the aforementioned independent and dependent variables. Additionally, we stratified exposure variables by sex to explore whether there were differences in factors that may affect smoking behaviors in girls and boys. Logistic regression analyses were conducted to identify key determinants of tobacco use among adolescents in Saudi Arabia controlling for sex and age. Many of the variables specifically pertained to either waterpipe or cigarette smoking behaviors. Thus, as the multivariate logistic regression equations were generated, only variables that pertained to cigarettes were included in the models of associations with current cigarette smoking. Waterpipe specific exposures were only included in the bivariate and multivariate models of associations with current waterpipe smoking status. However, all cigarette and waterpipe specific exposures were included in the bivariate and multivariate models for any type of smoking.

We conducted backward elimination and forward selection to determine the final models for the given outcome variables. Using the backward elimination and forward stepwise approaches to determine the final multivariate models allowed us to see which variables overlapped and those which were included in one model but not the other. We aimed to arrive at a subset of predictors that indicated the strongest associations with specific tobacco use outcomes. For the purposes of this analysis, we chose to report the

forward selection model estimates because of the exploratory nature of the study. Further, the forward selection variables were determined by manually entering in univariate statistically significant variables to the model and individually dropping independent variables as they became insignificant when another variable was added to the model. The exceptions to this rule were age and sex. Based on literature, we know that age and gender are associated with smoking status; therefore, all estimates were adjusted for age and gender. Results were considered significant if the confidence interval did not include the null value of one.

Results

In the 2010 GYTS from the Kingdom of Saudi Arabia, 2,564 students ranging from grades one through three participated, 71 percent of whom were between the ages of 13 and 15 years, 10.6 percent were 12 years old or younger, 18.2 percent were 16 years or older; 1,314 (51.2%) were girls. The characteristics of the 2007 and 2010 analytic sample are shown in Table 1.

Out of the total number of students that responded regarding smoking status in 2010, 10.6 percent of them reported being current cigarette smokers, 11.0 percent reported being current waterpipe smokers, 15.0 percent of students indicated smoking either, and 5.8 percent reported smoking both waterpipe and cigarettes. Also, 25.1 percent of the adolescents indicated having experimented with cigarettes, 18.2 percent indicated having ever experimented with waterpipe, and 30.5 percent indicated ever having experimented with smoking either. The proportion of those that ever tried cigarette smoking that are now current cigarette smokers was 41.7 percent, while the

proportion of those that ever tried waterpipe smoking that are now current waterpipe smokers was 60.6%. Among smokers of either, the proportion of those ever trying either that currently smoke was 48.9%. (Table 2)

As a comparison, in 2007, 8.6 percent of adolescents indicated being a current cigarette smoker, 8.5 percent reported being current waterpipe smokers, 2.9 percent reported smoking both waterpipe and cigarettes, and 13.1 indicated smoking either form of tobacco. There were more adolescents that reported experimenting with tobacco in 2007 than in 2010. However, in 2007, the proportion of students that indicated having ever been a smoker and indicating current smoking (27-29 percent) was less in comparison to those from the 2010 sample (42-61 percent).

Exploring factors associated with adolescent tobacco use in 2010

The data for these analyses are not shown, but more than 30 percent of the students reported having close peers that smoke cigarettes and more than 19 percent indicated having at least one parent that smokes cigarettes. Among adolescents that indicated never having smoked, 15.9 percent (n=1,329) reported having parents that smoke whereas 43.2 percent (n=151) of adolescents who indicated being current smokers had parents that were smokers. Specifically, among the current cigarette smokers (n=2,456), 39.1 percent of the adolescents were male who also had parents that were tobacco users. An estimated 49.4 percent were females who also had parents that were smokers. Over 20 percent of the students reported having close peers that smoke

waterpipe and more than 13 percent indicated having at least one parent that smokes waterpipe (all data not shown).

We explored other exposures pertaining to adolescents' access and availability to tobacco products. Among current cigarette smokers (n=2,456), 21.1 percent of adolescents indicated purchasing cigarettes in a store, 92.5 percent of whom reported buying cigarettes in a store in the past 30 days and were not refused purchasing cigarettes due to age. Nearly 16 percent of current smokers reported having someone else buy cigarettes for them. Among all adolescents, 76.5 percent indicated smoking should be banned from public places (data not shown).

We were also interested in understanding adolescents' perceptions of the dangers of tobacco use and their exposure to secondhand smoke. When adolescents were asked about secondhand cigarette smoke and smoke from waterpipe (n=2,564), 61.4 percent of students indicated that secondhand smoke from cigarettes is definitely harmful while 59.5 percent indicated that smoke from waterpipe was harmful. Also, 28 percent of adolescents reported that waterpipe smoking for only a year or two was safe, as long as they quit after that timeframe whereas 43.2 percent indicated it was definitely not safe. Intention to quit was explored by asking if adolescents wanted to stop smoking now. The majority of respondents did not answer the question (75 percent), however, 8.9 percent indicated they did wish to stop smoking now and 6.2 percent reported not having a desire to quit immediately.

Bivariate Analysis for Current Cigarette Smokers

Table 3 presents a summary of the results when we separately examined the relationships between a number of independent variables and current cigarette smoking. Compared to not having parents who smoke, paternal smoking (OR 2.714, 95% CI 1.984, 3.714), both parents smoking cigarettes (OR 5.323, 95% CI 2.899, 9.776), and uncertainty regarding parental smoking status (OR 3.037, 95% CI 1.340, 6.879) were associated with cigarette smoking. Also, compared to those in the 11year old age group, experimentation at ages 12 years (OR 0.13, 95% CI 0.045, 0.390), and 13 years (OR 0.24, 95% CI 0.107, 0.539) were associated with lower prevalence of being a current cigarette smoker. Other factors that were associated with a lower odds of being a current cigarette smoker included having household members as cigarette smokers (OR 0.218, 95% CI 0.165, 0.287), having a perception that boys (OR 0.304, 95% CI 0.217, 0.425) and girls who smoke are less attractive (OR 0.304, 95% CI 0.217, 0.425), and having no close friends as cigarette smokers (OR 0.076, 95% CI 0.052, 0.1100). Female sex was associated with a lower odds of current cigarette smoking (OR 0.366, 95% CI 0.275, 0.487). Finally, perceiving cigarette smoke from others (secondhand smoke) as probably not harmful (OR 3.738, 95% CI 2.432, 5.747) and experimentation at age 16 or older (OR 4.951, 95% CI 1.681, 14.582), compared to their respective comparison groups, were significantly associated with current cigarette smoking. Other associated variables not discussed are shown in Table 3.

Bivariate Analysis for Current Waterpipe Smokers

Table 4 presents a summary of the results when we separately examined the relationships between independent variables and being a current waterpipe smoker. The estimates provided show the probability of an adolescent being a current waterpipe smoker were lower with younger age: 12 years old (OR 0.17, 95% CI 0.072, 0.398), 13 years old (OR 0.20, 95% CI 0.102, 0.410), 14 years old (OR 0.30, 95% CI 0.156, 0.585), and 16year olds (OR 0.47, 95% CI 0.238, 0.940) were protective against current waterpipe smoking.

Also, experimentation at age 10 or 11 (OR 2.42, 95% CI 1.279, 4.578), age 14 or 15 (OR 2.65, 95% CI 1.312, 5.341), and age 16 or older (OR 7.56, 95% CI 1.970, 28.991) was associated with higher risk of current waterpipe smoking. Other strong associations included having both parents as waterpipe smokers (OR 16.74, 95% CI 10.910, 25.693), a father that smokes waterpipe (OR 2.67, 95% CI 1.796, 3.963), or a mother that smokes waterpipe (OR 14.66, 95% CI 6.557, 32.772). Having household members that were waterpipe smokers (OR 0.09, 95% CI 0.065 0.112), those that never experimented with waterpipe (OR 0.01, 95% CI 0.007, 0.025), the perception that boys (OR 0.25, 95% CI 0.186, 0.348) and girls (OR 0.40, 95% CI 0.294, 0.541) are less attractive when smoking waterpipe were all associated with lower prevalence of waterpipe smoking. Having no close friends as waterpipe smokers (OR 0.08, 95% CI 0.055, 0.111) was also protective, but when most close friends were waterpipe smokers (OR 4.12, 95% CI 2.615, 6.477), and all close friends were waterpipe smokers (OR 3.71, 95% CI 2.228, 6.186), the odds of waterpipe smoking were higher. Similar to cigarette smoking, perceiving waterpipe smoking from others (secondhand smoke) as probably not harmful (OR 3.86, 95% CI

2.578, 5.782) and probably harmful (OR 3.57, 95% CI 2.634, 4.842) were related to higher odds of waterpipe smoking. Other significant associations are listed in Table 4.

Bivariate Analysis for Any Smokers

In Table 5, we noted that younger age [12 years old (OR 0.21, 95% CI 0.083, 0.502) and 13 years old (OR 0.27, 95% CI 0.129, 0.566)] was associated with a lower prevalence of smoking either cigarettes or waterpipe. Experimentation was linked to current use: those that never tried smoking waterpipe (OR 0.06, 95% CI 0.033, 0.106) had lower odds, but those that experimented at age 8 or 9 (OR 2.87, 95% CI 1.449, 5.696), 10 or 11 (OR 2.87, 95% CI 1.449, 5.696), 14 or 15 (OR 3.16, 95% CI 1.477, 6.767), and 16 or older (OR 11.59, 95% CI 2.437, 55.151) had a higher odds of being a current smoker. Having both parents as waterpipe smokers (OR 12.96, 95% CI 8.266, 20.316), paternal only smoking (OR 2.73, 95% CI 1.918, 3.890), maternal only smoking (OR 14.74, 95% CI 5.981, 36.310), and uncertainty regarding parental smoking status (OR 2.31, 95% CI 1.260, 4.244) were significantly associated with being a current smoker. Having household members as waterpipe smokers (OR 0.10, 95% CI 0.075, 0.126) and cigarette smokers (OR 0.17, 95% CI 0.136, 0.222) was protective against any smoking. Male sex (OR 0.37, 95% CI 0.293, 0.477), peer influences and perceptions of weight gain and loss due to waterpipe and cigarette smoking were strongly associated with current any smoking. Finally, perceiving waterpipe smoke from others as probably not harmful (OR 4.53, 95% CI 3.175, 6.458) and probably harmful (OR 2.88, 95% CI 2.188, 3.777) was associated with higher

prevalence of smoking either cigarettes or waterpipe. Other significant associations are shown in Table 5.

Multivariate analysis for current cigarette smokers

Table 6 presents a summary of the results when we examined the relationships between multiple exposures simultaneously and current cigarette smoking. One of the strongest factors associated with current cigarette smoking was having both parents that smoke (OR 11.46, 95% CI 3.974, 33.045) while only having a mother that smokes cigarettes was associated with a lower prevalence of cigarette smoking (OR 0.21, 95% CI 0.069, 0.634). In multivariable models adjusting for all other covariates, having never smoked cigarettes (OR < 0.01, 95% CI <0.001, 0.012) was protective, while experimentation with cigarettes at age 14 or 15 (OR 3.40 95% CI 1.348, 8.596), the belief that cigarette smoke from others as probably not harmful (OR 3.63, 95% CI 1.436, 9.175), and the belief that cigarette smoking was definitely not harmful (OR 2.52, 95% CI 1.100, 5.763) were associated with higher odds of current cigarette smoking. The only significant association between current cigarette smoking and having closest friends that smoke cigarettes was having most closest friends as cigarette smokers (OR 8.06, 95% CI 3.307, 19.651). Also, recollection of seeing or hearing a lot of anti-smoking media messages did not deter from higher odds of current cigarette smoking (OR 3.53, 95% CI 1.854, 6.725). When added to the model, male sex was not significantly associated with current cigarette smoking (OR 0.97, 95% CI 0.555, 1.708).

Multivariate analysis for current waterpipe smokers

Table 7 presents a summary of the results when we explored the relationships between multiple exposures simultaneously and current waterpipe smoking. The strongest factor protecting against current waterpipe smoking was having no closest friends as waterpipe smokers (OR 0.24 95% CI 0.13, 0.43), while having most friends (OR 4.33 95% CI 1.49, 12.59) and all friends as waterpipe smokers (OR 5.17 95% CI 2.42, 11.06) or both parents as waterpipe smokers (OR 4.41 95% CI 1.87, 10.42) were all associated with higher prevalence of current waterpipe smoking.

Also, having never smoked cigarettes (OR 0.01, 95% CI 0.004, 0.025), holding the perception that boys who smoke waterpipe are less attractive (OR 0.32, 95% CI 0.164, 0.628) and more attractive (OR 0.45, 95% CI 0.238, 0.858) were related to lower prevalence of waterpipe smoking. Perception that waterpipe smoking influences weight gain (OR 2.68, 95% CI 1.265, 5.662) was associated with a higher odds of waterpipe smoking. Sex did not reach statistical significance with current waterpipe smoking (OR 0.94, 95% CI 0.519, 1.691).

Multivariate analysis for any current smoker

Table 8 presents a summary of the results when we explored the relationships between multiple exposures simultaneously and currently smoking either cigarettes or waterpipe. The strongest factors protecting against being a current smoker of either cigarettes or waterpipe were having household members that are waterpipe smokers (OR 0.37 95% CI 0.20, 0.68) or cigarette smokers (OR 0.56 95% CI 0.34, 0.96). Similar to

bivariate waterpipe smoking associations, having no close friends that are waterpipe smokers (OR 0.35, 95% CI 0.204, 0.612) was associated with lower odds of smoking, while having most friends as waterpipe smokers (OR 6.26 95% CI 1.674, 23.404), and all close friends as waterpipe smokers (OR 2.68, 95% CI 1.201, 5.991) were significantly associated with higher odds of current smoking. Also, the perception regarding boys who smoke waterpipe as less attractive (OR 0.37, 95% CI 0.210, 0.643) and more attractive (OR 0. 0.37, 95% CI 0.182, 0.755) were both related to current smoking, but this relationship was difficult to interpret. Owning paraphernalia with a cigarette logo (OR 0.48, 95% CI 0.253, 0.907) as well as never having experimented with waterpipe (OR 0.06, 95% CI 0.014, 0.270) and having never smoked cigarettes (OR 0.03, 95% CI 0.012, 0.086) were all significantly associated with lower odds of current smoking. In the models examining any form of smoking, age and sex did not appear to be statistically related.

Discussion

In this representative study of 13 to 15 year olds in Saudi Arabia, having some, most, or all friends smoking was most strongly associated with current cigarette, waterpipe, or smoking either. Smoking among parents and household members was also significantly related to current smoking, but to a lesser extent. These findings are consistent with previous studies.(65-67) Multiple studies have indicated that households and peer influences are important factors in an adolescent's decision to smoke.

The Social Learning Theory suggests that behavior is learned through direct modeling by others.(68, 69) A multitude of studies have shown that maternal and paternal smoking are strongly associated with an adolescent's onset of smoking.(70-72) One study suggests that the parent dose-response effect shows that the risk of smoking among children increases as the number of parents who smoke increases.(73) In our analyses, compared to neither parent smoking, both parents smoking, having a mother that smokes, or not reporting parental smoking were all significantly related to being a current cigarette smoker. Compared to no parental smoking, parental smoking status, specifically, paternal smoking, both parents as smokers, or not reporting parental smoking status were all strongly associated with current waterpipe smoking. As suggested by the Social Learning Theory, these results may be indicative of the modeling effects of adolescents following similar behavior patterns as their parents.(67)

Having one's close friends as either cigarette or waterpipe smokers appears to be important in Saudi Arabia too. Furthermore, we found that adolescents who had most of their closest friends as cigarette smokers compared to only some closest friends as cigarette smokers related to a greater odds of cigarette smoking. Similarly, adolescents who have most or all of their closest friends as waterpipe smokers compared to only some of their closest friends as waterpipe smokers results in a greater odds of waterpipe smoking. Findings from other studies demonstrate that adolescents develop positive attitudes regarding important people in their lives. Maintaining positive images can result in an adolescents' use of cigarettes in an effort to foster such characteristics of individuals whom they revere.(74)

Another significant factor associated with the three types of current smoking: cigarette, waterpipe, and smoking either were the ages at which adolescents experimented with the respective form of tobacco. Literature suggests that there are variations in the progression from experimenting with smoking to regular use; however, the average is approximately two to three years for this transition to occur.(75) Findings from one study showed that the rate of acceleration varied by age. Thus, rates of transition appeared to be higher among middle-aged adolescents (i.e., 14-16 years old) compared to early-aged adolescents (i.e., 10-12 years old).(76)

Understanding the trajectories associated with transitioning from an experimenting smoker to a daily smoker is important as it will allow public health practitioners to identify high risk youth who may need more specialized interventions. An example would be adolescents who progress early and quickly.(77) In our study, 41.7 percent of those that ever tried cigarette smoking are now current cigarette smokers while 60.6 percent of those that ever tried waterpipe smoking are now current waterpipe smokers. Among smokers of either, 48.9 percent of those that ever tried either are currently smokers. Among students that indicated having tried both waterpipe and cigarettes, 18.5 percent became current users of both whereas among students that reported trying either, 29.2 percent became current any smokers.

Perceptions about physical attractiveness and body weight were associated with current waterpipe smoking or being a current smoker of waterpipe or cigarettes.

Respondents indicated that waterpipe smoking makes boys look less attractive when compared to the physical attractiveness of a non-smoker. Also, the belief that waterpipe smoking influences weight gain compared to no differences in weight regardless of smoking status seems to have an opposite effect than expected. The findings related to weight gain among current waterpipe smokers is not consistent with other studies. One study reported that adolescents who believed smoking helped lose weight were more likely to smoke.(65) Our study indicated the opposite. Additionally, respondents in our study indicated that smoking waterpipe makes boys less attractive which seems to have a protective effect. This finding supports the notion that physical appearance is of importance among adolescents. This finding might indicate a cultural phenomenon where the appearance of females may be more important than the appearance of males. Further, it is imperative that physical appearance and body weight are addressed in education and prevention measures.

Additionally, we found that owning paraphernalia displaying a logo related to tobacco products was associated with an increased likelihood of being a current smoker. This finding is in line with other studies as well.(78) Owning a product(s) with a cigarette logo may reflect that the adolescent is receptive to the promotion efforts or that the adolescent was in an environment that allowed tobacco manufacturers to advertise aggressively and to youth. As of 2010 in Saudi Arabia, there were a mix of direct and indirect bans on tobacco advertising, though there are areas in which bans have not been placed in Saudi Arabia including at point of sale, on the internet, allowing tobacco products to appear on television or in films, and at sponsored events.(15)

After adjusting for all other factors associated with tobacco use, some predictors did not appear to be statistically associated with current cigarette, waterpipe, or any smoking, including age and gender. Male gender is significantly associated with smoking however this strong association should not overshadow the prevalence of smoking among females. Similar findings were reported in other studies and may be explained by societal restrictions that women experience in Saudi Arabia, which may restrict the amount of tobacco smoked but it may be less likely to prevent females from occasionally experimenting with some form of tobacco.(79) Thus, it is important to consider strategies to reduce the impact of tobacco use on women's health.(80)

Predictors not resulting in statistical significance may still be noteworthy factors to be taken into account when designing an intervention program. Moreover, in the bivariate analyses, the perception that smoking cigarettes and waterpipe is harmful to health was significant in exploring the association between current smoking and beliefs around the harmful effects of tobacco. Significant effects, including those that are and are not protective should not be dismissed.

Study Strengths and Limitations

Since the GYTS is a school-based survey, adolescents have more privacy than through household surveys and this fact may result in more accurate reporting of smoking behavior. Smoking prevalence has been shown to be higher when adolescents complete questionnaires versus when they are expected to respond to an interviewer over the phone.(81) However, we defined current smoking by classifying adolescents who smoked

cigarettes or waterpipe one day in the past 30 days. This is a lower threshold than other definitions(82) therefore our estimates may be overestimates of prevalence. It was important to create three multivariate models that would allow us to differentiate between the specific factors that may influence cigarette smoking, waterpipe smoking, and any smoking, respectively. Furthermore, we applied different modeling approaches (forward and backward) to explore the consistency of relationships between independent variables and the outcomes.

One of the limitations is school participation. School participation may be compromised by asking sensitive questions of which students may feel uncomfortable answering. Furthermore, if in the future, laws require informed parental consent, student response rates would decline thus resulting in prevalence estimates to change drastically. (81)

Conclusion

In conclusion, our findings, taken in context with those from previous studies, suggest that peer perception and influences, parental influences, and age at experimentation with cigarettes and waterpipe are strongly associated with current cigarette smoking, current waterpipe smoking, and currently smoking either. Further, peer smoking and lack of reinforcements on restrictions for selling tobacco products, namely cigarettes, to adolescents may indicate a need to increase awareness of the dangers of smoking among adolescents and stronger political support of strict reinforcements of tobacco control policies. Also, increasing health promotion campaigns

related to tobacco prevention with a strong focus on social context as it relates to tobacco use are critical in the development of successful long-standing tobacco prevention programs targeting adolescents.

CHAPTER 3: PUBLIC HEALTH IMPLICATIONS AND POSSIBLE FUTURE DIRECTIONS

In high income countries, like the Kingdom of Saudi Arabia, tobacco use and burdens are common. Use of tobacco products other than cigarettes, such as waterpipe, is a primary concern in Saudi Arabia and the Middle Eastern Region. The prevalence of waterpipe smoking among 13 to 15 year olds increased by approximately 2.5 percent between 2007 and 2010. Given the rooted cultural practices around waterpipe smoking and the spread of waterpipe smoking among adolescents outside of the Arab countries, interventions, cessation programs, and other tobacco control efforts in the Eastern Mediterranean Region must include a specialized component of the program directed specifically toward reducing the ubiquity of waterpipe smoking and the risk factors that are associated with waterpipe smoking.

The American Lung Association reported waterpipe smoking as the 'emerging deadly trend.' However, to-date, there has only been one systematic review discussing waterpipe tobacco smoke and its possible associations with health outcomes. Using the Cochrane Collaboration methodology for conducting systematic reviews, Akl et al., indicated that waterpipe smoking is potentially associated with lung cancer, respiratory illnesses, low birth-weight, and periodontal disease.(83) However, as the WHO Study Group on Tobacco Product Regulation indicated, further quantitative and qualitative research is necessary.(84) The Middle East is unique in that waterpipe smoking practices are not an emerging phenomenon. The waterpipe smoking practice is embedded in Saudi culture, therefore, in an effort to develop effective interventions, qualitative research is

needed to explore perceptions of waterpipe smoking and attitudes towards resistance in experimentation and quitting. Given that adolescents tend to be invested in social acceptance, it would be instrumental to know whether it is socially unacceptable among adolescents to refuse participation in waterpipe smoking. The three national GYTS datasets indicate that waterpipe smoking among youth in Saudi Arabia is increasing more rapidly than cigarette smoking. Coupling qualitative findings with quantitative results, behavioral scientists and health educators may create stronger interventions targeting youth watepipe smokers.

In order to better understand the health burden, there is a need for higher quality studies that can better identify and quantify health effects of waterpipe smoking. Further, there is a need for a standardized exposure measurement to assess waterpipe use in future epidemiologic studies.(85) Currently, policy makers have comparatively weak evidence suggesting associations of health outcomes with waterpipe smoking. Despite the lack of evidence indicating specific health outcomes and their associations with waterpipe smoking, public health policy makers could focus on tackling other problems related to tobacco use including cigarette smoking among adolescents. There is a pool of high quality evidence that discusses the health effects of cigarette smoking, namely among youth.

In addition to strengthening efforts to reduce youth cigarette smoking, the WHO Support Group also reported public health initiatives that could be used to reduce waterpipe smoking and associated illnesses. The Tobacco Regulation Committee of the

WHO recommends that a document be produced in the WHO Technical Report Series to evaluate the health effects of waterpipes and develop evidence-based recommendations. Additional action suggestions for regulators include regulating wateripes as cigarettes and that other tobacco products are also regulated. Also, regulators might consider incorporating waterpipes in comprehensive tobacco control movements, though this will take careful thought and cultural sensitivity, specifically for Saudi Arabia. In Saudi culture, it is socially and culturally acceptable to offer children to smoke waterpipe but traditionally, not cigarettes. Encouraging adolescents to develop refusal skills to use when their parents and or peers offer them waterpipe might create larger challenges as the dynamic between peers and adolescents should be assessed differently than the dynamic between household member adults or parents and adolescents.

An avenue for communicating with a large proportion of adolescents is at school. School-based programs for smoking prevention have been developed and evaluated rigorously in the United States.(86) Implementing school-based interventions is advantageous as it is a forum to reach almost all children. Furthermore, the school environment is inherently a learning environment, thus focusing on educating students about the dangers of tobacco use fits naturally with the daily activities.

The Cochrane Review on school-based programs for preventing smoking discussed five types of interventions in schools based on different theoretical models. Among the five types of interventions, the social competence curricula which uses enhancement interventions (also referred to as Affective Education) is based on the

previously discussed social learning theory.(68) If schools in Saudi Arabia were to use this theoretical model as a basis for creating socially appropriate and culturally sensitive cigarette and waterpipe prevention interventions, children would theoretically use modeling, imitation, and reinforcement techniques to teach self-management and social skills as well as problem-solving and decision making skills. This might also be an effective strategy because such programs use cognitive-behavioral skills which assist in building self-esteem, increases assertiveness, and encourages interaction with those of the opposite sex.(87)

In our study, peers strongly influenced decision-making regarding cigarette and waterpipe smoking behaviors. Other influential factors were household influences, age at experimentation with cigarettes and or waterpipe, as well as recollection of hearing or seeing anti-smoking media messages. The type of school-based intervention described in the Cochrane Review would address each of the factors that were significantly associated with current cigarette, waterpipe, and any smoking as well as incorporate factors that did not appear to be statistically significant but are culturally and socially relevant (e.g., gender).

Tobacco use among girls is increasing in the Eastern Mediterranean Region. In fact, the most recent data from the GYTS on the prevalence of smoking among girls is as high, or higher, than the prevalence of smoking among adult women in nine of 11 countries in the region. Given the addictive nature of cigarettes, it is important to intervene during adolescence with strong tobacco prevention and awareness programs

that target youth that are susceptible to both waterpipe and cigarette smoking, youth that have already started experimenting with smoking, as well as youth that are smoking at least one cigarette or waterpipe at least one day in the past month. Also, findings indicate that cultural traditions and social influences in the region may be shifting toward a more accepting behavior of girls smoking at home or in public. Using a school-based approach may prove effective in building the skills necessary to refuse tobacco from household members and peers while increasing awareness of the dangers of smoking among all forms of tobacco, especially if there are booster interventions once the adolescents transitions from middle school to high school. Finding an appropriate level of intervention is imperative not only for the health of those currently in Saudi Arabia but also for the future generations.

Saudi Arabia has made major strides in regard to WHO's MPOWER strategy. In addition, intervening and developing prevention policies specifically related to reducing tobacco use among adolescents will be complementary to these efforts. The country has shown dedication to tobacco control by signing the WHO Framework Convention on Tobacco Control (WHO FCTC) on June 24, 2004 and ratifying it on May 9, 2005. As more evidence is generated around health effects and social beliefs around waterpipe, the challenge will be to facilitate a shift in perceived effects of cigarette and waterpipe use as socially acceptable to perceptions of health behaviors that are harmful to the individual as well as other around them.

REFERENCES:

1. WHO. 10 facts on the global tobacco epidemic. 2012. (http://www.who.int/features/factfiles/tobacco_epidemic/en/). (Accessed).
2. Bassiony MM. Smoking in Saudi Arabia. *Saudi Medical Journal* 2009;30(7):876-81.
3. Schultz H, Ezzat A, Allam A, et al. Smoking and Health: New insights and recent developments. *Annals of Saudi Medicine* 1998;18(1):1-5.
4. Doll R, Hill AB. Smoking and carcinoma of the lung; preliminary report. *British medical journal* 1950;2(4682):739-48.
5. Public Health Service DoH, Education, and Welfare. Smoking and health: report of the Advisory Committee to the Surgeon General of the Public Health Service. *Washington, DC: US Department of Health, Education, and Welfare, Public Health Service* 1964;(PHS)64-1103.
6. CDC. Guidelines for School Health Programs to Prevent Tobacco Use and Addiction. *MMWR* 1994;43(RR-2):1-18.
7. Schepis TS, Rao U. Epidemiology and etiology of adolescent smoking. *Current opinion in pediatrics* 2005;17(5):607-12.
8. CDC. Youth risk behavior surveillance-United States, 2009. *MMWR* 2010;59(SS-5):1-142.
9. WHO. WHO global report: mortality attributable to tobacco. 2012. (http://www.who.int/tobacco/publications/surveillance/rep_mortality_attributable/en/index.html). (Accessed 2013).

10. Maziak W, Ward K, Afifi Soweid R, et al. Tobacco smoking using a waterpipe: a re-emerging strain in a global epidemic *Tobacco Control* 2004;13(4):327-33.

11. CDC. Global Youth Tobacco Surveillance, 2000--2007. *MMWR Surveillance Summaries* 2008;57(SS01):1-21.

12. CDC. Smoking-attributable mortality years of potential life lost, and productivity losses-United States, 2000-2004. *MMWR* 2008;57(45):1226-8.

13. WHO. Tobacco Trade *The Tobacco Atlas* 2002.

14. Al-Nozha MM, Arafah MR, Al-Mazrou YY, et al. Coronary artery disease in Saudi Arabia. *Saudi Med J* 2004;25(9):1165-71.

15. WHO. WHO Report on the Global Tobacco Epidemic, 2011. 2011. (http://www.who.int/tobacco/surveillance/policy/country_profile/sau.pdf). (Accessed 2013).

16. Kingdom of Saudi Arabia Ministry of Health. Saudi Arabia global youth tobacco survey fact sheet 2012.

17. Maziak W. The waterpipe: An emerging global risk for cancer. *Cancer Epidemiology* 2013;37(1):1-4.

18. Shafogoj YA MF. Levels of maximum end-expiratory carbon monoxide and certain cardiovascular parameters following hubble-bubble smoking. *Saudi Medical Journal* 2002;23:953-8.

19. WHO. Advisory note: waterpipe tobacco smoking: health effects, research needs and recommended actions by regulators/ WHO Study Group on Tobacco Product Regulation., 2005:20.

20. Maziak W, Eissenberg T, Ward KD. Waterpipe use and dependence: implications for intervention development. *Pharmacology, Biochemistry, and Behavior* 2005;80:173-9.

21. Shafagoj YA, Mohammed FL, Hadidi KA. Hubble-bubble (water pipe) smoking: levels of nicotine and cotinine in plasma, saliva and urine. *Int J Clin Pharmacol Ther* 2002;40:249-55.

22. Zahran FM, Ardawi MSM, al-Fayez S. Carboxyhaemoglobin concentrations in smokers of sheesha and cigarettes in Saudi Arabia. . *BMJ* 1985;291:1768-70.

23. El-Awa F, Warren CW, Jones NR. Changes in tobacco use among 13-15-year-olds between 1999 and 2007: findings from the Eastern Mediterranean Region. *Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit* 2010;16(3):266-73.

24. Maziak W, Eissenberg T, Rastam S, et al. Beliefs and attitudes related to narghile (waterpipe) smoking among university students in Syria. *Annals of epidemiology* 2004;14(9):646-54.

25. Rice VH, Templin T, Hammad A, et al. Health issues in the Arab American community. Collaborative research of tobacco use and its predictors in Arab and non-Arab American 9th graders. *Ethnicity & disease* 2007;17(2 Suppl 3):S3-19-S3-21.

26. Rice V. Water pipe smoking among the young- The rebirth of an old tradition. *The Nursing clinics of North America* 2012;47:141-8.

27. Knishkowy B, Amitai Y. Waterpipe (narghile) smoking: an emerging health risk behavior. *Pediatrics* 2005;116(1):e113-e9.

28. Wolfram RM, Chehne F, Oguogho A, et al. Narghile (water pipe) smoking influences platelet function and (iso-)eicosanoids. *Life Sci* 2003;74(47-53).

29. Kandela P. Nargile smoking keeps Arabs in Wonderland. *Lancet* 2000;356(9236):1175.

30. Asfar T, Ward KD, Eissenberg T, et al. Comparison of patterns of use, beliefs, and attitudes related to waterpipe between beginning and established smokers. *Bmc Public Health* 2005;5:19.

31. Castrucci BC, Gerlach KK, Kaufman NJ, et al. The association among adolescents' tobacco use, their beliefs and attitudes, and friends' and parents' opinions of smoking. *Maternal and child health journal* 2002;63(3):159-67.

32. Forrester K, Biglan A, Severson HH, et al. Predictors of smoking onset over two years. . *Nicotine & Tobacco Research* 2007;9:1259-67.

33. Tiffany ST. Modern science and tobacco research. *Health Psychology* 2008;27(3 suppl):S187-S8.

34. Al-Yousaf MA, Karim A. Prevalence of smoking among high school students. *Saudi Medical Journal* 2001;22(10):872-4.

35. Felimban FM, Jarallah JS. Smoking habits of secondary school boys in Riyadh, Saudi Arabia. *Saudi Medical Journal* 1994;15(6):438-42.

36. Hasim TJ. Smoking habits of students in college of applied medical science, Saudi Arabia. *Saudi Medical Journal* 2000;21(1):76-80.

37. Uyar M, Filiz A, Bayram N, et al. A randomized trial of smoking cessation. Medication versus motivation. *Saudi Medical Journal* 2007;28(6):922-6.

38. Panday S, Reddy SP, Ruiter RA, et al. Determinants of smoking among adolescents in the Southern Cape-Karoo region, South Africa. *Health Promotion International* 2007;22(3):207-17.

39. Jarallah JS, Bamgboye EA, Al-Ansary LA, et al. Predictors of smoking among male junior secondary schools students in Riyadh, Saudi Arabia. *Tobacco Control* 1996;5(1):26-9.

40. Albert DA, Severson HH, Andrews JA. Tobacco use by adolescents: The role of the oral health professional in evidencebased cessation programs. *Pediatric Dentistry* 2006;28:177-87.

41. Park HK, Al Agili DE, Bartolucci A. Factors affecting tobacco use among middle school students in Saudi Arabia. *Maternal and child health journal* 2012;16(9):1828-36.

42. Van Zundert RM, Engels RC, Van den Eijnden RJ. Adolescent smoking continuation: Reduction and progression in smoking after experimentation and recent onset. *Journal of behavioral medicine* 2006;29(5):435-47.

43. Chassin L, Presson CC, Sherman SJ, et al. Four pathways to young adult smoking status: adolescent social-psychological antecedents in a Midwestern community sample. *Health Psychology* 1991;10:409-18.

44. Jafarabadi MA, Allahverdipour H, Bashirian S, et al. Modeling the Underlying Predicting Factors of Tobacco Smoking among Adolescents. *Iranian Journal of Public Health* 2012;41(5):46-57.

45. Botvin GJ, Batson HW, Witts-Vitale S, et al. A psychosocial approach to smoking prevention for urban black youth. *Public Health Rep* 1989;104:573-82.

46. Murray DM, Pirie P, Luepker RV, et al. Four- and five-year follow-up results from four seventh grade smoking prevention strategies. *Journal of behavioral medicine* 1988;12(2):207-18.

47. Milton B, Cook PA, Dugdill L, et al. Why do primary school children smoke? A longitudinal analysis of predictors of smoking uptake during pre-adolescence. *Public Health* 2004;118:247-55.

48. Biglan A, Duncan TE, Ary DV, et al. Peer and parental influences on adolescent tobacco use. *Journal of behavioral medicine* 1995;18(315-330).

49. Flay BR, Hu FB, Siddiqui O, et al. Differential influences of parental smoking and friends' smoking on adolescent initiation and escalation of smoking. *J Health Soc Behav* 1994;35(248-265).

50. Taylor JE, Conard MW, O'Byrne KK, et al. Saturation of tobacco smoking models and risk of alcohol and tobacco use among adolescents. *J Adolesc Health* 2004;35:190-6.

51. van den Bree MB, Whitmer MD, Pickworth WB. Predictors of smoking development in a population-bases ample of adolescents: a prospective study. *J Adolesc Health* 2004;35(172-181).

52. Tilson EC, McBride CM, Lipkus IM, et al. Testing the interaction between parent-child relationship factors and parent smoking to predict youth smoking. *J Adolesc Health* 2004;35(182-189).

53. Ellickson PL, Orlando M, Tucker JS, et al. From adolescence to young adulthood: racial/ ethnic disparities in smoking. *Am J Public Health* 2004;94:293-9.

54. Brook JS, Pahl T, Balka EB, et al. Smoking among New Yorican adolescents: time 1 predictors fo time 2 tobacco use. *J Genet Psychol* 2004;165:324-40.

55. Chassin L, Presson CC, Sherman SJ, et al. Predicting the onset of cigarette smoking in adolescents: a longitudinal study *Journal of Applied Social Psychology* 1984;14(3):224-43.

56. Barman SK, Pulkkinen L, Kaprio J, et al. Inattentiveness, parental smoking and adolescent smoking initiation. *Addiction (Abingdon, England)* 2004;99:1049-61.

57. Jarvelaid M. Adolescent tobacco smoking and associated psychosocial health risk factors. *Scand J Prim Health Care* 2004;22:50-3.

58. La Greca AM, Fisher EB, Jr., Walsh RA, et al. Adolescent smoking

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Smoking and normative influence among Egyptian youth: a review of the literature

Theory, measurement, and methods in the study of family influences on adolescent smoking

Tobacco use among Romanian youth

Youth tobacco use: a global perspective for child health care clinicians. *Pediatr Ann* 1992;21(4):241-4, 7-8.

59. Fritz DJ, Wider LC, Hardin SB, et al. Program strategies for adolescent smoking cessation. *Journal of School Nursing* 2008;24(1):21-17.

60. Al-Faris EA. Smoking habits of secondary school boys in rural Riyadh. . *Public Health* 1995;109(1):47-55.

61. Rowlands DF, Shipster PJ. Cigarette smoking amongst Saudi schoolboys. *Saudi Medical Journal* 1987;8(6):613-8.

62. Al-Damegh SA, Saleh MA, Al-Alfi MA, et al. Cigarette smoking behavior among male secondary school students in the Central region of Saudi Arabia. *Saudi Medical Journal* 2004;25(2):215-9.

63. Islam S, Johnson CA. Correlates of smoking behavior among muslim arab-american adolescents. *Ethnicity and Health* 2003;8(4):319-37.

64. Knishkowy B, Amitai Y. Water-pipe (Narghile) Smoking: An Emerging Health Risk Behavior. *Pediatrics* 2005;116(1):e113-e9.

65. Christophi CA, Savvides ECG, Warren CW, et al. Main determinants of cigarette smoking in youth based on the 2006 Cyprus GYTS *Preventive medicine* 2009;48:232-6.

66. Leatherdale ST, McDonald PW, Cameron R, et al. A multi-level analysis examining how smoking friends, parents, and older students in the school environment are risk factors for susceptibility to smoking among non-smoking elementary school youth. *Prevention science : the official journal of the Society for Prevention Research* 2006;7(4):397-402.

67. Otten R, Engels RC, van de Ven MO, et al. Parental smoking and adolescent smoking stages: the role of parents' current and former smoking, and family structure. *Journal of behavioral medicine* 2007;30(2):143-54.

68. Bandura A. *Social Learning Theory.* . Englewood Cliffs, NJ: Prentice Hall; 1977.

69. A. B. *Social foundations of thought and action: A social congitive theory.* Upper Saddle River, NJ: Prentice Hall 1986.

70. Bailey SL, Ennett ST, Ringwalt CL. Potential mediators, moderators, or independent effects in relationship between parents' former and current cigarette use and their children's cigarette use. *Addict Behav* 1993;18(6):601-21.

71. Bauman KE, Fisher LA, Koch GG. External variables, subjective expected utility, and adolescent behavior with alcohol and cigarettes. *J Appl Soc Psychol* 1989;19(10):789-804.

72. Chassin L, Presson CC, Todd M, et al. Maternal socialization of adolescent smoking: The intergenerational transmission of parenting and smoking. *Dev Psychol* 1998;34(6):1189-201.

73. Peterson AV, Leroux BG, Bricker JB, et al. Nine-year prediction of adolescent smoking by number of smoking parents. *Addict Behav* 2006;31(5):788-801.

74. Blanton H, Gibbons FX, Gerrard M, et al. Role of family and peers in the development of prototypes associated with substance use. *J Fam Psychol* 1997;11(3):271-88.

75. Leventhal H, Baker T, Brandon T, et al. *Intervening and preventing cigarette smoking*. New York: John Wiley & Sons.; 1989.

76. Fergusson DM, Horwood LJ. Transitions to cigarette smoking during adolescense *Addict Behav* 1995;20(5):627-42.

77. Turner L, Mermelstein R, Flay B. Individual and contextual influences on adolescent smoking. *Annals of the New York Academy of Sciences* 2004;1021:175-97.

78. Sargent JD, Dalton M, Beach M, et al. Effect of cigarette promotions on smoking uptake among adolescents. *Preventive medicine* 2000;30(4):320-7.

79. Al Moamary MS, Al Ghobain MO, Shehri SN, et al. Predicting tobacco use among high school students by using the global youth tobacco survey in Riyadh, Saudi Arabia. *Annals of Thoracic Medicine* 2012;7(3):122-9.

80. CDC. Women and Smoking: A report of the Surgeon General. Executive Summary. . *MMWR Recommendations and Reports* 2002;51(RR-12):1-13.

81. Giovino GA. Epidemiology of tobacco use among US adolescents. *Nicotine Tobacco Reserach* 1999;1(Suppl 1):S31-40.

82. National Institute on Drug Abuse, National Institutes of Health. Monitoring the Future. 2012. (http://www.monitoringthefuture.org/). (Accessed).

83. Akl EA, Gaddam S, Gunukula SK, et al. The effects of waterpipe tobacco smoking on health outcomes: a systematic review. *International Journal of Epidemiology* 2010;39:834-57.

84. Note. WSGoTPRTA. Waterpipe Tobacco Smoking: Health Effects, Research Needs and Recommended Actions by Regulators. WHO: Geneva, 2005.

85. Maziak W, Ward KD, Afifi Soweid RA, et al. Standardizing questionnaire items for the assessment of waterpipe tobacco use in epidemiological studies. *Public Health* 2005;119(5):400-4.

86. Thomas R, Perera R. School-based programmes for preventing smoking. *Cochrane database of systematic reviews (Online)* 2006(3):CD001293.

87. Thomas RE, Perera R. School-based programmes for preventing smoking (Review). 2008.

TABLES

Table 1. Global Youth Tobacco Survey 2010 Demographics

Table 1. GYTS Saudi Arabia 2010 Demographics			
Variable	2010 Frequency	Weighted Percent	Standard Error Percent
Sex	(n=2,410)		
Male	1167	48.22	2.95
Female	1243	51.78	
Age	(n=2,517)		
≤ 11 years old	61	2.32	0.39
12 years old	207	8.30	1.24
13 years old	558	22.53	1.43
14 years old	616	24.28	1.53
15 years old	623	24.31	1.6
16 years old	319	12.95	1.42
≥ 17 years old	133	5.31	0.9

Table 2. Adolescents that experimented with tobacco and indicated being current smokers in 2007 and 2010

Table 2. Adolescents that experimented with tobacco and indicated being current smokers in 2007 and 2010				
2007 Characteristics	Frequency	Weighted Percent	Standard Error Percent	Current to Ever Smoker Ratio
Proportion of Current Smokers n= 3,829				
Cigarette (n=3,651)	303	8.57	0.76	28.40%
Waterpipe (n=3,747)	314	8.54	0.67	27.10%
Both(n=3,580)	101	2.91	0.33	18.50%
Any (n=3,580)	458	13.05	1.02	29.20%
Proportion of Ever Smokers (Experimentation)				
Cigarette	1066	29.68	1.41	
Waterpipe	1157	32.03	1.78	
Both	546	15.76	1.05	
Any	1567	44.77	1.79	
2010 Characteristics	Frequency	Weighted Percent	Standard Error Percent	Current to Ever Smoker Ratio
Proportion of Current Smokers n= 2,564				
Cigarette (n=2,456)	261	10.57	1.4	41.70%
Waterpipe (n=2,542)	282	10.97	1.37	60.60%
Both (n=2,446)	144	5.79	0.91	47.40%
Any (n=2,446)	367	14.97	1.56	48.90%
Proportion of Ever Smokers (Experimentation)				
Cigarette	626	25.05	1,86	
Waterpipe	465	18.19	1.74	
Both	304	12.26	1.48	
Any	757	30.49	2.09	

Table 3. Factors associated with current cigarette smoking among adolescents in Saudi Arabia in 2010

Table 3. Factors associated with current cigarette smoking among adolescents in Saudi Arabia in 2010

Factors	Odds Ratio	95% Confidence Interval	P-Value
Age Group			
11 years old or younger	referent		
12 years old	0.13	0.045, 0.390	<.0001
13 years old	0.24	0.107, 0.539	<.0001
14 years old	0.52	0.246, 1.115	0.6033
15 years old	0.67	0.316, 1.411	0.2569
16 years old	0.83	0.384, 1.799	0.0216
17 years old or older	2.03	0.900, 4.563	<.0001
Sex	0.37	0.275, 0.487	<.0001
Age at experimentation with cigarettes			
7 years old or younger	referent		
I have never smoked cigarettes	0.00	<0.001, 0.008	<.0001
8 or 9 years old	0.67	0.277, 1.608	0.7267
10 or 11 years old	1.49	0.761, 2.898	<.0001
12 or 13 years old	1.58	0.843, 2.951	<.0001
14 or 15 years old	1.43	0.768, 2.660	<.0001
16 years old or older	4.95	1.681, 14.582	<.0001
Parent Cigarette Smoking Status			
Neither parents smoke waterpipe	referent		
Both	5.32	2.899, 9.776	0.0029
Father only	2.71	1.984, 3.714	0.4804
Mother only	1.86	0.851, 4.051	0.4269
I don't know	3.04	1.340, 6.879	0.5008
Household member Cigarette Smokers (aside from parents)	0.22	0.165, 0.287	<.0001
Closest friends as waterpipe smokers			
Some closest friends	referent		
None of them vs. some of them	13.19	9.127, 19.068	0.0002
Most of them vs. some of them	17.33	10.656, 28.182	<.0001
All of them vs. some of them	22.58	12.051, 42.314	<.0001
Cigarette smoking makes boys look more or less attractive			
No difference from non-smokers	referent		

More attractive	1.02	0.737, 1.398	<.0001
Less attractive	0.30	0.217, 0.425	<.0001
Cigarette smoking makes girls look more or less attractive			
No difference from non-smokers			
More attractive	0.86	0.594, 1.231	0.1294
Less attractive	0.45	0.328, 0.604	<.0001
Weight gain or loss due to cigarette smoking			
No difference from non-smokers	referent		
Gain weight	0.54	0.337, 0.856	0.0854
Lose weight	0.63	0.478, 0.838	0.3561
Cigarette smoking harmful to health			
Definitely yes	referent		
Definitely not	3.55	2.086, 6.052	0.3107
Probably not	3.00	1.836, 4.885	0.8384
Probably yes	6.46	4.559, 9.160	<.0001
Cigarette smoking from others is harmful to you			
Definitely yes	referent		
Definitely not	2.10	1.432, 3.070	0.1704
Probably not	3.74	2.432, 5.747	<.0001
Probably yes	1.12	0.786, 1.588	0.0013
Owns paraphernalia with cigarette logo	0.38	0.278, 0.509	<.0001
Number of anti-smoking media messages seen or heard within the past month			
None	referent		
A lot	1.43	1.015, 2.002	0.102
A few	1.29	0.902, 1.853	0.5906
Taught about dangers of smoking in class during the school year			
No	referent		
Yes	1.42	1.050, 1.908	0.0638
Not sure	1.19	0.809, 1.761	0.9851
Ever offered a cigarette by a cigarette representative	0.35	0.241, 0.498	<.0001

† Data analyzed using bivariate logistic regression.

Table 4. Factors associated with current waterpipe smoking among adolescents in Saudi Arabia in 2010

Table 4. Factors associated with current waterpipe smoking among adolescents in Saudi Arabia in 2010			
Factors	**Odds Ratio**	**95% Confidence Interval**	**P-Value**
Age Group			
11 years old or younger	referent		
12 years old	0.17	0.072, 0.398	0.0004
13 years old	0.20	0.102, 0.410	<.0001
14 years old	0.30	0.156, 0.585	0.0068
15 years old	0.55	0.291, 1.046	0.1097
16 years old	0.47	0.238, 0.940	0.7499
17 years old or older	1.35	0.662, 2.765	<.0001
Sex	0.42	0.322, 0.554	<.0001
Age at experimentation with waterpipe			
7 years old or younger	referent		
I have never smoked waterpipe	0.01	0.007, 0.025	<.0001
8 or 9 years old	0.85	0.388, 1.846	0.7602
10 or 11 years old	2.42	1.279, 4.578	<.0001
12 or 13 years old	1.04	0.500, 2.168	0.6375
14 or 15 years old	2.65	1.312, 5.341	<.0001
16 years old or older	7.56	1.970, 28.991	0.0001
Parent Waterpipe Status			
Neither parents smoke waterpipe	referent		
Both	16.74	10.910, 25.693	<.0001
Father only	2.67	1.796, 3.963	0.0464
Mother only	14.66	6.557, 32.772	<.0001
I don't know	1.39	0.609, 3.150	0.0025
Household member Waterpipe Smokers (aside from parents)	0.09	0.065, 0.112	<.0001
Closest friends as waterpipe smokers			
Some closest friends	referent		
None of them vs. some of them	0.08	0.055, 0.111	<.0001
Most of them vs. some of them	4.12	2.615, 6.477	<.0001
All of them vs. some of them	3.71	2.228, 6.186	<.0001
Waterpipe smoking makes boys look more or less attractive			
No difference from non-smokers	referent		

More attractive	0.90	0.658, 1.236	<.0001
Less attractive	0.25	0.186, 0.348	<.0001
Waterpipe smoking makes girls look more or less attractive			
No difference from non-smokers	referent		
More attractive	1.01	0.720, 1.423	0.0016
Less attractive	0.40	0.294, 0.541	<.0001
Weight gain or loss due to waterpipe smoking			
No difference from non-smokers	referent		
Gain weight	0.55	0.377, 0.812	0.1999
Lose weight	0.50	0.374, 0.670	0.0116
Waterpipe smoking harmful to health			
Definitely yes	referent		
Definitely not	2.55	1.549, 4.208	0.8096
Probably not	5.62	3.876, 8.159	<.0001
Probably yes	3.56	2.485, 5.087	0.047
Waterpipe smoking from others is harmful to you			
Definitely yes	referent		
Definitely not	2.77	1.836, 4.189	0.4551
Probably not	3.86	2.578, 5.782	0.0021
Probably yes	3.57	2.634, 4.842	0.0006
Number of anti-waterpipe media messages seen or heard within the past month			
None	referent		
A lot	0.93	0.673, 1.272	0.4171
A few	0.67	0.470, 0.942	0.027
Taught about dangers of smoking in class during the school year			
No	referent		
Yes	0.93	0.701, 1.234	0.8972
Not sure	0.90	0.623, 1.290	0.6685
† Data analyzed using bivariate logistic regression.			

Table 5. Factors associated with current any smoking among adolescents in Saudi Arabia in 2010

Table 5. Factors associated with current any smoking among adolescents in Saudi Arabia in 2010			
Factors	**Odds Ratio**	**95% Confidence Interval**	**P-Value**
Age Group			
11 years old or younger	referent		
12 years old	0.21	0.083, 0.502	<.0001
13 years old	0.27	0.129, 0.566	<.0001
14 years old	0.51	0.254, 1.038	0.0701
15 years old	1.05	0.529, 2.088	<.0001
16 years old	0.83	0.404, 1.704	0.1191
17 years old or older	2.12	0.989, 4.539	<.0001
Gender	0.37	0.293, 0.477	<.0001
Age at experimentation with waterpipe			
7 years old or younger	referent		
I have never smoked waterpipe	0.06	0.033, 0.106	<.0001
8 or 9 years old	1.29	0.562, 2.951	0.8264
10 or 11 years old	2.87	1.449, 5.696	0.0012
12 or 13 years old	1.16	0.532, 2.530	0.5378
14 or 15 years old	3.16	1.477, 6.767	0.0019
16 years old or older	11.59	2.437, 55.151	0.001
Parent Waterpipe Status			
Neither parents smoke waterpipe	referent		
Both	12.96	8.266, 20.316	<.0001
Father only	2.73	1.918, 3.890	0.0195
Mother only	14.74	5.981, 36.310	0.0007
I don't know	2.31	1.260, 4.244	0.0277
Parent Cigarette Smoking Status			
Neither parents smoke waterpipe	referent		
Both	5.07	2.839, 9.061	0.9404
Father only	2.40	1.790, 3.206	<.0001
Mother only	74.21	30.772, 178.963	<.0001
I don't know	3.38	1.609, 7.101	0.2223
Household member Waerpipe Smokers (aside from parents)	0.10	0.075, 0.126	<.0001
Closest friends as waterpipe smokers			
Some closest friends	referent		

None of them vs. some of them	0.09	0.068, 0.124	<.0001
Most of them vs. some of them	2.81	1.754, 4.497	<.0001
All of them vs. some of them	3.15	1.841, 5.394	<.0001
Closest friends as cigarette smokers			
Some closest friends	referent		
None of them vs. some of them	0.07	0.054, 0.098	<.0001
Most of them vs. some of them	1.00	0.674, 1.493	0.0004
All of them vs. some of them	1.46	0.837, 2.558	<.0001
Age at experimentation with cigarettes			
7 years old or younger	referent		
I have never smoked cigarettes	0.03	0.019, 0.060	<.0001
8 or 9 years old	0.48	0.200, 1.141	0.0746
10 or 11 years old	1.11	0.576, 2.155	0.1897
12 or 13 years old	1.32	0.714, 2.453	0.0161
14 or 15 years old	3.16	1.673, 5.955	<.0001
16 years old or older	4.25	1.372, 13.172	0.0003
Household member Cigarette Smokers (aside from parents)	0.17	0.136, 0.222	<.0001
Cigarette smoking makes boys look more or less attractive			
No difference from non-smokers	referent		
More attractive	0.66	0.494, 0.875	0.03
Less attractive	0.24	0.183, 0.321	<.0001
Cigarette smoking makes girls look more or less attractive			
No difference from non-smokers			
More attractive	0.68	0.499, 0.934	0.1211
Less attractive	0.30	0.229, 0.390	<.0001
Waterpipe smoking makes boys look more or less attractive			
No difference from non-smokers	referent		
More attractive	0.73	0.544, 0.978	0.005
Less attractive	0.25	0.188, 0.324	<.0001
Waterpipe smoking makes girls look more or less attractive			
No difference from non-smokers	referent		
More attractive	0.72	0.521, 0.986	0.1574
Less attractive	0.34	0.262, 0.449	<.0001
Weight gain or loss due to waterpipe smoking			

No difference from non-smokers	referent		
Gain weight	0.67	0.480, 0.920	0.8399
Lose weight	0.47	0.362, 0.615	<.0001
Weight gain or loss due to cigarette smoking			
No difference from non-smokers	referent		
Gain weight	0.63	0.422, 0.940	0.0334
Lose weight	0.91	0.712, 1.150	0.3192
Waterpipe smoking harmful to health			
Definitely yes	referent		
Definitely not	2.05	1.260, 3.346	0.217
Probably not	4.90	3.391, 7.073	<.0001
Probably yes	4.48	3.243, 6.179	<.0001
Cigarette smoking harmful to health			
Definitely yes	referent		
Definitely not	2.75	1.672, 4.508	0.625
Probably not	2.68	1.724, 4.177	0.684
Probably yes	5.27	3.806, 7.300	<.0001
Waterpipe smoking from others is harmful to you			
Definitely yes	referent		
Definitely not	2.50	1.721, 3.643	0.7296
Probably not	4.53	3.175, 6.458	<.0001
Probably yes	2.88	2.188, 3.777	0.06
Cigarette smoking from others is harmful to you			
Definitely yes	referent		
Definitely not	2.60	1.859, 3.631	0.0592
Probably not	3.46	2.303, 5.206	0.0005
Probably yes	1.96	1.485, 2.583	0.6686
Owns paraphernalia with cigarette logo	0.46	0.349, 0.605	<.0001
Number of anti-smoking media messages seen or heard within the past month			
None	referent		
A lot	0.77	0.589, 1.010	0.5936
A few	0.68	0.504, 0.907	0.0455
Number of anti-waterpipe media messages seen or heard within the past month			
None	referent		

A lot	0.86	0.653, 1.143	0.5248
A few	0.63	0.464, 0.851	0.0069
Taught about dangers of smoking in class during the school year			
No	referent		
Yes	1.01	0.786, 1.301	0.737
Not sure	0.94	0.677, 1.308	0.6686
Ever offered a cigarette by a cigarette representative	0.38	0.272, 0.528	<.0001

† Data analyzed using bivariate logistic regression.

Table 6. Factors associated with current cigarette smoking among adolescents in Saudi Arabia in 2010: A multivariate analysis

Table 6. Factors associated with current cigarette smoking among adolescents in Saudi Arabia in 2010: A multivariate analysis			
Factors	**Odds Ratio**	**95% Confidence Interval**	**P-Value**
Age Group			
11 years old or younger	referent		
12 years old	0.13	0.010, 1.686	0.0994
13 years old	0.28	0.031, 2.490	0.3732
14 years old	0.39	0.043, 3.612	0.8405
15 years old	0.16	0.018, 1.409	0.0042
16 years old	0.45	0.049, 4.125	0.5433
17 years old or older	0.95	0.087, 10.305	0.0572
Sex	0.97	0.555, 1.708	0.9252
Age at experimentation with cigarettes			
7 years old or younger	referent		
I have never smoked cigarettes	0.00	<0.001, 0.012	<.0001
8 or 9 years old	0.81	0.241, 2.706	0.4768
10 or 11 years old	0.95	0.420, 2.130	0.0566
12 or 13 years old	1.60	0.699, 3.677	<.0001
14 or 15 years old	3.40	1.348, 8.596	<.0001
16 years old or older	1.92	0.434, 8.528	0.0432
Parent Cigarette Smoking Status			
Neither parents smoke waterpipe	referent		
Both	11.46	3.974, 33.045	<.0001
Father only	1.53	0.867, 2.701	0.9846
Mother only	0.21	0.069, 0.634	<.0001
I don't know	2.23	0.506, 9.825	0.5319
Closest friends as cigarette smokers			
Some closest friends	referent		
None of them vs. some of them	4.13	2.336, 7.312	0.8474
Most of them vs. some of them	8.06	3.307, 19.651	0.0306
All of them vs. some of them	7.36	2.207, 24.568	0.1531
Cigarette smoking from others is harmful to you			
Definitely yes	referent		

Definitely not	2.52	1.100, 5.763	0.1953
Probably not	3.63	1.436, 9.175	0.0229
Probably yes	0.87	0.471, 1.614	0.0059
Number of anti-smoking media messages seen or heard within the past month			
None	referent		
A lot	3.53	1.854, 6.725	0.0008
A few	2.05	1.097, 3.841	0.7349

† Data analyzed using multivariate logistic regression.

Table 7. Factors associated with current waterpipe smoking among adolescents in Saudi Arabia in 2010: A multivariate analysis

Table 7. Factors associated with current waterpipe smoking among adolescents in Saudi Arabia in 2010: A multivariate analysis			
Factors	**Odds Ratio**	**95% Confidence Interval**	**P-Value**
Age Group			
11 years old or younger	referent		
12 years old	0.37	0.071, 1.927	0.6599
13 years old	0.39	0.109, 1.379	0.5079
14 years old	0.37	0.107, 1.265	0.3606
15 years old	0.26	0.075, 0.937	0.0499
16 years old	0.44	0.115, 1.717	0.8879
17 years old or older	0.78	0.201, 3.034	0.1625
Sex	0.94	0.519, 1.691	0.8278
Age at experimentation with waterpipe			
7 years old or younger	referent		
I have never smoked waterpipe	0.01	0.004, 0.025	<.0001
8 or 9 years old	1.09	0.369, 3.228	0.1516
10 or 11 years old	1.01	0.409, 2.489	0.0942
12 or 13 years old	0.67	0.225, 1.969	0.8766
14 or 15 years old	1.83	0.703, 4.750	0.0006
16 years old or older	2.84	0.444, 18.155	0.0492
Parent Waterpipe Status			
Neither parents smoke waterpipe	referent		
Both	4.41	1.868, 10.420	0.0018
Father only	0.69	0.343, 1.382	0.0437
Mother only	3.60	0.540, 23.968	0.2148
I don't know	0.44	0.152, 1.255	0.0124
Closest friends as waterpipe smokers			
Some closest friends	referent		
None of them vs. some of them	0.24	0.130, 0.430	<.0001
Most of them vs. some of them	4.33	1.489, 12.590	0.0069
All of them vs. some of them	5.17	2.420, 11.059	<.0001
Waterpipe smoking makes boys look more or less attractive			
No difference from non-smokers	referent		
More attractive	0.45	0.238, 0.858	0.4239
Less attractive	0.32	0.164, 0.628	0.0125
Weight gain or loss due to waterpipe smoking			

No difference from non-smokers	referent		
Gain weight	2.68	1.265, 5.662	0.026
Lose weight	1.51	0.804, 2.818	0.7813
† Data analyzed using multivariate logistic regression.			

Table 8. Factors associated with current any smoking among adolescents in Saudi Arabia in 2010: A multivariate analysis

Table 8. Factors associated with current any smoking among adolescents in Saudi Arabia in 2010: A multivariate analysis			
Factors	**Odds Ratio**	**95% Confidence Interval**	**P-Value**
Age Group			
11 years old or younger	referent		
12 years old	0.30	0.055, 1.603	0.1787
13 years old	0.60	0.188, 1.915	0.6313
14 years old	0.75	0.264, 2.105	0.8334
15 years old	0.58	0.209, 1.613	0.4666
16 years old	0.77	0.257, 2.318	0.7664
17 years old or older	1.45	0.398, 5.303	0.0958
Gender	0.63	0.376, 1.064	0.0842
Age at experimentation with waterpipe			
7 years old or younger	referent		
I have never smoked waterpipe	0.06	0.014, 0.270	<.0001
8 or 9 years old	0.86	0.115, 6.390	0.2178
10 or 11 years old	0.43	0.083, 2.181	0.8319
12 or 13 years old	0.21	0.035, 1.242	0.2403
14 or 15 years old	0.25	0.035, 1.705	0.4494
16 years old or older	1.17	0.070, 19.478	0.3043
Household member Waterpipe Smokers (aside from parents)	0.37	0.204, 0.677	0.0012
Closest friends as waterpipe smokers			
Some closest friends	referent		
None of them vs. some of them	0.35	0.204, 0.612	<.0001
Most of them vs. some of them	6.26	1.674, 23.404	0.0028
All of them vs. some of them	2.68	1.201, 5.991	0.0628
Age at experimentation with cigarettes			
7 years old or younger	referent		
I have never smoked cigarettes	0.03	0.012, 0.086	<.0001
8 or 9 years old	0.38	0.083, 1.739	0.5955
10 or 11 years old	0.51	0.165, 1.588	0.9802
12 or 13 years old	1.23	0.425, 3.551	0.0085
14 or 15 years old	1.72	0.545, 5.449	0.002
16 years old or older	0.74	0.084, 6.546	0.6808

Household member Cigarette Smokers (aside from parents)	0.56	0.323, 0.962	0.0357
Waterpipe smoking makes boys look more or less attractive			
No difference from non-smokers	referent		
More attractive	0.37	0.182, 0.755	0.126
Less attractive	0.37	0.210, 0.643	0.0486
Owns paraphernalia with cigarette logo	0.48	0.253, 0.907	0.0238
Number of anti-smoking media messages seen or heard within the past month			
None	referent		
A lot	1.68	0.886, 3.200	0.0182
A few	0.81	0.437, 1.488	0.0595
† Data analyzed using multivariate forward stepwise logistic regression.			