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ABSTRACT

MICHAEL BRANDON TALLEY
Examining the Impact of Development, Tobacco Taxation, and Tobacco Prices on Global Adult Male Smoking Prevalence
(Under the direction of Michael Eriksen, Faculty Member)

Tobacco use is the leading cause of preventable death in the world. Nevertheless, the global tobacco epidemic continues to spread throughout much of the world, particularly in developing countries. Previous research suggests that smoking status may be associated with a variety of social, economic, and cultural factors. This study examines the impact of development, tobacco taxation, and tobacco prices on estimates of global adult male smoking prevalence. Data for this study was obtained from the United Nations' *Human Development Indices: A Statistical Update, 2008* and the World Health Organization's *Report on the Global Tobacco Epidemic, 2009: Implementing Smoke-free Environments*. Global adult male smoking prevalence was significantly associated with development, tobacco taxation, and tobacco prices. More rigorous examination of the link between male smoking prevalence and development, tobacco taxation, and tobacco prices is needed to strengthen tobacco control policies and interventions in developing and developed countries.

INDEX WORDS: adult male smoking, development, tobacco taxation, tobacco prices

EXAMINING THE IMPACT OF DEVELOPMENT, TOBACCO TAXATION, AND TOBACCO PRICES ON GLOBAL ADULT MALE SMOKING PREVALENCE

by

MICHAEL BRANDON TALLEY

B.S., GEORGIA INSTITUTE OF TECHNOLOGY

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MASTER OF PUBLIC HEALTH

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2010

EXAMINING THE IMPACT OF DEVELOPMENT, TOBACCO TAXATION, AND

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS iii
LIST OF TABLES viii
LIST OF FIGURES ix
INTRODUCTION i
1.1 Background i
1.2 Purpose of Study 3
1.3 Research Questions 5
REVIEW OF THE LITERATURE 8
2.1 Characteristics of Global Adult Tobacco Smoking 8
2.2 Global Adult Male Tobacco Smoking Prevalence and Characteristics 11
2.3 Adult Literacy Rates and Smoking Tobacco 17
2.4 Educational Attainment and Smoking Tobacco 19
2.5 The GDP and Smoking Tobacco 21
2.6 Life Expectancy and Smoking Tobacco 22
2.7 Tobacco Taxation, Tobacco Prices, and Smoking Prevalence 24
2.8 Summary 27
METHODS AND PROCEDURES 28
3.1 Data Source 28
3.2 Study Population 33
3.3 Statistical Analyses 34
RESULTS 35
4.1 Descriptive Statistics for the HDI Values, Adult Male Tobacco Smoking Prevalence, and Tobacco Taxation 35
4.2 The HDI Value, Tobacco Prices, Tobacco Taxation, and Adult Male Tobacco Smoking Prevalence 41
DISCUSSION AND CONCLUSION 51
5.1 Discussion 51
5.2 Study Limitations 55
5.3 Recommendations 58
5.4 Conclusions 60
REFERENCES 61

LIST OF TABLES

Table 1 Descriptive statistics, HDI composite variables, global adult male smoking prevalence, tobacco taxation, and tobacco prices (n=98) 36

Table 2 Descriptive statistics comparing excluded and included countries on HDI composite variables and global adult male smoking prevalence 37

Table 3 Pearson correlation coefficients for development factors, prevalence, tobacco pricing, and tobacco taxation (n=98) 39

Table 4 Spearman correlation coefficients for development factors, prevalence, tobacco pricing, and tobacco taxation (n=98) 40

Table 5 Model summary, males currently smoking any tobacco product, HDI, tobacco prices, and tobacco taxation (n=98) 43

Table 6 Regression analysis, males currently smoking any tobacco product, HDI, tobacco prices, and tobacco taxation (n=98) 44

Table 7 Model summary, males smoking any tobacco product daily, HDI, tobacco prices, and tobacco taxation (n=98) 45

Table 8 Regression analysis, males smoking any tobacco product daily, HDI, tobacco prices, and tobacco taxation (n=98) 46

Table 9 Model summary, males currently smoking cigarettes, HDI, tobacco prices, and tobacco taxation (n=98) 47

Table 10 Regression analysis, males currently smoking cigarettes, HDI, tobacco prices, and tobacco taxation (n=98) 48

Table 11 Model summary, males smoking cigarettes daily, HDI, tobacco prices, and tobacco taxation (n=98) 49

Table 12 Regression analysis, males smoking cigarettes daily, HDI, tobacco prices, and tobacco taxation (n=98) 50

LIST OF FIGURES

Figure 1 Thesis schematic model..... 7

Figure 2 The WHO regional map 12

Figure 3 Scatter plot for males currently smoking any tobacco product and HDI 43

Figure 4 Scatter plot for males smoking any tobacco product daily and HDI..... 45

Figure 5 Scatter plot for males currently smoking cigarettes and HDI 47

Figure 6 Scatter plot for males smoking cigarettes daily and HDI..... 49

CHAPTER I

INTRODUCTION

1.1 Background

The tobacco epidemic kills 5.4 million people a year from various tobacco-related illnesses (World Health Organization [WHO], 2008). By year 2030, if current tobacco use trends continue, 8 million people per year will die from these diseases; by year 2100, nearly a billion people could die as a result of tobacco use (WHO, 2008). To prevent these trends from becoming a public health reality, the WHO and more than three-quarters of its member states enacted the Framework Convention on Tobacco Control (FCTC). The FCTC treaty, which was the first treaty negotiated by WHO with its member states, is an evidence-based treaty that represents a comprehensive strategy for controlling tobacco use (WHO, 2003). Unlike previous drug control treaties, which focused primarily on reducing drug use, FCTC takes aim not only at reducing tobacco use but also at controlling the supply of tobacco (WHO, 2003). On February 27, 2005, with ratification by the first 40 member states, FCTC was entered into force (Framework Convention Alliance [FCA], 2010). As of November 2009, 168 out of 193 WHO member states had signed the treaty, which covered over 85 percent of the world's population (FCA, 2010).

The FCTC's demand reduction requirements are set forth in Articles 6-14 of the treaty. These articles call for the following of treaty signatories:

1. Article 6 – Establish price and tax measures to reduce the demand for tobacco;
2. Article 7 – Establish non-price measures to reduce the demand for tobacco;
3. Article 8 – Protect people from exposure to tobacco smoke;
4. Article 9 – Regulate the contents of tobacco products;
5. Article 10 – Regulate tobacco product disclosures;
6. Article 11 – Regulate packaging and labeling of tobacco products;
7. Article 12 – Educate, communicate, and train the public about the dangers of tobacco use;
8. Article 13 – Ban tobacco advertising, promotion, and sponsorship; and
9. Article 14 – Implement demand reduction measures concerning tobacco dependence and cessation (WHO, 2003).

The FCTC's supply reduction requirements are set forth in Articles 15-17 of the treaty. These articles call for the following of treaty signatories:

1. Article 15 – Prevent illicit trade in tobacco products;
2. Article 16 – Prohibit sales to and by minors; and
3. Article 17 – Provide support for economically viable alternatives (WHO, 2003).

The articles above outline signatories' legal obligations to control tobacco use. These articles also demonstrate a global consensus on the need for tobacco control and identify a strategy for reducing tobacco use. Both the legal obligation to control tobacco use and indentifying a strategy for doing so are critically important to improving the health of populations worldwide. The treaty, however, only creates the legal duty for countries to

act per the terms and conditions set forth in the treaty. The treaty does not instruct or provide guidance to countries on the practical aspects of implementing FCTC.

The practical guidance related to the implementation of FCTC is specifically addressed in a WHO policy initiative known as MPOWER. The MPOWER policy package is comprised of six FCTC-based policies that are designed to curb the tobacco epidemic and serve as a gauge for a country's compliance to the FCTC (WHO, 2008). The six MPOWER policies include the following:

- **M**ONITOR tobacco use and prevention policies;
- **P**ROTECT people from tobacco smoke;
- **O**FFER help to quit tobacco use;
- **W**ARN about the dangers of tobacco;
- **E**NFORCE bans on tobacco advertising, promotion, and sponsorship; and
- **R**AISE taxes on tobacco (WHO, 2008; WHO, 2009).

Through these six policies, MPOWER enables a country to evaluate the effectiveness of its tobacco control interventions against not only the FCTC articles but also against the status of other member states.

1.2 Purpose of Study

The FCTC and MPOWER policy package are effective resources for reducing tobacco consumption and monitoring key tobacco control polices; however, neither FCTC nor MPOWER provide all the tools necessary to appropriately contextualize a

country's tobacco epidemic. In order to more fully understand the scope of a country's tobacco epidemic, additional socio-cultural and socio-economic data are needed. The United Nations Development Programme's (UNDP) Human Development Index (HDI)[1], which focuses on attainment of wellness, length of life, an individual's access to knowledge through education, and attainment of a decent standard of living, can add much needed socio-cultural and socio-economic context to discussions regarding tobacco's role in diminishing the public's health (UNDP, 2010).

Specifically, the HDI data can be analyzed in relation to global adult male smoking prevalence in an effort to provide a more robust understanding of the nature of the tobacco epidemic in that population. Additionally, MPOWER data can be used to further that understanding by investigating the impact of tobacco control policies on prevalence in the world's adult male population. For this study, analysis will first focus on identifying relationships between countries' adult male smoking prevalence and the component variables of HDI. Then, the study will investigate the relationship between a country's adult male smoking prevalence and its HDI value. Finally, the study will look at data related to the "R" portion of the MPOWER policy package to determine the influence of tobacco prices and taxation on tobacco consumption in the global adult male population.

By linking the socio-cultural and socio-economic data of HDI with the tobacco control policy data in the "R" portion of MPOWER, this study seeks to determine if a country's adult male smoking prevalence is associated not only with the HDI but also

[1] Specifically, the HDI composite variables measure adult literacy rates, educational attainment, gross domestic product, and life expectancy (UNDP, 2010). These measures will be discussed in greater detail in Chapter III.

with tobacco pricing and rates of taxation. If an association is found to exist, then countries will have a better understanding of how development-related factors, such as illiteracy or low gross domestic product (GDP), and tobacco taxation impact the prevalence of smoking. The results from this study could furnish policy makers, public health practitioners, and countries with information that provides opportunities for improving upon interventions and influences policies that reduce the total number of male adult tobacco users within a given country.

1.3 Research Questions

Overall, the purpose of this study is to add to the existing body of literature, which associates adult male smoking prevalence with development factors and tobacco taxation policies, by answering the following questions (Figure 1):

1. Research Question 1: Individually, do the HDI component variables, price per pack, and taxation rates correlate with increased prevalence of adult male tobacco smoking in countries?
2. Research Question 2: Does a higher HDI value predict lower prevalence of adult male tobacco smoking in a given country?
3. Research Question 3: Controlling for developmental factors such as HDI and its composite factors, do cigarette price per pack or tobacco taxes predict prevalence of adult male smoking in countries?

In the next chapter, Chapter II, the literature review will discuss the background and history of the tobacco epidemic, including the current state of global adult male

tobacco smoking prevalence. In Chapter III, the study variables including the HDI, its components, measures of smoking prevalence, and taxation and pricing, will be described in detail. Then, in Chapter III, multivariate regression analysis will be discussed as the preferred method of statistical analysis for this study. Discussion of analysis will conclude with a presentation of the regression results in Chapter IV. Finally, recommendations, limitations, and conclusions that consider these results will be presented in Chapter V.

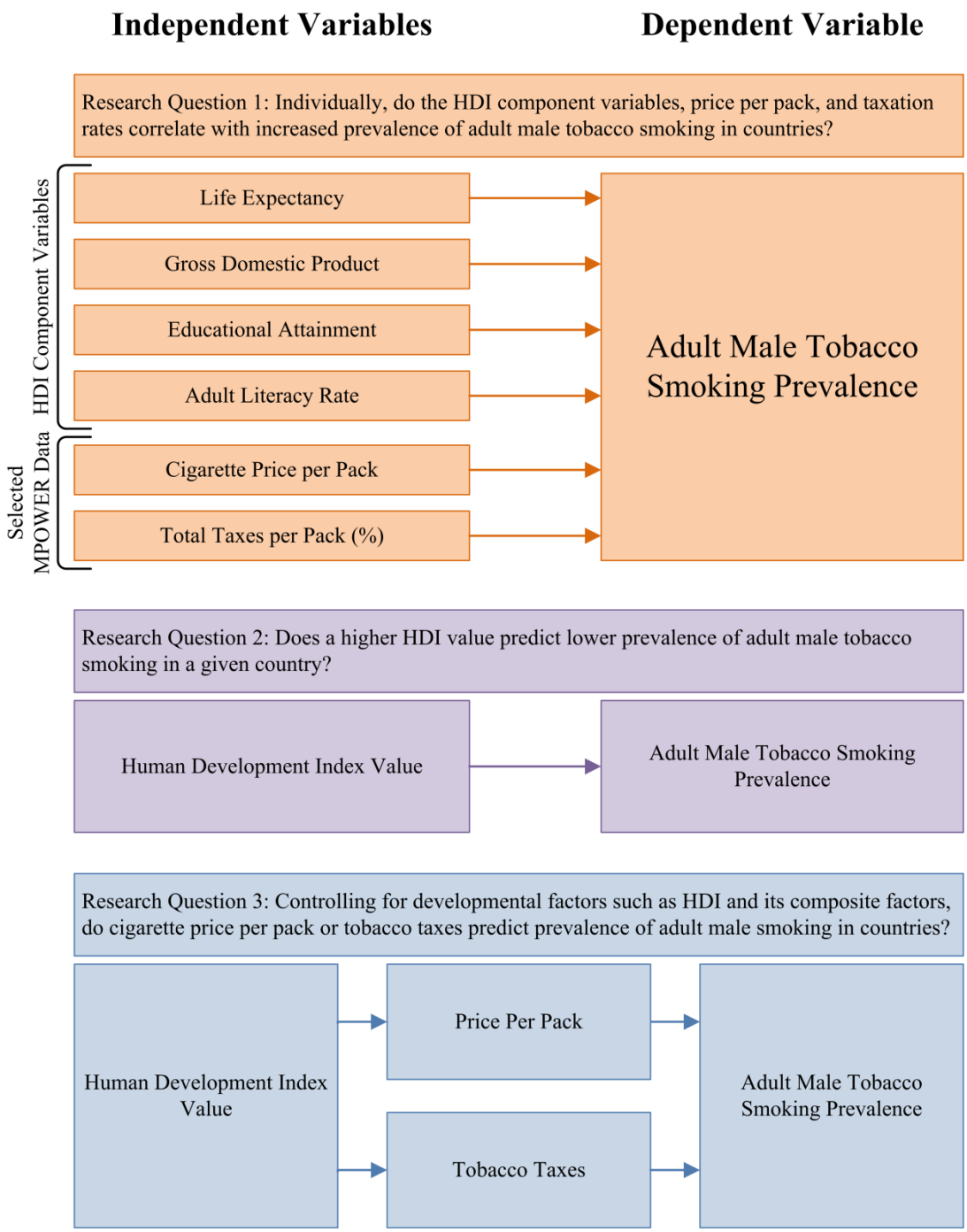


Figure 1 Thesis schematic model

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study is to determine if adult male tobacco smoking prevalence in a country is associated with the country's rank on the HDI, tobacco taxation, or pricing. To support the rationale for this study, a review of the literature was conducted and will demonstrate the current knowledge of the characteristics of global adult tobacco smoking as well as male smoking specifically, the predictive value of the HDI's composite variables for smoking tobacco, and the role of tobacco taxation and pricing in reducing tobacco consumption. Additionally, this review will consider gender differences in tobacco smoking prevalence that could impact the general usefulness of the HDI as a predictor for smoking prevalence beyond male populations.

2.1 Characteristics of Global Adult Tobacco Smoking

Throughout the world, tobacco smokers find various vehicles to deliver nicotine to their bodies. Depending on the country, a smoker might smoke "roll-your-own" cigarettes, cigars, bidis[2], kreteks[3], water pipes, sticks[4], or manufactured cigarettes

[2] Bidis consist of sun-dried tobacco wrapped in a leaf and tied with string (CDC, 2010).

[3] Clove-flavored cigarettes (CDC, 2010).

[4] Sun-cured tobacco wrapped in cigarette paper (Shafey, Eriksen, Ross, & Mackay, 2009)

(Shafey, Erisksen, Ross, & Mackay, 2009). Manufactured cigarettes not only comprise the greatest share of manufactured tobacco products but also represent over 95 percent of total tobacco sales (Shafey, Erisksen, Ross, & Mackay, 2009). The standard cigarette is the most frequently smoked tobacco product; however, the other aforementioned types of smoked tobacco are becoming increasingly popular throughout the world (WHO, 2008). Currently, approximately one quarter of the world's population smokes tobacco (Eriksen & Shafey, 2006).

In the nearly 130 years since the cigarette-rolling machine was invented (Shafey, Eriksen, Ross & Mackay, 2009), the tobacco epidemic has undergone a number of demographic shifts. Two recent and prominent shifts that occurred in tobacco smoking prevalence regard income status (low-, middle-, or high- income) and gender. Peto and colleagues examined the role of a country's income status on smoking prevalence. They concluded that in the 20th century approximately 100 million people died as a result of smoking (2009). Of these 100 million people, approximately 70 percent lived outside of low- and middle-income countries (Peto, Lopez, Boreham, & Thun, 2009). In contrast, the 21st century will see the prevalence of tobacco smoking shift from high-income countries to low- and middle-income countries. Based on current smoking trends, more than 70 percent of the one billion deaths that are attributable to smoking in the 21st century will occur outside of high-income countries, such as those in Western Europe and North America (Jha et al., 1996; Peto & Lopez, 2001). Currently, approximately two out of every three smokers resides in one of ten countries, including: Bangladesh, Brazil, China, Germany, India, Indonesia, Japan, Russian Federation, Turkey, and the United States of America (WHO, 2008).

In addition to income-related changes in smoking prevalence, smoking by males and females has changed over time. Globally, male smoking prevalence reached its peak during the 20th century and has since declined in nations like Canada, the United Kingdom, and the United States (WHO, 1997). Still, in many countries – particularly in developing countries – the decline in male smoking rates has been mixed (Shafey, Erisken, Ross, & Mackay, 2009). For example, Thailand's male smoking prevalence hovered near 60 percent in the early 1990s (Levy, Benjakul, Ross, & Ritthiphakdee, 2008). Largely due to the country's aggressive tobacco control policies (Levy et al., 2008), Thailand reported in its year 2010 *Global Adult Tobacco Survey (GATS)* that male smoking prevalence was 45.6 percent.

On the other hand, in some countries, such as China and Indonesia, smoking has risen since the late 1960s (Jha, 2009). China saw its rate of currently smoking males increase three and one-half percent from 1984 to 1996 (Yang et al., 1999) while Indonesia's rose from 53 percent to 63 percent between 1995 and 2004 (Barber, Adioetomo, Ahsan, & Setyonaluri, 2008). The distinction of China and Indonesia from other low- or middle-income countries is important because of the large populations of male smokers in those countries; estimates from 2008 indicated that male smokers exceed 300 million in China and 50 million in Indonesia (Shafey, Erisken, Ross & Mackay, 2009). As of 2009, nearly one billion men smoke tobacco products worldwide (Shafey, Erisken, Ross & Mackay, 2009).

Global smoking trends among females differ from those of males in several ways. First, smoking prevalence among female populations in high-income countries has declined similarly to the male populations in these industrialized nations; however, recent

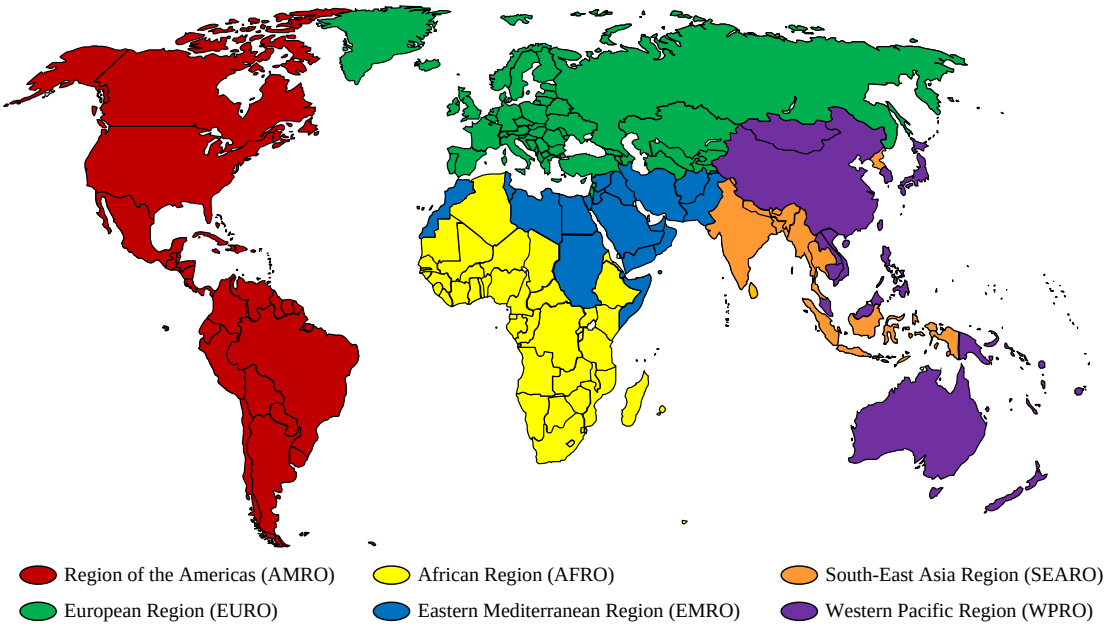
studies have shown that smoking rates are on the rise for females in many low- or middle-income countries (Shafey, Erisken, Ross & Mackay, 2009). Historically, the data also shows that female smoking prevalence was found to be lower than male prevalence in all countries for which valid and reliable statistics existed. Second, the female tobacco epidemic usually lagged several decades behind that of the men (Lopez, Collishaw, & Piha, 1994).

The Russian Federation presented an example of such a lag. Although the country's male smoking rates have remained high throughout the last several decades, females largely avoided smoking (Perlman, Bobek, Gilmore, & McKee, 2007). It was not until the Russian Federation transitioned to a market economy during the early 1990s that women began smoking in greater numbers (Perlman et al., 2007). Perlman and colleagues (2007) reported that smoking doubled among women between 1992 and 2003. Third, data from the *Global Youth Tobacco Survey (GYTS)* found that the smoking gap between males and females, which has been quite wide in the past, was narrowing in adolescents (Warren, Jones, Eriksen, & Asma, 2006). The narrowing trend is particularly troubling for tobacco control efforts because most adult smokers acquired the habit during adolescence (Aklin, Moolchan, Luckenbaugh, & Ernst, 2009; Lenney & Enderby, 2008).

2.2 Global Adult Male Tobacco Smoking Prevalence and Characteristics

Global adult male tobacco smoking prevalence varied not only in terms of actual smoking rates but also regarding types of tobacco products smoked. Regarding

prevalence, adult male smoking rates were linked to a number of variables that influence smoking initiation and continued smoking of tobacco products. That is, the type of smoked tobacco product available to the individual often dictated his smoking preferences. As previously mentioned, there are numerous types of smoked tobacco products; however, due to regional – and even national variations – male smoking preference was often closely linked to the particular products available in the given market. For the sake of consistency between terms used here, the review of male adult smoking prevalence and types of tobacco smoked that is presented below is categorized according to the WHO's six regions as noted in Figure 2.



WHO, 2010

Figure 2 The WHO regional map

Global adult male tobacco smoking prevalence varied widely throughout the different WHO regions. The prevalence data presented in the *Global Tobacco Control*

Report, *2008*, classified male smoking prevalence according to four categories: smoking any tobacco product, current[5]; smoking any tobacco product, daily[6]; smoking cigarettes, current[7]; and smoking cigarettes, daily[8] (WHO, 2008). Particularly high male prevalence was noted in certain EMRO, EURO, SEARO, and WPRO countries while generally low prevalence was found throughout many of the African countries.

Types of tobacco smoked throughout the world were often influenced by a complex matrix of economic, social, and cultural variables. Even within the same geographic region, marked differences in type of smoked tobacco were often seen. To illustrate this point, India and Indonesia – two countries from the same WHO region – were examined in detail.

India's most prevalent smoked tobacco among males was the hand-rolled bidi, which is a cheap form of smoked tobacco found throughout the country and produced in the cottage or home-based industry (Pednekar & Gupta, 2007; Reddy & Gupta, 2004). Home-based bidi manufacturers generally produced only small quantities of the product; consequently, they were largely exempted from excise taxes, which become effective once a manufacturer produces 2 million bidis annually (Campaign for Tobacco Free Kids [TFK], 2008; Gupta & Asma, 2007; Sunley, 2008). Additionally, even when taxes were due, the unorganized nature of home-based bidi production made collection of any taxes

---

[5] Definition: Smoking daily or non-daily at the time of the survey, including cigarettes, cigars, pipes, bidis, etc. (WHO, 2008).

[6] Definition: Smoking any tobacco product, including cigarettes, cigars, pipes, bidis, etc., everyday (WHO, 2008).

[7] Definition: Currently smoking cigarettes, including daily and non-daily (WHO, 2008).

[8] Definition: Smoking cigarettes everyday (WHO, 2008).

on the product difficult (Shimkhada & Peabody, 2003). For these and other reasons, bidis in India are under-taxed when compared to manufactured cigarettes (TFK, 2008; Gupta & Asma, 2007; Sunley, 2008). The favorable tax structure for bidis contributed to a significantly lower price for the product; generally, a 25-pack of bidis in India cost less than one-fifth the price of a 20-pack of manufactured cigarettes (Sunley, 2008).

In addition to a favorable tax structure, bidi manufacturers were also protected by other policies that took aim at manufactured cigarettes. For example, the *Cigarettes Act of 1975* required cigarette packs and cartons to carry labels that warned about the dangers of smoking; however, non-cigarette tobacco products – like bidis – were not required to carry such labels (Gupta & Asma, 2007). More recently, the Indian government banned foreign investment in domestic cigarette manufacturing (Pradhan & Chatterjee, 2010). Although the cabinet committee responsible for this action asserted that the ban was aimed at reducing smoking, the move came one month after the government increased taxes on manufactured cigarettes while leaving bidi taxes unchanged (Mukherjee, 2010; Pradham & Chatterjee, 2010).

Similar to India, the Indonesian tobacco market – both in terms of production and consumption – was dominated by a specific tobacco product: the kretek. Kretek use among males in Indonesia has been driven by a number of factors, including protectionism and favorable tax structures. As protectionism and favorable tax structures drove male smokers towards kreteks, sales of white cigarettes[9] dramatically decreased. In the early 1970s, manufactured white cigarettes enjoyed annual sales that were nearly

[9] White cigarettes are manufactured cigarettes that are similar in blend and appearance to those cigarettes widely smoked in the Americas and Europe. White cigarettes, unlike clove-flavored kreteks, contain only tobacco (Barber, Adioetomo, Ahsan, & Setyonaluri, 2008).

80 percent of that of kreteks (Lawrence & Collin, 2004). By the early 2000s, estimates indicated that white cigarettes represented roughly one out of every ten cigarettes sold while nearly nine out of ten was a kretek (Barber et al., 2008; Lawrence & Collin, 2004).

In the past several decades, the Indonesian government consistently supported tax structures and actions that promoted kretek production in favor of white cigarette production (Lawrence & Collin, 2004). For example, excise tax increases on kreteks implemented during the early 1990s were overturned by century's end; although, taxes on white cigarettes remained (Lawrence & Collin, 2004). Additionally, small-scale manufacturers, which predominantly manufactured kreteks, were protected by a tiered tax system that favored – as recently as 2008 – production of fewer numbers of sticks (Barber et al., 2008). In 2007, the WHO reported that manufactured cigarettes (white cigarettes and kreteks) were taxed between 26 and 40 percent while hand-made kreteks ranged from four to 22 percent (WHO, 2007).

In addition to an unfavorable tax structure, foreign cigarette manufacturers' – the largest producer of white cigarettes – factories were temporarily seized by the government during Sukarno's 1945-1967 presidency (Lawrence & Collin, 2004). Although the foreign cigarette manufacturers expected a reprieve from such protectionism after Sukarno was ousted during a coup, the 1970s were a boon for domestic kretek manufacturers as regulations continued to favor these producers and the kretek rolling machine was introduced (Lawrence & Collin, 2004). Moreover, the 1970s brought with it an era of compulsory transmigration in the country. Compulsory transmigration was meant to reduce the population of the main island of Java; however, it also spread the use of kreteks throughout the country as populations shifted (Hanusz,

2004). These issues were further compounded by the number of domestic workers employed in the tobacco sector during that decade: nearly 40 percent of Indonesia's manufacturing sector compared with only about five percent today (Achadi, Soerojo, & Barber, 2005). The large number of domestically employed tobacco workers reduced political will for restraining kretek production or use (Achadi et al., 2005). The hostile attitudes exhibited by the Indonesian government coupled with the increases in kretek manufacturers' production efficiency led to dramatic decreases in market share for white cigarettes. In the 1980s, white cigarettes enjoyed a market share of nearly 45 percent (Lawrence & Collin, 2004). In contrast, by 2009, kreteks led the Indonesia tobacco market with a 93 percent market share (British American Tobacco [BAT], 2009).

The cases of India and Indonesia demonstrated that types of tobacco smoked among men can vary within the same geographic region. This trend was identified in other areas of the world as well. In addition to bidis and kreteks, water pipes and manufactured cigarettes were common in many SEARO countries (Maziak, Ward, Afifi Soweid, & Eisenberg, 2004; Shafey, Eriksen, Ross, & Mackay, 2009). In EURO countries, the most common form of tobacco smoked was the manufactured cigarette; however, male smokers in the region also consumed cigars, "roll-your-own" cigarettes, and pipes (Shafey, Eriksen, Ross, & Mackay, 2009; Strong, Guthold, Yang, Lee, Petit, & Fitzpatrick, 2008). Similar to EURO countries, males in the WPRO countries mostly smoked manufactured cigarettes, sticks, "roll-your-own" cigarettes, pipes, and cigars (Shafey, Eriksen, Ross, & Mackay, 2009). This trend was seen to repeat as well in many of the AMRO countries (Shafey, Eriksen, Ross, & Mackay, 2009). In the AFRO and

EMRO countries, smoking of manufactured cigarettes and water pipes was highly prevalent (Maziak et al., 2004; Shafey, Eriksen, Ross, & Mackay, 2009; WHO, 2005).

2.3 Adult Literacy Rates and Smoking Tobacco

Researchers have recognized the important role that literacy plays in improving health outcomes (Berkman et al., 2004; DeWalt, 2004; Kirsch, Jungeblut, & Jenkins, 2002; Pignone, DeWalt, Sheridan, Berkman, & Lohr, 2005; Sentell & Halpin, 2006). In addition to recognizing literacy's role in health outcomes, research indicated that low levels of literacy within populations were linked with higher levels of tobacco consumption (Gupta, 2006; Wolf, Gazmararian, & Baker, 2007). Research also revealed that low literacy rates were associated with increased smoking rates and difficulty in quitting tobacco use.

Numerous studies conducted in various countries support the assertion that low literacy rates contributed to high rates of tobacco smoking among men (Gupta, 2006; Le, Chongsuvivatwong, & Greater, 2007; Marinho, 2008). In Brazil, Marinho and colleagues (2008) found that illiteracy was positively associated with increased tobacco smoking, accounting for a nearly 35 percent increase in smoking rates among men and women. In China, a recent study focusing on the southwestern provinces reported that low literacy increased smoking among both males and females (Le, Chongsuvivatwong, & Greater, 2007). Moreover, of the determinants of health listed by the WHO, Gupta (2006) found that in developing countries like India, literacy rates served as a strong indicator for smoking in both men and women. Although Brazil, China, and India represent only a

small number of countries, the findings regarding smoking rates and literacy in these countries are noteworthy because the populations of these countries are so large and these countries illustrate the changing demographics of tobacco use from predominantly high-income countries to predominantly low- and middle-income countries.

Although understanding the link between literacy and smoking rates is critical to shaping public health interventions, it is also necessary to recognize the impact of literacy on the smoker's ability to quit using tobacco. To promote cessation of tobacco use, the WHO's Report on the Global Tobacco Epidemic prescribed a number of policies (2008). While a number of these prescriptions indirectly discouraged demand through pricing policies like increasing tobacco taxes, several of these policies required the direct involvement of the smoker (WHO, 2008). For example, the FCTC included non-price measures like rotating warning labels on tobacco packs and establishing anti-tobacco education campaigns (2003). These non-price measures were designed to reduce demand, but they also required smokers to take an active role in quitting tobacco by reading pack labels, seeking cessation support, reading cessation materials, or understanding quit options.

One of the essential skills required to engage in the aforementioned smoking cessation activities included a minimal level of literacy (Ciampa, 1996). Weiss and colleagues reported that the information on tobacco-cessation products was often written at a higher literacy level than a low literacy smoker could comprehend (2010). They also discovered that individuals with higher levels of literacy also had trouble understanding the complex instructions and materials that accompanied tobacco-cessation products,

which could contribute to misuse of the products by both low- and high-literacy smokers (2010).

2.4 Educational Attainment and Smoking Tobacco

Educational attainment is considered to be a strong predictor of an individual's tobacco smoking status. Numerous studies conducted worldwide indicated that lower levels of education are associated with higher rates of smoking tobacco (Storr et al., 2009; de Walque, 2006; Pampel, 2008; Huisman, Kunst, and Mackenbach, 2005; Xu et al., 2006). Historically, studies assessing direct causality between education and tobacco smoking rates focused on three overarching variables that were identified as influencing smoking behavior: (1) education, coupled with the resultant higher incomes, raised the value of staying alive; (2) education improved access to health information and fostered better health literacy; and (3) unobservable variables like the discount factor that individuals apply to smoking (de Walque, 2006).

Huisman et al. (2005), researching countries in the European Union, indicated that male populations with higher levels of education were less likely to smoke tobacco. Similar results have been found to be true for female populations as well (Huisman et al., 2005). Schapp and colleagues' recent study on 18 European countries reinforced the findings of Huisman et al. (Schapp, Kunst, & Leinsalu, 2008). Analyzing quit ratios in terms of the implementation of tobacco control policies, the Schapp study found that higher educated smokers were more likely to quit smoking than lower educated smokers

(2008). The Schapp (2008) results held across all sex-age groups studied; however, the impact of educational inequalities diminished as smokers aged.

The results discussed above were not unique to European countries. Analyzing 16 countries in sub-Saharan Africa, Pampel reported that cigarette smoking is lower among those with higher levels of education (2008). The author was careful to note that the results were similar between male and female populations; however, the prevalence of female smokers was considerably lower than the prevalence of male smokers (Pampel, 2008). In China, tobacco smoking among males decreased significantly along the educational gradient. Tobacco smoking rates for Chinese males that received 13+ years of education was approximately half that of smokers who received zero to nine years of education (Xu et al., 2006). Furthermore, research conducted by de Walque revealed that American males and females smoked less as years of education increased (2006). The de Walque study also demonstrated that among individuals who smoked, male or female, those with the greatest level of education were most likely to quit smoking (2006). Although de Walque limited detailed analysis to the male population, other recent research performed more robust analysis of female smoking in the United States. In addition to delving into the impact of maternal smoking on the uptake of smoking by children, this research confirmed the de Walque results and indicated that less educated females were more likely to smoke tobacco (Kandel, Griesler, & Schaffran, 2009).

Although the evidence supporting the link between higher levels of education and lower rates of tobacco smoking seems fairly conclusive, Storr and colleagues (2009) recently analyzed data from 17 countries participating in the World Health Survey Consortium and drew somewhat different conclusions. Their study yielded nuances that

could be important for future research. The 17 countries analyzed included seven low- and middle-income countries and ten high-income countries.

2.5 The GDP and Smoking Tobacco

Higher GDP in a country has long been associated with better health outcomes (World Bank, 1993). The GDP has also been linked to reductions in all causes of mortality (Macinko, Starfield, & Shi, 2003). In addition, higher levels of GDP have been shown to be closely linked with a higher rank on the HDI scale; however, debate continues regarding the diminishing returns of increasing GDP on increasing levels of development (Cahill, 2002). Although the GDP-related reductions in all causes of mortality included smoking-related diseases and deaths, higher levels of human development did not necessarily equate to lower levels of smoking tobacco.

Using the HDI as a marker of human development, Guindon and Boisclair (2003) revealed that from 1970 to 2000 countries in high human development regions of the world recorded a decrease in tobacco use. In low development countries, growth in consumption was mostly flat from around 1980 until the mid-1990s. Per capita cigarette consumption began to increase in the low development countries during the mid-1990s (Guindon and Boisclair, 2003). For medium development countries, consumption increased for almost the entire 30-year period (Guindon and Boisclair, 2003).

Further studies have indicated that the impact of GDP on ever-smoking rates varied by gender. Schapp and colleagues (2009) noted the smoking rates in the male population tended to decrease as GDP increased; however, the opposite was generally true for the female populations. These findings are consistent with other

studies that indicated that trends in female populations lagged behind those of the male population and were associated with factors like increased civil rights for women or the availability and consumption of cigarettes as non-luxury goods (Amos and Haglund, 2000; Lopez et al, 1994; Mackay and Amos, 2003).

2.6 Life Expectancy and Smoking Tobacco

The significance of current global smoking prevalence is underscored by the well-documented negative health consequences of tobacco use, including smoking-attributable mortality (SAM) and years of potential life lost (YPLL). It is estimated that tobacco will kill one billion people this century (WHO, 2008). Additionally, there are more than 1 billion current or former smokers living today. Of those 1 billion people smoking today, nearly half will be killed as a result of smoking tobacco (WHO, 2008). If currents trends continue, most of the smoking-related deaths will be attributable to diseases other than cancers (Jha, 2009). Ezzati and colleagues (2004) reported that for high-, middle-, and low- income countries the leading causes of SAM were cardiovascular diseases, lung cancer, and chronic obstructive pulmonary disease (COPD). Cardiovascular disease globally led all other diseases in smoking-attributable deaths, killing 1.5 million people a year, including 800,000 acute heart attack deaths (Ezzati & Lopez, 2004; Lopez et al., 2007). However, SAM due to cardiovascular disease in the developing world only slightly outpaced deaths from smoking-related COPD (Ezzati & Lopez, 2004). An exception to this trend was noted in China, in which smoking-related cancer deaths were found to be nearly double that of smoking-related cardiovascular disease deaths (Gu et al., 2009).

In addition to cardiovascular disease, chronic lung disease also contributes to SAM. For example, nearly half of male and one-third of female chronic lung disease deaths in high-income countries are SAM-related (Peto, Lopez, Boreham, Thun, & Heath, 1994). Low- and middle-income countries demonstrated similar SAM for chronic lung disease. Half of male chronic lung disease deaths in China among those aged 30-69 years were attributed to smoking (Liu, B.Q. et al., 1998). For the same age group, more than 30 percent of males and ten percent of females in India that had chronic lung disease died due to smoking (Jha, et al., 2008). Although cancer is not the leading cause of SAM, the disease did account for a large number of smoking-related deaths. Of the total annual global deaths attributable to smoking, roughly 850,000 were due to cancer (Ezzati, Henley, Lopez, & Thun, 2005).

Although SAM was a robust indicator of the burden of disease due to smoking tobacco, it did not fully capture the scope of tobacco's impact on loss of life. The YPLL provided additional data that aided in the understanding of the impact of tobacco on life expectancy. A long-term perspective cohort study published in 2007 indicated that average tobacco smoking reduced life expectancy by 6.8 years (Streppel, Boshuizen, Ocké, Kok, & Kromhout, 2007). The same study further revealed that heavy smoking reduced life by 8.8 years (2007). Streppel and colleagues' (2007) analysis also indicated that cigarette smoking decreased years of disease-free life by 5.8 years and cigars or pipes did so by 5.2 years. Moreover, the researchers found that quitting cigarettes at age 40 increased life expectancy by 4.6 years (2007).

The Streppel et al. study was not unique in its findings. In a recent Morbidity and Mortality Weekly Report, the United States Centers for Disease Control and Prevention

(CDC) reported that cigarette smoking and secondhand smoke exposure contributed to 443,000 deaths and 5.1 million YPLL annually in the United States (2009). In Brazil, annual deaths due to all causes were approximately 175,000 for individuals over 35 years of age, of which nearly 25,000 were smoking-related (Corrêa, Barreto, & Passos, 2009). The deaths of these 25,000 individuals resulted in roughly 420,000 YPLL (Corrêa, Barreto, & Passos, 2009). In various other countries throughout different regions of the world, similar results were published that confirmed the significant toll on life attributed to smoking tobacco (CDC, 1995; Macinko, Starfield, & Shi, 2003; Welte, König, & Leidl, 2000; Yang et al., 2005; Zorilla-Torras, 2005).

2.7 Tobacco Taxation, Tobacco Prices, and Smoking Prevalence

A number of studies indicated that increasing tobacco taxes reduced smoking prevalence (Carpenter & Cook, 2008; Jha & Chaloupka, 2000; Gruber, 2008; Thomas et al., 2007). In 2000, Jha and Chaloupka, citing the idea that market failures in the tobacco market required some level of government intervention, asserted that inadequate information about the health risks and addictive nature of tobacco, when coupled with the cost to non-smokers, required greater taxes to reduce consumption. Moreover, the researchers found that the degree to which a market "failed" was often dictated in part by the income status of the country, that is, lower income countries demonstrated greater failures (2000). Jha and Chaloupka (2000) found that raising taxes was an effective method for reducing tobacco consumption regardless of a county's income. Their research revealed that a ten percent increase in the costs of tobacco products, which could be achieved by increasing tobacco taxes, resulted in a four percent reduction in smoking

among high-income countries and an eight percent reduction in low- or middle-income countries (2000).

Similar to Jha and Chaloupka, Gruber's research revealed that tobacco taxes contributed to reductions in tobacco consumption; however, he argued that taxes are often set too low to be completely effective at reducing tobacco use (2008). He found that traditional economic analysis of price elasticity, which ignored the addictive nature of tobacco use and hence underestimated demand, was insufficient for tobacco use (2008). Gruber (2008) challenged the accuracy of using a traditional utility maximizing function for consumption, (where is instantaneous utility at time *t* and is a "discount factor"[10] between 0 and 1), on tobacco products because the exponential discounting[11] required by this model implies that utility is not only time consistent but also dependent upon the distance between time periods. Such an assumption ignores the addictive nature of tobacco. Instead, Gruber (2008) suggested that hyperbolic discounting[12] more accurately represents the time-inconsistent demand for addictive products like tobacco because it weighted the present more heavily while differentiating very little between two points in the future.

As previously discussed, tobacco taxation is generally an important tool for reducing consumption. However, findings linking higher tobacco taxes to lower rates of smoking initiation have been mixed. A number of studies concluded that higher taxes do

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[10] The rate at which the value of a future event is reduced when compared to the present (Dunn, 2008).

[11] Definition: A model for consumption and utility that assumes valuations fall constantly per unit of delay (Gruber, 2008).

[12] Definition: A model for consumption and utility that assumes valuations fall rapidly for shorter delays but much less so for longer delays (Gruber, 2008).

not influence initiation; although, these same studies recognized the role of taxes in reducing tobacco consumption or encouraging cessation (Forster & Jones, 2001; Liu, 2009). Conversely, Tauras (2005) estimated that a ten percent price increase would likely reduce any smoking initiation from one to three percent. Moreover, these researchers found that this same price increase reduced chances of daily smoking by eight to 12 percent and heavy daily smoking by ten to 14 percent (2005). Other studies, citing the price sensitivity of adolescents, noted that higher prices for tobacco, which are achievable through tax increases, prevented youths from initiating smoking (Kidd & Hopkins, 2004).

As aforementioned, a number of studies supported the idea that increasing tobacco taxes reduces consumption of tobacco products; additionally, some studies demonstrated a negative association between pricing increases and smoking initiation. A third component to the relationship between tobacco taxes and consumption is substitution[13], that is, the switch from smoking a manufactured cigarette to some other tobacco product (bidi, kretek, smokeless, etc.). Returning to the example of Indonesia from Section 2.2, a substitution effect was evident in the tobacco market as kretek manufacturers benefited from a favorable tax structure (pricing) and protectionism. By the end of the 20th century, kreteks held a 93 percent share of the tobacco market (BAT, 2009). The substitution effect in Indonesia was not unique. Vietnam was another country that imposed an uneven tax structure on tobacco products (Guindon et al., 2010). In Vietnam's case, waterpipe tobacco is not taxed while cigarettes are taxed at varying

[13] In economic theory, the substitution effect occurs when a consumer purchases a lower priced good in lieu of a higher priced good (Guell, 2007)

degrees depending on the presence of filters (Guindon et al., 2010). Research demonstrated that switching from smoking cigarettes to waterpipes was significantly and positively associated with price (Laxminarayan & Deolalikar, 2004). Similar substitution effects were found in other countries like Taiwan (Tsai, Wen, Hu, Chang, & Huang, 2005) and Germany (Hanewinkel, Radden, & Rosenkranz, 2008).

2.8 Summary

Numerous studies have substantiated the association between adult male tobacco smoking prevalence and the composite elements of the HDI; however, fewer studies have measured the direct association between a country's value on the index and its adult male tobacco smoking prevalence. In addition, few studies have concomitantly analyzed the variable of interest in the broader context of development factors and tobacco control policies like tobacco taxes. Each HDI composite element and tobacco taxation demonstrated varying degrees of association with rates of smoking, and it is important for public health practitioners and policy makers to understand the relationship between these four variables as they consider efforts towards reducing tobacco consumption – first, because less is known about how these variables jointly impact smoking prevalence, and second, because doing so provides a more robust evidence-base for supporting the implementation of tobacco control policies. By gaining a better understanding of the predictors of adult male tobacco smoking prevalence, this study aims to reduce tobacco use by providing evidence that informs the development and implementation of effective tobacco control policies.

CHAPTER III

METHODS AND PROCEDURES

3.1 Data Source

The data used in this study were obtained from the UNDP's *Human Development Report, 2008,* and the *WHO Report on the Global Tobacco Epidemic, 2009*. Both reports are publicly available and contain the statistical tables used to conduct this study. The first *Human Development Report*, which was published in 1990 and commissioned by the UNDP, represents a collaborative effort of many development experts and advisers (UNDP, 2008). The HDI, which is included in the *Human Development Report*, broadly measures countries' development in terms of attaining a long and healthy life, gaining access to knowledge, and reaching a decent standard of living (UNDP, 2008). The *WHO Report on the Global Tobacco Epidemic*, which was first published in 2008 and funded by the Bloomberg Philanthropies, collected global data on tobacco use and tobacco control policies. The data collected in the report was arranged in accordance with categories set forth in the aforementioned FCTC (WHO, 2008).

As previously mentioned, the HDI views human development as a composite measure of several different variables. The first variable, attaining a long and healthy life, is determined by looking at life expectancy at birth. The report goes further and specifically defines the life expectancy at birth as the length of life an infant would

expect given the current age-specific mortality rates (UNDP, 2008). Life expectancy estimates used in calculating the HDI were acquired from the United Nations Population Division (UNPD) (UNDP, 2008).

The second and third variables, which consider the population's access to knowledge, are reflected in two different measurements: educational attainment and adult literacy rates. Educational attainment is based on the levels set forth by United Nations Educational, Scientific, and Cultural Organization in its International Standard Classification of Education (ISCED) (UNDP, 2009). More specifically, educational levels are categorized as primary, secondary, post-secondary, and tertiary (UNESCO, 1997). Each educational category corresponds to increasing years of schooling, further development of skills, and specialization (UNESCO, 1997). Educational attainment is quantified in terms of gross enrollment (UNDP, 2008). Gross enrollment encompasses the total number of students enrolled in the three levels, regardless of age, as a percentage of the country's total population (UNDP, 2008).

Adult literacy rates are defined as percentage of a given population, in total or by gender, above the age of 15 years that can read and write a short statement about his or her life (UNDP, 2008). As a cross-sectional "snapshot" these rates are usually taken at some specific point in the year, usually mid-year (UNDP, 2008). Adult literacy rates as presented in the HDI calculations were collected from the UNESCO's Institute for Statistics (UIS). The UIS literacy rates were compiled by combining direct national estimates with global age-specific literacy projection models (UNDP, 2009). National estimates were collected by UIS from national censuses between 1995 and 2007 (UNDP, 2009).

The fourth variable, reaching a decent standard of living, is quantified through the use of GDP. The Human Development Report defines GDP as the value of services and goods produced in a single year in a given country (UNDP, 2008). The GDP figures, which were collected from the World Bank, stand as a proxy for standard of living and socioeconomic development in the figuring of the HDI (UNDP, 2008). Additionally, the HDI was computed using an indexed version of GDP that allowed for comparisons of standard of living across countries. The "indexed version" of the GDP is referred to as the GDP per capita in PPP US$ (UNDP, 2008). The PPP equalizes GDP calculations by removing country-level price differences (UNDP, 2008).

To calculate the HDI, the four variables listed above are standardized to values between 0 and 1 (UNDP, 2008). Once the values are calculated, a simple average is taken and an overall value between 0 and 1 is assigned (UNDP, 2008). The simple average arrived at during this calculation is then used to classify the country according to rank; the closer that value is to 1, the higher its level of development is considered to be (UNDP, 2008). Further classification is made into three broader categories: high (averages of .800 or above), medium (averages between .500 and .800), or low (averages below .500) development (UNDP, 2008).

In addition to the HDI collected from the *Human Development Report*, the study also uses data from the *WHO Report on the Global Tobacco Epidemic, 2009*. The *Report on the Global Tobacco Epidemic* is arranged along six FCTC-based policies, which are collectively known as MPOWER (WHO, 2008; WHO, 2009). The MPOWER acronym, as previously mentioned, stands for the following:

- **M**ONITOR tobacco use and prevention policies;
- **P**ROTECT people from tobacco smoke;
- **O**FFER help to quit tobacco use;
- **W**ARN about the dangers of tobacco;
- **E**NFORCE bans on tobacco advertising, promotion, and sponsorship; and
- **R**AISE taxes on tobacco (WHO, 2008; WHO, 2009).

To obtain the MPOWER data, a multi-question survey for each country included in the report was completed by the WHO Tobacco Free Initiative (TFI) focal point and verified by the country (WHO, 2008). Male adult smoking prevalence for manufactured cigarettes and any tobacco products was collected via this questionnaire (WHO, 2008; WHO, 2009).

Once crude country-level prevalence data was collected, it was adjusted to account for differences in data collection dates, sampling methodology (including rural/urban and gender), definition of smoking, and age categories via the WHO Global InfoBase (WHO, 2008; WHO, 2009). Survey data that was included in the adjustments contained the following: 1) at least one of the following tobacco use definitions: current smoker, daily smoker, current cigarette smoker, or daily cigarette smoker; 2) randomly selected sample that demonstrated general population representativeness; 3) prevalence by age and sex; and 4) prevalence for the adult population aged 15-years or older (WHO, 2008; WHO, 2009). Prevalence estimates from the *WHO Report on the Global Tobacco Epidemic, 2009*, were generated for year 2006 (WHO, 2009). In countries where data was collected after 2006, trending was done to look back at year 2006. In countries

where data existed only prior to year 2006, trending was done to look forward towards 2006.

Additionally, several overarching processes were employed during analysis of country-reported prevalence data to enable global comparability. First, data was checked for errors and analyzed to determine association between age and the aforementioned tobacco use definitions (WHO, 2008). Second, country-reported data were evaluated in order to produce globally standardized country-level estimates (WHO, 2008). Third, the globally standardized country-level estimates were coupled with United Nations Statistics Division regional and sub-regional designations to arrive at estimates for those designations (WHO, 2008). The following logit transformations for daily and current smokers represent an example of the regression analysis used to derive estimates for the variables of interest (gender, age, region, etc.):

- logit (prevalence of daily smokers) = $\alpha + \beta_1$ *logit (prevalence of current smokers) β_2 (prevalence of current smokers)*mid-age + β_3 * mid-age + ε; and
- logit (prevalence of current smokers) = $\alpha + \beta_1$ *logit (prevalence of daily smokers) β_2 (prevalence of daily smokers) *mid-age + β_3 * mid-age + ε.

  (WHO, 2008)

These formulas assume that (1) "ε" is a normally distributed error term and (2) "mid-age" represents the midpoint in years of each observation (WHO, 2008). Finally, age-standardized prevalence, which is the focus of this study, was presented using the WHO Standard Population (WHO, 2008; WHO, 2009). This fictitious population is particularly meant to represent the population of low- and middle-income countries (WHO, 2009).

In addition to prevalence data, tobacco prices and taxation rates were also obtained from the MPOWER data sets. Tobacco prices were calculated on a tax-

inclusive basis and were presented in purchasing power parity in United States dollars (PPP US$) on a per pack basis (WHO, 2009). Retail prices for the most widely purchased cigarette brand for a given country were the only ones presented in the data sets, and pack sizes were adjusted to reflect the price of a 20-unit pack (Jennifer Ellis, personal communication, July 19, 2010). To account for varying tobacco taxation policies found throughout the world, analysts used a number of methods to ensure that the magnitude of taxes on a pack could be fully understood. These methods included but were not limited to researching country level tax policy to understand where in the stage of the manufacturing or purchasing of a pack taxes were levied (WHO, 2009). For example, analysts must account for whether or not sales taxes are applied equally across all products. In Egypt for example, the sales tax on tobacco products was applied at a higher rate than on other non-tobacco products, yielding an excise tax effect (WHO, 2009). Such taxation differences must be considered to ensure that tobacco tax calculations remain unbiased.

3.2 Study Population

Population delimitations were established so that only those United Nations (UN) member states possessing sufficient HDI component data were included (UNDP, 2008). For example, Zimbabwe was removed because its latest GDP estimates were deemed inaccurate (UNDP, 2008). A total of 179 countries were considered to have sufficient data for conducting HDI calculations. The selection was further limited based on the availability of sufficient tobacco smoking prevalence data. Internationally comparable adjusted prevalence data were available for 145 countries from the WHO (2009).

Because the UN and WHO use different criteria to determine member states, differences in the two organizations' list of members required further modifications to the dataset. For example, the Cook Islands are considered a WHO member state but not an UN member state. A number of countries also lacked data for the variables of interest relevant to this study; these countries were removed from the data set. These additional modifications resulted in a total of 98 countries that were found to have sufficient data to be compatible with the research objectives set forth in this study.

3.3 Statistical Analyses

Descriptive analyses were conducted for all study variables in order to investigate the distributional properties of the variables. Information from these analyses was used to inform decisions regarding appropriate variable transformations and analyses. To investigate bivariate relationships, scatterplots andPearson's and Spearman correlation coefficients were used. Finally, multiple linear regression analysis was used to build a model predicting male smoking prevalence from HDI, tobacco pricing, and tobacco taxation rate.

CHAPTER IV

RESULTS

4.1 Descriptive Statistics for the HDI Values, Adult Male Tobacco Smoking Prevalence, and Tobacco Taxation

Descriptive statistics for the sample are presented in Table 1. In total, 98 countries were analyzed. The mean HDI value for the sample was .75, which equates to a medium level of development per the *Human Development Report*. The daily male smoking prevalence estimates ranged from a low of approximately 2% to a high of approximately 65%. The currently smoking prevalence estimates ranged from a low of approximately 7% to a high of approximately 70%. A number of countries (n=36) were excluded from the analysis because of missing data. An analysis of variance between excluded and included countries concluded that, with the exception of adult literacy rates, no statistically significant variation was present in the data of these two groups (Table 2).

Table 1 Descriptive statistics, HDI composite variables, global adult male smoking prevalence, tobacco taxation, and tobacco prices (n=98)

	Minimum	Maximum	Mean	SD
HDI Index	.36	.97	.75	.18
Life Expectancy (years)	40.20	81.60	69.13	10.78
Adult Literacy (%)	22.90	99.80	83.17	19.85
Educational Enrollment (%)	30.20	114.20	74.15	18.66
GDP/1000 (PPP US$)	.28	77.09	14.28	15.16
Males Currently Smoking Any Tobacco Product (%)	9.00	70.00	32.94	13.38
Males Smoking Any Tobacco Product Daily (%)	2.00	65.00	27.36	13.20
Males Currently Smoking Cigarettes (%)	7.00	70.00	31.12	14.03
Males Smoking Cigarattes Daily (%)	2.00	65.00	25.49	13.66
Per Pack Price (PPP US$)	.22	11.75	3.59	2.24
Percent Tax on Pack (%)	2.00	79.00	44.43	18.73

Table 2 Descriptive statistics comparing excluded and included countries on HDI composite variables and global adult male smoking prevalence

	Excluded Countries (n=36)[a]		Included Countries(n=98)[b]		
	Mean	SD	Mean	SD	t-value(df), p-value
HDI Index	.76	.13	.75	.18	.26(90.49), .795
Life Expectancy (years)	69.25	8.73	69.13	10.78	.06(76.54), .95
Adult Literacy (%)	89.99	12.71	83.17	19.85	2.34(97.59), .021
Educational Enrollment (%)	73.89	13.17	74.15	18.66	-.08(88.31), .930
GDP/1000 (PPP US$)	9.91	10.72	14.28	15.16	-1.86(88.20),.066
Males Currently Smoking Any Tobacco Product (%)	37.00	15.55	32.94	13.38	1.39(55.15),.170
Males Smoking Any Tobacco Product Daily (%)	31.36	17.01	27.36	13.20	1.28(51.31),.207
Males Currently Smoking Cigarettes (%)	35.67	15.90	31.12	14.03	1.51(56.24),.136
Males Smoking Cigarattes Daily (%)	29.94	17.24	25.49	13.66	1.40(52.01),.168

[a] Albania, Armenia, Bahrain, Barbados, Belarus, Belize, Bosnia and Herzegovina, Croatia, Cuba, Dominican Republic, Ecuador, Fiji, Georgia, Japan, Kazakhstan, Korea (Republic of), Kyrgyzstan, Liberia, Maldives, Myanmar, Namibia, Oman, Pakistan, Saint Lucia, Samoa, Sao Tome and Principe, Saudi Arabia, Serbia, South Africa, Sudan, Tanzania (United Republic of), Tonga, Tunisia, Ukraine, United Arab Emirates, Uzbekistan

[b] Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cambodia, Cameroon, Canada, Cape Verde, Chad, Chile, China, Comoros, Congo, Congo (Democratic Republic of the), Costa Rica, Côte d'Ivoire, Czech Republic, Denmark, Egypt, Eritrea, Estonia, Ethiopia, Finland, France, Gambia, Germany, Ghana, Greece, Guatemala, Hungary, Iceland, Inia, Indonesia, Iran (Islamic Republic of), Ireland, Israel, Italy, Jamaica, Jordan, Kenya, Kuwait, Lao People's Democratic Republic, Latvia, Lebanon, Lithuania, Luxembourg, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Nepal, Netherlands, New Zealand, Nigeria, Norway, Paraguay, Philippines, Poland, Portugal, Romania, Russian Federation, Saint Vincent and the Grenadines, Senegal, Seychelles, Singapore, Slovakia, Slovenia, Spain, Sri Lanka, Suriname, Swaziland, Sweden, Switzerland, Syrian Arab Republic, Thailand, Turkey, Uganda, United Kingdom, United States, Uruguay, Vanuatu, Venezuela (Bolivarian Republic of)Viet Nam, Yemen, Zambia

Correlation coefficients for the sample are presented in Tables 3 and 4. The correlation coefficients for both Pearson and Spearman's Rho demonstrated similar relationships, not only in value, but also in the direction of the correlation, between the variables identified for this study. For example, in the case of life expectancy and

prevalence of male smoking current (any), the Pearson's r value was .406 and Spearman's was .345. These values were statistically signigicant at value of .05 or less.

Interestingly, the correlation coefficients for the HDI composite variables (life expectancy, adult literacy, school enrollment, and GDP) and the various smoking categories for males (current any, current cigarette, daily any, and daily cigarette) usually showed a positive relationship for Pearson and Spearman. A case of such correlation was found between life expectancy and daily male smoking of any tobacco product. The *r* value for life expectancy and daily male smoking of any tobacco product was .351, and the ρ value was .293; both of these correlations reached statistical significance. This trend between life expectancy and daily male smoking of any tobacco product is counter-intuitive given the literature supporting the link between smoking and SAM. The counter-intuitive trend has implications for data analysis in this study and will be discussed in greater detail in Chapter 5.

Table 3 Pearson correlation coefficients for development factors, prevalence, tobacco pricing, and tobacco taxation (n=98)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. HDI Index	1.000										
2. Life Expectancy (years)	.933**	1.000									
3. Adult Literacy (%)	.897**	.757**	1.000								
4. Educational Enrollment (%)	.923**	.801**	.853**	1.000							
5. GDP/1000 (PPP US$)	.776**	.678**	.595**	.710**	1.000						
6. Males Currently Smoking Any Tobacco Product (%)	.396**	.406**	.441**	.342**	.131	1.000					
7. Males Smoking Any Tobacco Product Daily (%)	.338**	.351**	.375**	.304**	.102	.973**	1.000				
8. Males Currently Smoking Cigarettes (%)	.485**	.472**	.534**	.433**	.206*	.986**	.951**	1.000			
9. Males Smoking Cigarettes Daily (%)	.444**	.429**	.486**	.413**	.188	.966**	.982**	.975**	1.000		
10. Per Pack Price (PPP US$)	.209*	.209*	.168	.177	.273**	-.166	-.159	-.165	-.160	1.000	
11. Percent Tax on Pack (%)	.494**	.477**	.433**	.476**	.413**	.159	.111	.212*	.169	.418**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 4 Spearman correlation coefficients for development factors, prevalence, tobacco pricing, and tobacco taxation (n=98)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10	11.
1. HDI Index	1.000										
2. Life Expectancy (years)	.948**	1.000									
3. Adult Literacy (%)	.901**	.804**	1.000								
4. Educational Enrollment (%)	.931**	.848**	.901**	1.000							
5. GDP/1000 (PPP US$)	.973**	.901**	.866**	.881**	1.000						
6. Males Currently Smoking Any Tobacco Product (%)	.360**	.345**	.448**	.356**	.336**	1.000					
7. Males Smoking Any Tobacco Product Daily (%)	.302**	.293**	.385**	.320**	.278**	.962**	1.000				
8. Males Currently Smoking Cigarettes (%)	.438**	.416**	.530**	.438**	.412**	.982**	.933**	1.000			
9. Males Smoking Cigarettes Daily (%)	.429**	.409**	.515**	.449**	.404**	.959**	.968**	.973**	1.000		
10. Per Pack Price (PPP US$)	.336**	.342**	.227*	.279**	.308**	-.127	-.118	-.130	-.113	1.000	
11. Percent Tax on Pack (%)	.517**	.530**	.417**	.490**	.484**	.267**	.223*	.285**	.277**	.415**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

4.2 The HDI Value, Tobacco Prices, Tobacco Taxation, and Adult Male Tobacco Smoking Prevalence

The correlation coefficients for the HDI component variables and adult male smoking prevalence, as was previously mentioned, showed a positive correlation. Given the counter-intuitive nature of these results, further detailed examination was required. To examine this relationship, the four smoking prevalence categories for males were plotted against the HDI values for the countries (Figures 3-6). The HDI value, which is an index of the four development-related composite variables, served as a sufficient proxy measure for the composite variables because the composite variables were all highly correlated with each other. By using the HDI value as a proxy for the four composite variables, the effect of multicollinearity on the analysis was reduced.

Examination of the scatter plots yielded two key findings (Figures 3-6). First, an initial examination concluded that the relationship between HDI values and each of the four smoking categories was poorly explained by a linear relationship, i.e., straight "best fit" line. Second, further examination indicated that the relationships between HDI values and smoking status were better explained by a quadratic, i.e. curvilinear, relationship. To account for the curvilinear relationship of the variables in the analysis, an additional predictor variable was included by transforming the HDI values into squared terms.

The regression model summary for HDI values, price per pack, tobacco taxation, and males currently smoking any tobacco product (Table 5) generally indicated statistical significant. The HDI value contributed to 15.6% of the variance, and the inclusion of the transformed HDI value (squared) explained an additional 12.6% of the variance. The

addition on the MPOWER-related data led to mixed results. While price per pack contributed 3.6% to the variance above the HDI values, tobacco taxation had no statistically significant impact on variance.

The regression coefficients for HDI values and HDI values squared reached statistical significance with values of .149 and -.432, respectively, when both variables were added to the model (Table 6). The HDI values were centered at the mean of .75, which reflects the mean of HDI values represented in Table 1. The addition of price per pack and taxation rate to the models that already included the HDI variables, as with variance, led to mixed results. Price per pack was a statistically significant predictor of prevalence, but taxation was not. The results of these analyses are reported in Tables 6. Similar findings were found in each of the other smoking categories: males smoking any tobacco product daily (Tables 7 and 8), males currently smoking cigarettes (Tables 9 and 10), and males smoking cigarettes daily (Tables 11 and 12). Although the total taxation regression coefficient was negative in all of the models, it was not found to be a statistically significant predictor of prevalence when controlling for HDI and price per pack.

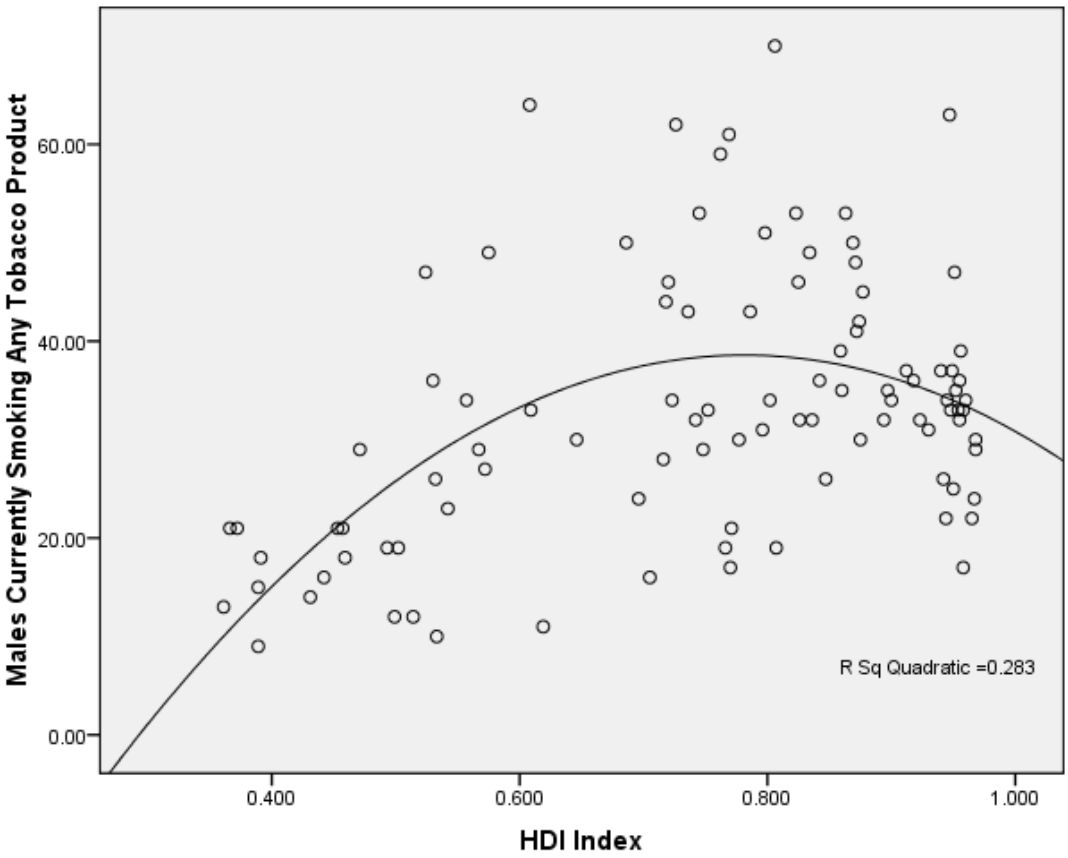

Figure 3 Scatter plot for males currently smoking any tobacco product and HDI

Table 5 Model summary, males currently smoking any tobacco product, HDI, tobacco prices, and tobacco taxation (n=98)

					Change Statistics		
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	Sig. F Change
1	.396[a]	.156	.148	12.36	.156	17.805	.000
2	.532[b]	.283	.267	11.45	.126	16.701	.000
3	.565[c]	.319	.297	11.22	.036	5.025	.027
4	.568[d]	.323	.294	11.25	.004	.539	.465

a. Predictors: (Constant), HDI

b. Predictors: (Constant), HDI, HDI squared

c. Predictors: (Constant), HDI, HDI squared, Per pack price

d. Predictors: (Constant), HDI, HDI squared, Per pack price, Percent tax on pack

Table 6 Regression analysis, males currently smoking any tobacco product, HDI, tobacco prices, and tobacco taxation (n=98)

Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	32.939	1.248		26.391	.000
	HDI	28.647	6.789	.396	4.220	.000
2	(Constant)	38.409	1.769		21.709	.000
	HDI	10.776	7.664	.149	1.406	.163
	HDI Squared	-161.836	39.601	-.432	-4.087	.000
3	(Constant)	42.107	2.393		17.599	.000
	HDI	15.637	7.814	.216	2.001	.048
	HDI Squared	-145.100	39.500	-.388	-3.673	.000
	Per pack price	-1.187	.529	-.199	-2.242	.027
4	(Constant)	40.206	3.529		11.394	.000
	HDI	13.178	8.519	.182	1.547	.125
	HDI Squared	-145.706	39.605	-.389	-3.679	.000
	Per pack price	-1.337	.569	-.224	-2.351	.021
	Percent tax on pack	.055	.075	.078	.734	.465

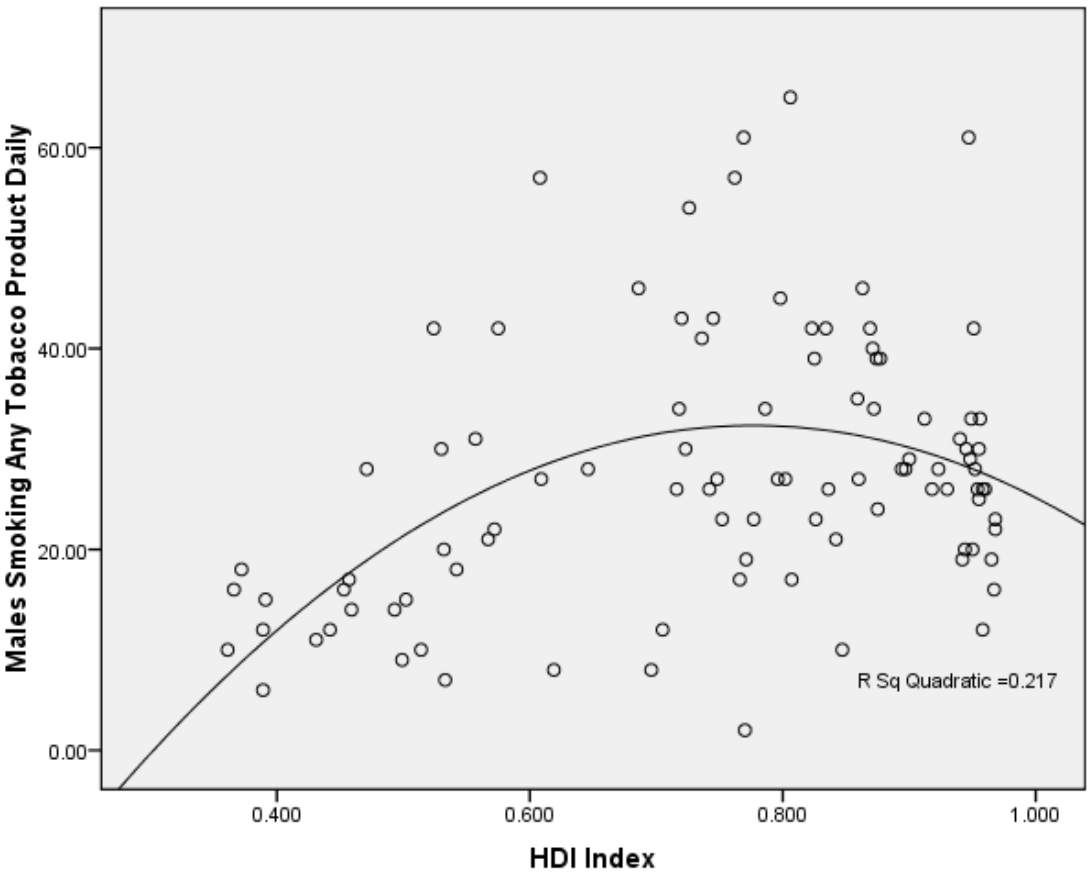

Figure 4 Scatter plot for males smoking any tobacco product daily and HDI

Table 7 Model summary, males smoking any tobacco product daily, HDI, tobacco prices, and tobacco taxation (n=98)

					Change Statistics		
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	Sig. F Change
1	.338[a]	.114	.105	12.49183	.114	12.369	.001
2	.465[b]	.217	.200	11.80878	.102	12.427	.001
3	.498[c]	.248	.224	11.62926	.032	3.956	.050
4	.499[d]	.249	.217	11.68435	.001	.116	.735

a. Predictors: (Constant), HDI

b. Predictors: (Constant), HDI, HDI squared

c. Predictors: (Constant), HDI, HDI squared, Per pack price

d. Predictors: (Constant), HDI, HDI squared, Per pack price, Percent tax on pack

Table 8 Regression analysis, males smoking any tobacco product daily, HDI, tobacco prices, and tobacco taxation (n=98)

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	27.357	1.262		21.680	.000
	HDI	24.139	6.864	.338	3.517	.001
2	(Constant)	32.221	1.824		17.665	.000
	HDI	8.247	7.901	.115	1.044	.299
	HDI Squared	-143.920	40.826	-.390	-3.525	.001
3	(Constant)	35.622	2.480		14.364	.000
	HDI	12.718	8.099	.178	1.570	.120
	HDI Squared	-128.529	40.944	-.348	-3.139	.002
	Per pack price	-1.091	.549	-.185	-1.989	.050
4	(Constant)	34.708	3.666		9.467	.000
	HDI	11.535	8.850	.161	1.303	.196
	HDI Squared	-128.820	41.146	-.349	-3.131	.002
	Per pack price	-1.164	.591	-.198	-1.969	.052
	Percent tax on pack	.027	.078	.038	.340	.735

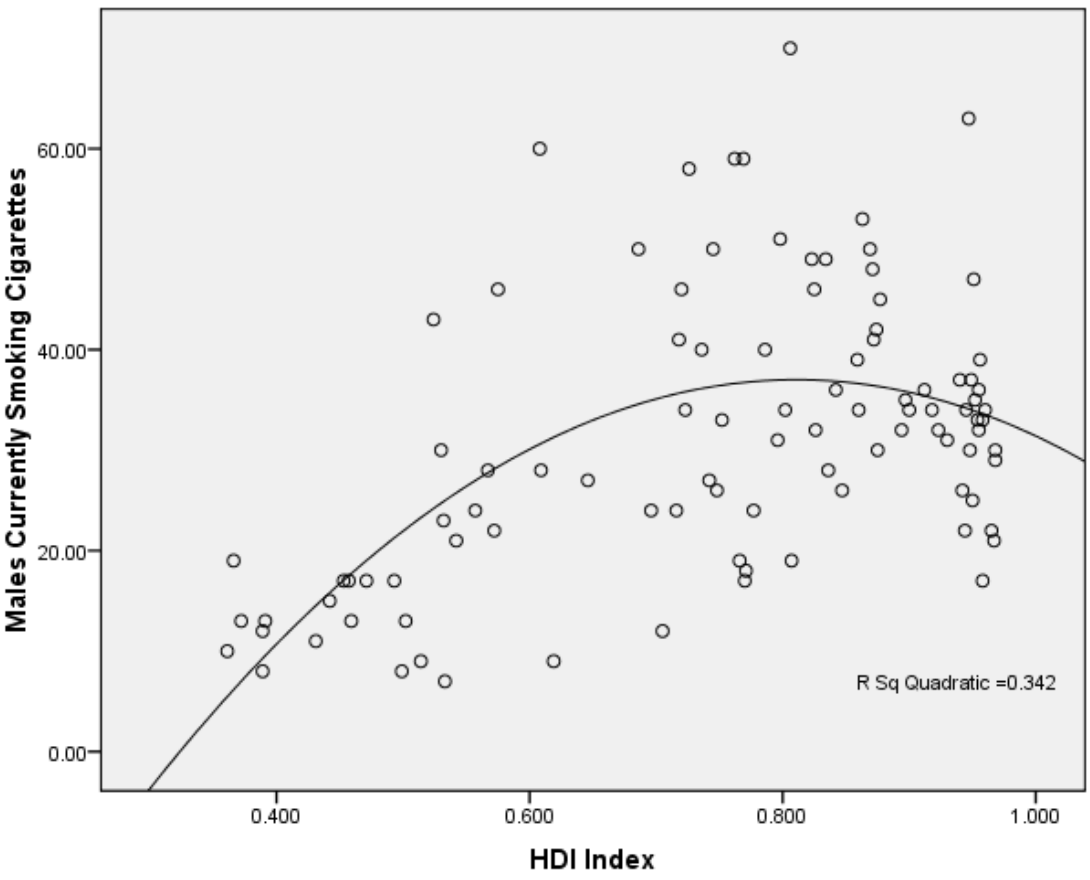

Figure 5 Scatter plot for males currently smoking cigarettes and HDI

Table 9 Model summary, males currently smoking cigarettes, HDI, tobacco prices, and tobacco taxation (n=98)

					Change Statistics		
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	Sig. F Change
1	.485[a]	.235	.227	12.34	.235	29.473	.000
2	.584[b]	.342	.328	11.51	.107	15.386	.000
3	.622[c]	.387	.368	11.16	.046	7.044	.009
4	.628[d]	.394	.368	11.16	.007	.999	.320

a. Predictors: (Constant), HDI

b. Predictors: (Constant), HDI, HDI squared

c. Predictors: (Constant), HDI, HDI squared, Per pack price

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.485[a]	.235	.227	12.34	.235	29.473	.000
2	.584[b]	.342	.328	11.51	.107	15.386	.000
3	.622[c]	.387	.368	11.16	.046	7.044	.009
4	.628[d]	.394	.368	11.16	.007	.999	.320

a. Predictors: (Constant), HDI

b. Predictors: (Constant), HDI, HDI squared

d. Predictors: (Constant), HDI, HDI squared, Per pack price, Percent tax on pack

Table 10 Regression analysis, males currently smoking cigarettes, HDI, tobacco prices, and tobacco taxation (n=98)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	31.123	1.246		24.971	.000
	HDI	36.805	6.779	.485	5.429	.000
2	(Constant)	36.396	1.777		20.479	.000
	HDI	19.574	7.698	.258	2.543	.013
	HDI Squared	-156.036	39.780	-.398	-3.923	.000
3	(Constant)	40.750	2.379		17.128	.000
	HDI	25.298	7.770	.333	3.256	.002
	HDI Squared	-136.332	39.279	-.347	-3.471	.001
	Per pack price	-1.397	.526	-.223	-2.654	.009
4	(Constant)	38.184	3.500		10.908	.000
	HDI	21.978	8.450	.289	2.601	.011
	HDI Squared	-137.150	39.288	-.350	-3.491	.001
	Per pack price	-1.601	.564	-.256	-2.836	.006
	Percent tax on pack	.075	.075	.100	.999	.320

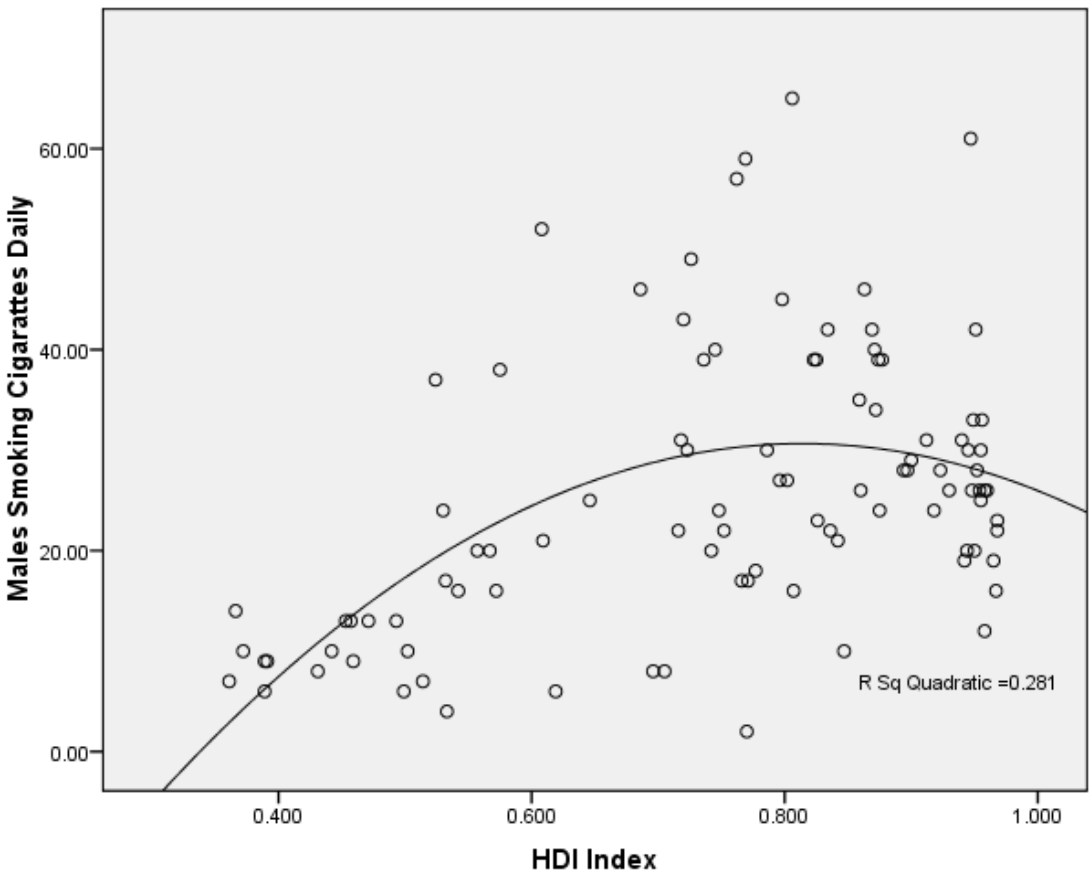

Figure 6 Scatter plot for males smoking cigarettes daily and HDI

Table 11 Model summary, males smoking cigarettes daily, HDI, tobacco prices, and tobacco taxation (n=98)

					Change Statistics		
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	Sig. F Change
1	.444[a]	.197	.189	12.31	.197	23.533	.000
2	.531[b]	.281	.266	11.70	.085	11.183	.001
3	.570[c]	.324	.303	11.41	.043	5.977	.016
4	.571[d]	.327	.298	11.45	.002	.291	.591

a. Predictors: (Constant), HDI

b. Predictors: (Constant), HDI, HDI squared

c. Predictors: (Constant), HDI, HDI squared, Per pack price

d. Predictors: (Constant), HDI, HDI squared, Per pack price, Percent tax on pack

Table 12 Regression analysis, males smoking cigarettes daily, HDI, tobacco prices, and tobacco taxation (n=98)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	25.490	1.243		20.506	.000
	HDI	32.801	6.761	.444	4.851	.000
2	(Constant)	30.062	1.807		16.634	.000
	HDI	17.863	7.829	.242	2.282	.025
	HDI Squared	-135.275	40.452	-.354	-3.344	.001
3	(Constant)	34.162	2.432		14.045	.000
	HDI	23.253	7.943	.315	2.927	.004
	HDI Squared	-116.719	40.156	-.306	-2.907	.005
	Per pack price	-1.316	.538	-.216	-2.445	.016
4	(Constant)	32.741	3.592		9.115	.000
	HDI	21.415	8.672	.290	2.469	.015
	HDI Squared	-117.172	40.317	-.307	-2.906	.005
	Per pack price	-1.428	.579	-.234	-2.466	.015
	Percent tax on pack	.041	.077	.057	.539	.591

CHAPTER V

DISCUSSION AND CONCLUSION

5.1 Discussion

As previously mentioned in Chapter 1, tobacco use kills millions of people annually. Moreover, the rates at which people are dying due to tobacco use increases with each passing year. Despite these facts, many countries throughout the world have failed to implement tobacco control policies that sufficiently protect the public from the addictive nature of tobacco and the fatal consequences of its use. Much of the current research supports the need for comprehensive tobacco control efforts through strategic, evidence-based policy initiatives such as the MPOWER policy package. Unfortunately, there is less research on how to maximize the benefits of these policies by tailoring tobacco control efforts to country-specific situations.

This study sought to partly address the issue of adapting tobacco control policies to country-specific situations by examining relationships among a country's male smoking prevalence, development, and implementation of a selected tobacco control policy (raising tobacco taxes). Development has long been an indicator of the general status of population health within in a country. Lower development is frequently associated with reduced access to quality healthcare, malnutrition, increased risks of infectious diseases, and – as life expectancy rises even in the lesser developed countries –

an increased risk of death from non-communicable diseases (NCD). Moreover, countries with lower development often lack the necessary country-level data to fully understand the scope of their public health challenges. In terms of tobacco control, the lack of sound data often stymies political will and efforts to improve policies and interventions when less developed countries are struggling with more immediate challenges, such as managing infectious diseases and providing access to food and clean water.

The absence of sound data coupled with its deleterious effects on political will is particularly troubling when viewed against the rise in global rates of NCDs and tobacco consumption. As developing countries begin to tackle and conquer public health challenges like infectious diseases, it appears these countries will face new challenges related to chronic disease prevention. Currently, many developing countries appear wholly unprepared – either due to lack of data or necessity – to address the new public health challenges related to NCDs and tobacco consumption. To help provide better data to countries, this study was undertaken in an attempt to expand the knowledge of one of the major risk factors for NCDs, smoking tobacco, by answering questions that delve into the links between tobacco control policies, development, and smoking rates.

In answering the study's first questions, results of the analysis demonstrated that male smoking prevalence, regardless of smoking status (daily or current), was positively correlated with development. This positive trend, as aforementioned, was strongly counter-intuitive given the well-documented effect of smoking on reducing life expectancy, which was discussed in detail in Chapter 2, Section 6. Moreover, regarding the correlation between educational attainment and tobacco smoking, Storr and colleagues (2009) found among males and females that tobacco

smoking rates were not always inversely related to educational attainment. Focusing primarily on European data, the researchers hypothesized that the lack of a consistent relationship between smoking rates and educational attainment could be link to inconsistent implementation of tobacco control policies in the region (2009). The trends in life expectancy and educational attainment, as well as the other development factors, required further investigation and led to the development of the second research question. The second research question, unlike the first, assumed some degree of causality between HDI values and male smoking. Conclusions from the second question are discussed below.

First, the nature of the relationship between HDI values and male smoking prevalence was not linear. Rather, the trend between the development values and smoking prevalence was better explained by a curvilinear trend. In each of the four smoking categories, male smoking prevalence tended to be low in countries with lower development. As development increased, however, prevalence tended to increase until a country reached a status of medium development as defined by the *Human Development Report*. Generally, prevalence began trending downward in countries that reached an HDI value that was considered medium development. This downward trend continued through to the highest levels of development. In other words, as development continued to increase, prevalence continued to fall.

Guindon and Boisclair (2003) hypothesized that the downward tobacco consumption trends in developed countries could be the result of the implementation of tobacco control policies. If this hypothesis proves true, it would raise important questions for policy makers. For example, in countries with lower development, like

those in Africa, male smoking prevalence is quite low when compared to other countries or regions. If the trends identified in answering the second research question hold, then Africa could potentially face a surge in its male smoking prevalence as the region's countries become more developed. The comparatively low prevalence in Africa affords the region an important opportunity for policy makers to enact tobacco control policies before the tobacco epidemic has an opportunity to take hold.

The trend of increased smoking as development increases was noted briefly in the literature, specifically in the case of the Russian Federation. Although male smoking has historically been high in the country, female smoking and initiation rates among girls increased significantly since the collapse of the Soviet Union (Perlman et al., 2007). Moreover, the male smoking rates in the country, which models predict should be decreasing, have remained stubbornly high (Perlman et al., 2007). Though this study did not look at the Russian Federation's data individually, it is worth noting for future investigation that one of the key markers of development for HDI – GDP – rose substantially both in nominal and real terms during the post-Soviet years of the Putin administration, which lasted from 1999 to 2008.

In addition to the policy considerations raised for developing countries in regions like Africa or in countries like the Russian Federation, the second research question also highlighted trends that could bring about entirely different considerations for more developed countries. As aforementioned, this study indicated a downward trend in adult male smoking prevalence as development increased. Such a trend could be the result of a number of factors, including but not limited to the introduction of smoke-free policies, greater responsiveness to anti-tobacco messages, or better enforcement of tobacco control

policies. The joint impact of development and tobacco control policies on prevalence requires further exploration to gain a more complete understanding of the policy-development dynamic.

The third research question aimed at exploring the policy-development dynamic by looking at one particular MPOWER policy: raising tobacco taxes. Raising taxes has widespread recognition as an effective, if not perfect, strategy for reducing demand for tobacco. The third research question, which controlled for development, yielded an unexpected result: tobacco taxation was not significantly associated with reductions in adult male smoking prevalence, regardless of smoking status. The association between price per pack and prevalence, however, was found to be statistically significant. The price per pack's stronger relationship to prevalence has important implications for policy makers because it indicates that more detailed analysis is required to fully understand how tobacco taxes can be levied in such a way that prevalence is actually reduced. In order for tobacco taxes to be effective, they should be sufficiently high to impact price per pack in a meaningful way. Moreover, tobacco taxes should be broad-based and cover all tobacco products equally to prevent substitution from smoked tobacco to non-smoked tobacco. Lastly, to maintain long-term effectiveness, tobacco taxes should be structured so that tax rates are not outpaced – and hence diluted – by inflation.

5.2 Study Limitations

A study of this nature presents several limitations. First, many of the data points were collected at different periods in time and were adjusted to reflect a specific year.

For example, in the case of the prevalence data, all prevalence estimates were adjusted to year 2006 regardless of the year in which the data was actually collected. In addition to limitations related to the time at which prevalence data was collected, other adjustments were required to the current data set to account for differences in sample sizes, sample designs, and variations in tobacco use questionnaires.

Moreover, sample selection for individual country surveys could have been compromised by the absence of current census data, which impacts the enumeration and selection of a representative sample. In addition to the limitations already listed, tobacco use data has been considered somewhat imprecise because of issues with self-reporting. In many countries, tobacco use is highly stigmatized; as a result, many smokers will underreport their smoking status. Without biochemical measurements such as a salivary cotinine test, researchers must consider the bias that is introduced as a result of underreporting. All of these adjustments and considerations ultimately impact the ability to generalize results beyond the originally chosen samples and reduce the reliability and validity of the results.

Beyond prevalence data, tobacco prices per pack require additional scrutiny as well. Price per pack was determined by purchasing the most popular brand of cigarette in a given country at a given time. There are a number of limitations to such a method of determining prices in this manner. Perhaps the most notable is assuring that price per pack is truly indicative of prices at the national level. Minor variations in price per pack could have a significant effect on the conclusions drawn in this study. Likewise, the method for fully understanding total taxation rates – a component of price per pack – requires knowledge beyond the mere purchase of a pack of the most popular smoked

tobacco. For example, taxation rates vary widely throughout the world and each country uses a unique formula to levy tobacco taxes. To fully understand how and when tobacco taxes are levied requires familiarity with the tobacco taxation policy itself. Simply purchasing a pack of smoked tobacco typically fails to provide sufficient data to fully work out the total taxation rate on tobacco products.

Beyond the limitations of the tobacco data, the HDI data also has several limitations. The HDI values make it difficult to compare a country to itself over time because the countries are all ranked relatively against each other during every cycle of HDI calculations. For example, if Country X's life expectancy changes dramatically from one data collection cycle to the next, then the effect of this change in life expectancy could be muted or over exaggerated were other countries' life expectancy data to shift dramatically. Also, because the HDI composite variables are bounded by zero and one, the weight of composite variables that approach zero or one are reduced in comparison to other variables that are not as close to these bounds. For example, the life expectancy value is limited at 85 years of age. Were a country to cross this threshold, any additional HDI value gain attributed to an increase in life expectancy would be lost over that age. A limitation that is also seen with the prevalence, pricing, and taxation data is the reliance on national averages. All the data used in this study looks at the variables of interest on a national level. The absence of sub-national data impinges upon a country's ability to effectively support the implementation of robust tobacco control policies.

5.3 Recommendations

Although this study attempts to better understand the relationships among development, tobacco control policy, and adult male smoking prevalence at the global level, more research is required to determine how these factors influence each other within individual countries. As part of that country-level research, rigorous analyses accounting for all key indicators of the MPOWER policy package (not just tobacco taxation), development, and prevalence should be conducted on an ongoing basis at the global and national levels. Such systematic surveillance will give public health practitioners and policymakers the sound data needed to design interventions and implement tobacco control policies that actually reduce tobacco consumption. To that end, greater emphasis must be placed on providing support to standardizing not only the collection of tobacco use data but also the collection of development data.

In addition to collecting better data at the country level, public health practitioners and policymakers should look towards translating data into action by creating interventions and tobacco control policies that target country-specific needs. The scope of the tobacco epidemic varies widely among nations, and there is no single solution that will work in every country. Moreover, it is especially important that countries with low prevalence seize the opportunity to protect their populations from tobacco use before the tobacco industry has a chance to encourage growth of the tobacco epidemic. Likewise, countries with higher development should make greater efforts to not only understand their tobacco control successes but also share lessons learned with other countries.

While data collection and creating policies that reduce consumption are key to curbing the tobacco epidemic, stakeholders at all levels should look beyond the demand

reduction strategies that were the focus of this study. Demand reduction is but one piece of FCTC. The supply reduction requirements of FCTC, which are beyond the scope of the MPOWER policy package, represent major challenges for many countries. Until countries are able to substitute tobacco crops with non-tobacco crops in an economically sustainable way, tobacco will likely find ways into the markets. Without economically sustainable alternatives to tobacco production, many governments will remain tepid in their support for aggressive tobacco control policies. With the goal of reducing supply in mind, future tobacco-focused research efforts must work to generate sound data on strategies that enable countries to reduce their reliance upon the tobacco industry and its harmful, addictive products.

The recommendations above mainly focus on improving national level data. In addition to improving national level data, countries must also improve the collection of sub-national data. National data enables countries to gauge success on a worldwide level and align their tobacco control efforts with the evidence-based policies set forth in packages like MPOWER. However, to aggressively counter tobacco consumption and tobacco industry activities, countries will require nuanced information about variations in consumption in different areas or populations within a country. Without this type of data, policymakers and public health practitioners may find it difficult to make the case for comprehensive tobacco control measures.

5.4 Conclusions

Global adult male smoking prevalence is a significant public health threat. To combat this threat and stem the growing tobacco epidemic, research should continue investigating the variables that influence smoking prevalence. This study contributed to that research by recognizing a significant relationship between development and smoking rates. In addition, this study demonstrated that smoking rates, whether high or low, cannot be fully explained by tobacco control policies alone. To better understand the complex nexus of the social determinants of smoking and the tobacco control policies aimed at reducing consumption, further examination is required. By continuing research like that conducted here, tobacco researchers and experts will assist policymakers and public health practitioners by generating evidence that supports more ecological, less prescriptive, and perhaps more effective tobacco control measures.

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