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Comparison and Analysis of Youth Tobacco Surveillance Systems: Lessons Learned and Future Implications

Ichhya Pant

ABSTRACT

ICHHYA PANT

Comparison and Analysis of Youth Tobacco Surveillance Systems: Lessons Learned and Future Implications

(Under the direction of Michael Eriksen, FACULTY MEMBER)

Background: Tobacco use either in the form of smoking or smokeless tobacco is typically initiated or established behaviorally for adult smokers before 18 years of age. Given that data from monitoring and surveillance systems drives every policy and program, accurate surveillance of tobacco consumption by adolescents is a major part of curbing tobacco addiction.

Methodology: The consistency and reliability of youth smoking prevalence data was assessed by investigating discrepancies within versions of the Global Youth Tobacco (GYTS) as well as between GYTS and the Global School-based Health Survey (GSHS). Sources of errors and biases were examined in order to determine the cause for discrepancies in results.

Results: Significant discrepancies were found within GYTS versions as well as between the survey results produced by GYTS and GSHS. Discrepancies within GYTS versions were determined to be due to quality control errors. Analyzed by gender, negligible variation was found between boys and girls. When comparing the total smoking prevalence estimates between GYTS and GSHS, four of the six WHO administrative regions (Africa, Americas, Eastern-Mediterranean, South-Eastern and Western- Pacific) were found to have significantly different estimates. The European region did not consist of any significantly different estimates. When comparing variance in total smoking prevalence estimates, GSHS results were found to be lower than GYTS estimates with the exception of the EMRO region. The EMRO region was further analyzed to explore gender variation within the region and boys were found to have 44.5% more significantly different estimates in comparison to girls.

Conclusion: Up-to-date, reliable and consistent surveillance and monitoring efforts are part and parcel to solving this tobacco epidemic and fighting wealthy and powerful tobacco companies.

COMPARISON AND ANALYSIS OF YOUTH TOBACCO SURVEILLANCE SYSTEMS:

LESSONS LEARNED AND FUTURE IMPLICATIONS

by

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AUTHOR'S STAEMENT

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LIST OF ABBREVIATIONS

CDC: Centers for Disease Control and Prevention

WHO: World Health Organization

GYTS: Global Youth Tobacco Survey

GSHS: Global School-based Health Survey

USNLM: US National Library of Medicine

IPH: Institute of Public Health

HBSC: Health Behavior in School-aged Children

UNICEF: United Nations Children's Emergency Fund

TFI: Tobacco Free Initiative

CPHA: Canadian Public Health Association

OSH: Office on Smoking and Health

UNESCO: United Nations Educational, Scientific and Cultural Organization

AFRO: Regional Office for Africa

AMRO: Regional Office for the Americas

EURO: Regional Office for Europe

SEARO: Regional Office for South-East Asia

WPRO: Regional Office for Western-Pacific

CHAPTER I
INTRODUCTION

1.1 Background

Tobacco use either in the form of smoking or smokeless tobacco is typically initiated or established behaviorally for adult smokers before 18 years of age (The Centers for Disease Control and Prevention [CDC], 2012.a). The Centers for Disease Control and Prevention (CDC) estimates that an average of 19.5% of high school students defined as current smokers smoked one or more cigarettes in the month prior to participating in a health survey conducted in 2009. In terms of gender, 19.1% of female students and 19.8% of male students in high school were found to be current smokers. Additionally, the survey revealed that 5.2% of middle school students were current smokers. According to the same survey, 4.7% of female students and 5.6% of male middle school students were current smokers prior to beginning high school. Based on the data above, the pathway between initiation and addiction now ranges between middle school and high school for young smokers (CDC, 2012; The World Health Organization [WHO], 2012.a).

When looked at from a global perspective, the World Health Organization (WHO) reports that in five of its six geographical regions, young girls in the age group of 13 to 15 years old have higher smoking rates than their adult counterparts (WHO, 2012.a). WHO further reports average smoking rates for adolescent boys globally to be around 18%. The incidence rate for smoking of some form of tobacco among adult men is the highest at approximately 51% in WHO Western Pacific region in men aged 15 and over.

As for adult women, smoking rates are the highest at 22% in the WHO European region (WHO, 2012.a). These figures are alarming when one considers that adolescents have now initiated smoking at earlier ages and are more likely to continue smoking throughout their lifetime. These numbers help shed light on the challenges public health workers face in developing and implementing primary and secondary intervention policies for tobacco control and cessation measures. In order to accomplish such a task, it is crucial to generate awareness in younger generations regarding a lifelong nicotine addiction cycle perpetuated by smoking initiation at an early age (WHO, 2012.a).

According to the CDC, adolescent smoking is associated with the following factors: low socioeconomic status, use and approval of tobacco use by peers or siblings, exposure to smoking in movies, lack of skills to resist influences to tobacco use, smoking by parents or guardians and/or lack of parents support or involvement, accessibility, availability, price of tobacco products, a perception that tobacco is the norm, low levels of academic achievement, low self-image or self-esteem, exposure to tobacco advertising, aggressive behavior, high-risk sexual behavior and, use of alcohol and drugs (CDC, 2012.a). Tobacco use kills up to 50% of tobacco users and each year nearly 6 million people die from tobacco-attributable causes. Of these six million annual deaths, 5 million are among individuals who are current or ex-smokers and 600,000 deaths are attributed to second hand smoke exposure (WHO, 2012.b). If left unchecked and without urgent actions backed by monitoring and surveillance projects, policies and programs, WHO estimates more than 8 million deaths per annum by 2030 (WHO, 2012.b). Additionally, premature deaths caused by tobacco results in loss of family income and compromised

economic development. In the 20th century alone, the world has seen 100 million deaths caused by tobacco use (WHO, 2012.b).

When focusing on the startling current youth and adult smoking rates along with morbidity and mortality facts, a perilous picture of the future emerges. By the time adolescent smokers reach puberty, they are likely to be addicted to nicotine and attempts to quit become more difficult. If public health agencies want to focus on primary intervention strategies, which would curb the problem prior to it starting through awareness and education, the first step is to establish accurate, up-to-date and reliable global surveillance systems to monitor adolescent tobacco awareness, initiation and usage patterns. In doing so, accurate smoking rates and associated usage patterns emerge and provide baseline knowledge in order to develop tobacco control and cessation programs specifically geared towards adolescents. The ever increasing cost of healthcare is even more likely to become unsustainable in the near future with adolescents developing a full-fledged nicotine addiction at such early ages. WHO states that "surveillance is key" in curbing the tobacco epidemic by allowing for the possibility of measuring its reach then mitigating the associated risk and potential harm (WHO, 2012.b).

1.2 Purpose of the Study

To establish reliable tobacco surveillance systems with a distinct youth component, WHO and CDC have worked independently and in partnership to establish two surveillance systems that monitor tobacco use among adolescents – Global Youth Tobacco Survey (GYTS) and Global School-based Student Health Survey (GSHS). Both are school-based surveys that focus on adolescents aged 13 to 15 years old. When

comparing various versions of GYTS data, it was discovered that they were inconsistent with each other. The versions compared and discussed for this thesis are web-based data housed on official websites and data sets provided via personal communication while conducting research for an unrelated project. Given that data from monitoring and surveillance systems drives every policy and program, it was determined that a quality control process would prove beneficial with the end goal of having a master youth data set that would encompass the best of all versions available. Moreover, this study analyzed how the master GYTS data set compares to data provided by GSHS to see if and how they varied then created a data set that would contain the best of GYTS and GSHS data sets. It also included the methodology applied in order to populate the master data set with technical explanations for the variations that can be utilized by organizations to identify them accordingly. Doing so led to the development of a unique globally representative sample derived from the two state-of-the-art adolescent tobacco surveillance systems set up by WHO and CDC, in partnership with other health and government agencies.

1.3 Research Questions

This study was driven by an effort to standardize and draw a parallel between two existing adolescent tobacco surveillance data sets in order to provide consistent and comparable data that will inform policies and protocols on tobacco control and cessation projects globally. This was accomplished by answering the following questions –

1. How do the various versions of GYTS differ from each other in the data they provide? Additionally, what are some plausible reasons for the discrepancies to have occurred?
2. How does the GYTS data differ from the smoking rates provided by GSHS in common survey sites? Based on data comparison and analysis, what rationalizations can be drawn in order to account for the variation in the results?

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study is to draw parallels between two well established and recognized global tobacco surveillance systems initiated by reputable public health agencies, such as WHO and CDC. Furthermore, it is also a goal of this study to populate a master data set combining the most reliable, up-to-date and consistent estimates such that a comprehensive source of youth tobacco smoking rates is created with the best versions. However, this can only be accomplished by understanding and correctly classifying the various reasons for potential discrepancies in smoking rates that exist within GYTS and between GYTS and GSHS. The method applied in order to identify differences in smoking rates and then select the best estimates available will be provided in the methods section. In this section, we will explore the following topics in order to first gain an understanding of the similarities and differences that exist between the two data sets being compared (GYTS vs. GSHS) –

- GYTS and GSHS – dissemination and application in literature and research,
- Compare and contrast the methodology and survey design of GYTS and GSHS in order to understand the differences between the two to postulate rationalizations for differences in smoking rates,
- Various methodological considerations relating to adolescent health research,
- Explore the consistency and reliability of self-administered/self-reported accounts of smoking habits by adolescents,

- Explore the role of research settings, specifically school-based surveys, and how they affect self-reports of risky behaviors such as smoking.

By inspecting these topics further, it should be possible to understand if these factors are responsible for differences in smoking rates provided by GYTS and GSHS.

2.1 Dissemination and Application of GYTS and GSHS in Literature and Research

Since GYTS and GSHS both have analogous goals in studying and monitoring tobacco usage and patterns, it is necessary to understand how each data set is utilized by scientist, researchers, health care and public health professionals alike. If one searches "Global Youth Tobacco Survey" on a digital scientific library archive such as Pubmed, a plethora of studies utilizing GYTS is revealed. Since GYTS only consists of a questionnaire focused on tobacco usage and patterns, most of the studies utilizing GYTS are focused on smoking beliefs, attitudes, correlations and behavior, tobacco control policy, understanding prevalence and characteristics of cigarette smoking within a population and its subsets, exposure to second-hand smoke, effect of environment (school, home, work) on smoking habits etc. (US National Library of Medicine [NLM], 2012.a). Similarly, executing a search on Pubmed for "Global School-based Health Survey" reveals studies that are not only focused on tobacco related topics similar to GYTS but also studies focused on all ten topics covered by the GSHS questionnaire such as mental well-being, sexual health, physical activity, nutrition, drug use etc (NLM, 2012.b). Running a comparative search on Pubmed for both surveillance projects reveals that studies utilizing either GYTS or GSHS have similar objectives and goals even if GSHS has studies that utilize data from non-tobacco topics covered in the questionnaire.

A search for articles that utilize both studies revealed only one scientific article comparing the results of GYTS with GSHS by Page and Danielson (2011). The objective of the paper was to describe GSHS smoking rates and compare with GYTS. This was done by compiling the prevalence estimates from fact sheets available on the GSHS website. Boy to girl ratios were calculated in order to determine gender differences in tobacco use (Page & Danielson, 2011). Non over-lapping confidence intervals were applied in order to determine a statistical estimation of gender differences. The study thus provided the highest and lowest estimates along with gender and geographic comparisons of tobacco use prevalence within all six WHO regions. In their study, Page and Danielson (2011) discovered some critical similarities and differences between GYTS and GSHS–

- The GSHS determined a 0.9% smoking prevalence from a national survey conducted in Tajikistan in 2006 producing a very close estimate to the one provided by the GYTS (1.1%) in 2004. Tajikistan contains the lowest estimate for GSHS and is the lowest estimate for the European region,
- The lowest smoking rates were found to be in the Southeast Asia and Eastern Mediterranean regions in both GSHS and GYTS,
- In Macedonia, the GYTS determined a smoking prevalence of 7.7% in 2003 which varies from the estimate derived in 2007 by GSHS (10.5%),
- Varying estimates were for smoking rates in Myanmar. The GYTS reported the smoking prevalence as 10.2% in 2001 while the GSHS determined it to be only 2% in 2007.

It is evident that a range of discrepancies possibly exists between the GSHS and GYTS data sets. Therefore, the goals and objectives provided in this study would be crucial in shedding light in the comparability of both as stated in their missions.

2.2 Compare and Contrast – GYTS vs. GSHS

GYTS and GSHS are surveys that are very similar in design and methodology. Both surveys were designed to fulfill similar objectives. The survey results assist countries in developing priorities for adolescent health policies and programs. Additionally, they provide comparable smoking rates for various sites worldwide. While technical variances may exist for survey administration and data collection methods between the two surveys, the designs of the surveys are similar. One major variance is that while GYTS focuses solely on tobacco use and patterns GSHS covers ten additional topics focused on health behaviors such as nutrition, physical activity, mental well-bring etc. Another variance between the two surveys stems from the operational definitions designated to a student's smoking status. GYTS considers students to be current smokers if they smoked at least one cigarette in the month preceding the survey in comparison to GSHS which considers students to be current smokers if they smoked on one and more days out of the last 30 days.

In considering how and why the results of the two surveys may vary from each other, it is crucial to understand the differences between the two study designs. While the methodology and background of each survey has been described in detail in the methods section, this section details a synopsis of technical aspects for the two surveys. Both surveys are school-based self-administered which take up an average time of a class

period or 30 to 40 minutes in time. They consist of a core questionnaire model with the option to include country-specific questions and core-expanded questions. Surveys are administered to students aged 13 – 15 years old and utilize a standardized scientific process in survey administration, data collection and analysis. Both utilize a two-stage cluster sample design with randomized selection of eligible schools. In addition, they also consist of overlapping partnering agencies which provide technical assistance in various capacities. Further details can be found in Table 1 below. In comparing and contrasting the two surveys and their basic methodology, our hypothesis is that researchers should be able to derive analogous smoking rates from both surveys which can then be compared to the other for consistency and trends within the data (CDC, 2012.c; WHO, 2012.d).

Table 1. GYTS vs. GSHS – Compare and Contrast

MEASURES	GYTS	GSHS
Inception	1999	2003
Type	School-based survey	School-based survey
Survey interval	Every 4 years	3 to 5 years
Age	13 – 15 years old	13 – 15 years old
Focus	Tobacco use only	Obtains information on tobacco use among other leading morbidity and mortality causes mortality causes among children worldwide
Method of administration	Self-administered	Self-administered
Measure of Privacy	Anonymous and Voluntary	Anonymous and Voluntary
Duration of survey administration	30 – 40 minutes	One regular class period
Data Translation and Processing Tool	Computer-scannable answer sheets	Computer-scannable answer sheets
Partners	• Canadian Public Health Association • National Cancer Institute • United Nations Children Emergency Fund • WHO – Tobacco Free Initiative • CDC	• WHO • UNICEF • UNESCO • UNAIDS • CDC
Methodology	• Multistage sample design	• Standardized scientific sample selection

MEASURES	GYTS	GSHS
	with schools selected proportional to enrollment size utilizing a two-stage cluster sampling with random selection of schools for inclusion ● Classrooms chosen randomly within selected schools ● All students selected eligible for participation ● Anonymous and confidential participation ● Country-specific questions ● Computer scannable answer sheets ● Core questionnaire ● Country level data with regional stratification possible	process ● Common school-based methodology ● Two-stage cluster sampling with random selection of schools for inclusion ● Classrooms chosen randomly within selected schools ● Core questionnaire modules ● Core-expanded questions (optional) ● Country-specific questions
Operational definition of smoking	The survey defines current smokers as students who smoked cigarettes on at least 1+ day of the past 30 days. The measure utilized is percentage and all estimates of incidence are listed accordingly.	The survey defines current smokers as students who smoked cigarettes on at least 1 day during the month preceding the survey. The measure utilized is percentage and all estimates of incidence are listed accordingly.

2.3 Methodological Considerations – Adolescent Health Research

During adolescence, individuals are very impressionable because cognitive development and identity formation is still on-going (Stein, Colby, O'Leary, Monti, Rohsenaw, Spirito, Riggs & Barnett, 2002). Research suggests that adolescents that have established daily smoking by age 15 can be attributed partially to smoking habits formed between 11 to 13 years (Colder, Balanda, Mayhew, Pentz, Mehta, Campbell, Stanton & Flay, 2001). This implies that adolescence, especially at its initial stage, is a seminal period in determining and shaping the development smoking habits. Furthermore, epidemiological trends suggest that it is during adolescence that cigarette use peaks (Colder et al., 2001). Researchers claim that this is precisely why understanding and

identifying different patterns of smoking onset and escalation is crucial to curbing the smoking epidemic. For this reason, the adolescent state of mind is a major methodological consideration related to the objectives of this thesis. Colder et al. (2001) also maintain that there isn't enough known regarding the trajectory of cigarette consumption that leads to various etiological pathways for adolescents. The identification of sub-groups based on usage patterns and nicotine dependence is also considered crucial in developing and implementing effective interventions (Kleinjan, Vitaro, Wanner, Brug, Van & Engels, 2012). If researchers hope to curtail the smoking epidemic, given the addictive nature of nicotine and tobacco combined with the emotional, physical and lifestyle changes that occur during adolescence, it is imperative to understand the trajectory of nicotine dependence prior to initiation and throughout usage (Kleinjan et al., 2012). Additional technical methodological considerations, such as choice in research settings (household, school-based, clinical and correctional settings) and research instruments (interviewer vs. self-administered questionnaire), have special implications for emotionally volatile adolescents.

While both GYTS and GSHS have utilized identical research settings and instrument, literature suggests that it is still possible for variances to exist within data sets despite utilizing common methodology (CDC, 2012.a; CDC, 2012.b; Stein et al., 2002). A detailed overview describing the various nuances and associated implications of research findings related to these two factors have been provided below.

2.3.1 Self-Reported Cigarette Smoking Accounts – Is It Consistent and Reliable?

In order to expound further on the various reasons data may differ between GYTS and GSHS, one notable fact is that both surveillance systems utilize an anonymous self-administered survey to adolescents aged 13-15 years old. Self-reported accounts of smoking and behaviors have long been questioned and studied by researchers for their validity and reliability, due to various reasons such as perceptions of social undesirability, recall bias, under or over reporting and fear of disclosure or repercussions (Kleinjan et al., 2012). However, one cannot discount that self-administered surveys are cost effective and efficient means of getting data from a target population. A meta-analysis of 26 studies conducted to compare the validity of self-reported smoking accounts to biochemical assessments reported that self-reported surveys had an overall high sensitivity (87%) and specificity (89%) (Patrick, Cheadle, Thompson, Diehr, Keopsell & Kinne, 1994). However, sensitivity and specificity rates varied depending on research setting, study population, measurement methods, and study objective. This meta-analysis suggested that self-reported accounts of smoking habits are more likely to be accurate in interviewer-administered surveys in comparison to self-administered surveys. This was attributed to sensory cues that would be obvious to the interviewer thus causing the participant to more honest about their smoking status. With regard to research setting, student respondents, such as the ones involved in the GYTS and GSHS surveys were found to have lower sensitivity and therefore were more likely to deny smoking even when biochemical validation measures classified them as such in comparison to participants in the general population (Stein et al., 2002; Patrick et al., 1994). Given that

cigarette smoking is illegal for minors in most states and countries, the rationale behind the low specificity in students, as stated by the authors, was response distortion or misappraisal due to "conscious (fear of being found out) or unconscious (self-definition inconsistent with behavior)" rationalizations (Patrick et al., 1994). Researchers report that it is particularly difficult to assess accuracy in self-reports in adolescents because of their incomplete cognitive development as well as impressionable and immature identity formation (Stein et al., 2002).

One such pilot study conducted by Stein et al. (2002) sought to study the factors behind conscious and willful response distortion on the part of those who willfully misreport. Researchers discovered through this study that in an intervention setting, purposeful misreporting, such as under or over reporting, does occur with claims of truthful reporting being the most common approach taken by adolescents. They attributed maintaining impressions and fear of disclosure as a substantial factor to cause misreporting by adolescents with 25% to 40% of the study participants endorsing this rationalization as the most likely reason that adolescents misreport their smoking status. Researchers also state that often adolescent's under-report due to misappraisal and therefore not all response distortion is willful and purposeful on the respondents' part. Participants in such situations resort to self-deception and internal impression management to cope with their fears of being addicted, to manage feelings of guilt or to enforce their belief and desire to quit. As such it seems that rationalizations for response distortion are quite complex. Similar forms of misappraisal were found related to over-reporting of smoking habits where adolescents who feel dependent on tobacco may over-

report their usage. Moreover, researchers state that for some adolescents over-reporting may be a form of seeking help. It was also discovered that age is inversely correlated to misreporting and younger respondents were more likely to misreport due to fear of disclosure or parental/legal repercussions. This finding corroborates similar discoveries regarding minors and response distortion due to fears of being caught and reprimanded by Patrick et al. (1994).

For some researchers validation of smoking status through biochemical measures, such as cotinine (in plasma, saliva, or urine), carbon monoxide (in expired air), and thiocyanate (in plasma or saliva) is the "gold standard" in order to accurately classify smoking status in all populations (Patrick et al., 1994). Due to its high cost and logistical complexities, conducting biochemical validation isn't always practical for most researchers. Additionally, biochemical validation isn't absolute in its assessment according to Patrick et al. (1994). They state that elevated levels of carbon monoxide and thiocyanate can be found in non-smokers or tobacco users and similarly cotinine, a nicotine metabolite is also present in elevated levels in users of snuff and chewing tobacco. Furthermore, conducting biochemical validation requires substantial funding since the cost varies from $1 per sample for a carbon monoxide sampling to $20 per sample for cotinine analysis with additional costs associated with execution, logistics, storage and handling. If one considers the extra time and data analysis that is required on top of high costs and demanding logistical requirements, it is quickly evident that biochemical validation isn't ideal or practical for most studies wanting to assess smoking rates and trends. Patrick et al. (1994) based on the results from their meta-analysis

recommended self-administered surveys combined with biochemical validation due to the low specificity of student estimates in self-reported accounts. However, given that biochemical validation is a costly and cumbersome endeavor, Patrick et al. (1994) also recommend utilizing a procedure known as the bogus pipeline method as an alternative strategy. In the bogus pipeline procedure, researchers inform survey participants that their reports may be objectively verified utilizing biochemical tests. This is done in order to create a placebo effect in the minds of the participants so that they are forced to provide an accurate self-report of their smoking status. In actuality, verification does not take place despite taking samples and specimens.

It is evident based on the various studies described above that self-reported accounts especially among adolescents and students through self-administered questionnaires can produce varying smoking status accounts. Therefore, it can be considered as a plausible factor in accounting for differences found between the smoking rates provided by GYTS and GSHS.

2.3.2 The Role of Research Setting – Do Responses and Results Vary?

Another study design measure that is identical between GYTS and GSHS is that they are both school-based surveys and thus should result in similar data between the two surveys. However, it is worth exploring whether any methodological issues arise due to both surveillance projects utilizing schools as the research setting and if the estimates derived have inherent biases due to the chosen setting. For example, researchers hypothesize that school-based surveys in general produce higher estimates due to guaranteed anonymity and confidentiality in comparison to household surveys (Kann,

Brener, Warren, Collins & Giovino, 2002). Kann et al. (2002) state that when comparing surveys conducted in a school-based setting versus a household setting determined that self-reported accounts that varied the most were related to socially stigmatized behaviors or illegal activities. This further corroborates the findings that socially stigmatized or behaviors related to illegal activities in minors lead to response distortion and misappraisal. Findings by Kann et al. (2002) further conclude that the deciding factor which leads to response distortion may be related to privacy or the perception of privacy. Adolescents clearly fear disclosure, repercussions and reprimand and therefore always seek to manage internal and external impressions by resorting to response distortion or misappraisal. However, it is worth noting that the self-reported smoking status did not significantly vary between the two settings. Their findings are consistent with other studies that find higher smoking rates among school-based surveys in comparison to household surveys (Groefer, Wright & Kopstein, 1997; Rootman & Smart, 1985). It is also hypothesized that while school-based surveys populate higher smoking rates, they are closer to a biochemical measure of smoking incidence in comparison to household surveys (Hedges & Jarvis, 1998). This suggests greater accuracy in school-based surveys rather than over-reporting on the student's part (Hedges & Jarvis, 1998; Gans & Brindis, 1995). Given that both the GYTS and GSHS provide anonymity and confidentiality despite being conducted in schools should guarantee that fears of disclosure would be negated when reporting smoking status. Therefore, data derived from both should yield comparable smoking rates. With more common features between the two surveys rather

than discrepancies, youth smoking rates from common countries should in theory reveal analogous estimates.

CHAPTER III

METHODS AND PROCEDURES

3.1 Data Source

There are two primary data sources utilized in this thesis – Global School-based Health Survey and Global Youth Tobacco Survey. Versions of both studies were received by the Institute of Public Health (IPH) at Georgia State University as resources to gather data from while working on an unrelated project. At this time, various discrepancies were found within different versions of GYTS, which led to the objectives stated in this thesis. Detailed methodology applied in conducting quality control and populating master data sets are provided in section 3.4.

Global Youth Tobacco Survey (GYTS): GYTS was conceived as a result of a joint partnership between the World Health Organization – Tobacco Free Initiative (WHO-TFI), US Centers for Disease Control and Prevention – Office on Smoking and Health (CDC-OSH), Canadian Public Health Association (CPHA), and most WHO member states. It is a tobacco related survey that is conducted in schools among students aged 13-15 years old. The surveys are self-administered and can be completed within 30-40 minutes. The self-administered survey tool is a computer-scannable answer sheets. The goal of the survey was to produce global data on smoking prevalence through cost-efficient and practical means which would in turn result in tobacco control and prevention programs (CDC, 2012.c). With a successful pilot-tested study in 12 countries launched in 1999, GYTS had been conducted in 140 countries and 11 territories in all six administrative regions of WHO by 2007 (CDC, 2012.c). The Global Youth Tobacco

Survey (GYTS) falls under the surveillance and monitoring efforts for the Tobacco Free Initiative (TFI). TFI initiated a meeting in 1998 in partnership with the Centers for Disease Control (CDC), the United Nations Children's Emergency Fund (UNICEF), the World Bank and representative from the six regions of the World Health Organization (WHO) to develop a tobacco surveillance system which will provide "standardized mechanisms to collect youth tobacco use information on a global basis" (CDC, 2012.c). As a result of this meeting, GYTS was initiated and run by the CDC and WHO in partnership. GYTS is funded by the Canadian Public Health Association, National Cancer Institute, United Nations Children Emergency Fund (UNICEF), and the World Health Organization – Tobacco Free Initiative (WHO, 2012.a). Surveys are repeated in 4 to 5 year intervals in most countries. In the 13 years since its inception, GYTS has become the largest, practical and cost-efficient youth tobacco surveillance system (CDC, 2012.c).

The overall goal of GYTS as stated on WHO website for GYTS, is to assist countries enhancing their abilities to track tobacco use by youth in the population such that it aids tobacco prevention and control efforts. Furthermore, GYTS utilizes standardized methodology for all aspects of survey administration, collection, translation and management. In addition to all these applications of the GYTS data, it is a practical and easily accessible means for anyone with internet access to gather information on the following seven domains surrounding youth smoking – knowledge and attitudes of young people towards cigarettes, prevalence of cigarette smoking and other tobacco use among young people, role of the media and advertising in young people's use of

cigarettes, access to cigarettes, tobacco-related school curriculum, environmental tobacco smoke (ETS) and cessation of cigarette smoking (CDC, 2012.a).

Overall, GYTS consists of 56 core questions with an option to add additional country-specific questions if desired as well (CDC, 2012.a). Of the seven domains listed above, the only topic that applies to the objective of this thesis is the prevalence of cigarette smoking.

Global School-based Health Survey (GSHS): GSHS was chosen as a benchmark for conducting quality control in this thesis because it is very similar to GYTS as it is a school-based survey with students primarily aged 13 to 15 years old. Like GYTS, GSHS is a surveillance system tailored to monitor and evaluate health behavior and protective factors in ten areas involving adolescents (WHO, 2012.c). It was developed by WHO in a partnership with the Centers for Disease Control (CDC), the United Nations Children's Fund (UNICEF), UNCESCO and UNAIDS.

The purpose of GSHS is to garner accurate data on youth health behaviors and protective factors so that it facilitates countries in understanding what their health priorities are and to establish programs to mitigate these priorities. Furthermore, GSHS allows international agencies and countries to be able to draw comparisons with estimates from other homogenous surveys. Lastly, GSHS data should further health programs and evaluations by establishing trends in health behaviors and protective factors (WHO, 2012.c). GSHS, like GYTS, utilizes standardized methodology for all aspects of survey administration, collection, translation and management. However, unlike GYTS, GSHS does not only focus on tobacco use as their primary and sole factor of interest. Ten non-

tobacco related questionnaire modules are also conducted during the survey process – alcohol use, dietary behaviors, drug use, hygiene, mental health, physical activity, protective factors, sexual behaviors, tobacco use and violence and unintentional injury (WHO, 2012.c). In this thesis, we will only focus on the tobacco related data derived from GSHS. Thus far, more than 420,000 students have completed the GSHS survey with a total 73 countries having completed a full report. There are more than 107 countries that function as participating members of the GSHS and these states have been divided into the six WHO regions – Regional Office for Africa (AFRO), Regional Office for the Americas (AMRO), Regional Office for the Eastern Mediterranean (EMRO), Regional Office for Europe (EURO), Regional Office for South-East Asia (SEARO), and Regional Office for the Western-Pacific (WPRO) (WHO, 2012.e).

3.2 Study Population

Students aged 13 to 15 years old served as the survey participants for both GSHS and GYTS. The survey sites were schools within the six global administrative regions of WHO. A two-stage cluster sample design was used whereby schools were selected proportional to their enrollment size, and then classes were randomly selected in which all students in the selected classes were eligible to participate. GYTS has surveyed over 2 million students worldwide in 11,000 schools (CDC, 2008). This is representative of 140 countries and 11 territories (WHO, 2012.d). Similarly, GSHS has reached out to over 420,000 students representing more than 73 countries from all around the world (CDC, 2011). The overall response rate was reported to be greater than 80% in 199 sites and <60% in 8 sites for GYTS (CDC, 2008). For GSHS, the overall response ranged from

60% to 99.8% in a study which included 195,326 students that participated in GSHS (Page et al., 2011). The initial sample in the study consisted of 110 sites representing 44 countries. Of the 110 sites, 89 provided data on current cigarette smoking prevalence. These 89 sites represented 34 of the total 44 countries that conducted the survey and included tobacco use questions in the survey. Lack of data for some of the missing sites could be attributed to countries opting to not utilize and include survey questions on tobacco use (Page et al., 2011).

3.3 Study Measures

- **Operational Definition(s) -**

For the purpose of this thesis, current smokers have been defined as a percentage of students who smoked cigarettes on at least one day during the month preceding the survey by GYTS. Likewise, GSHS defined current smokers as a percentage of students who smoked cigarettes on at least 1+ day of the past 30 days. Operational definitions applied when designating a significance status for all comparisons are listed in Table 2.

Table 2. Significance Designation Coding Tool

SIGNIFICANCE DESIGNATION	DEFINITION
Yes	Significantly different from the estimate in the other data set
No	Not significantly different from the estimate in the other data set
Not applicable	Estimate for one data set is not available for comparison therefore significance cannot be determined
Not available	Data is not available for both data sets

In order to determine whether the data found within the two data sets are significantly different from each other, the following criterion was set – the data presented in the two data sets do not match each other and the prevalence estimate in one data set is outside the range for the confidence interval estimates provided in the other data set or vice-versa.

3.4 Data Analysis

3.4.1 Data Sets - Overview

One of the main objectives of this thesis project was to conduct quality control within the various versions of the GYTS data sets and create a master GYTS data set that would contain the best of both GYTS versions. In order to accomplish this goal, two versions of GYTS data sets (Original and Online) were compared. The first version titled GYTS Original was received via personal communication by the Institute of Public Health. The second version titled GYTS Online is housed on all official GYTS website and can be accessed by individuals at any given time with internet access from an official GYTS website. GYTS Combined was derived by selecting the best of GYTS Original and GYTS Online data sets. All comparisons conducted for this thesis were done manually on a country by country basis. Data analysis was conducted utilizing MS-EXCEL software specifically the formulas and functions tools. A total of 194 countries were chosen and these countries were modeled after the countries utilized in *The Tobacco Atlas* (2012).

Then, GYTS Combined was compared with the GSHS data set and differences between both data sets were analyzed to comprehend how the results of the two comparable surveys differed from each other. A master data set was created with the best

estimates available from either GYTS or GSHS. Although initially the GYTS Factsheets were to be one of the versions of GYTS data to be compared and utilized in GYTS Combined, this was not possible because the factsheets did not provide confidence interval estimates. Still, GYTS Factsheets were compared with GYTS Combined for sample sizes and also for the corroboration of conflicting prevalence estimates from either GYTS Original or Online. In the interest of having a globally representative sample, the master data set included sources outside of GYTS and GSHS in order to find smoking rates for countries that had data unavailable in either data sets. The criterion set for these searches was as follows –highest priority given to national surveys by the native government health agency. Otherwise, primary priority was still given to national or nationally representative samples, an alternative preferred source was the Health Behavior in School-aged Children (HBSC) data sets due to its similarity to both GYTS and GSHS surveillance study design and objectives. For countries that did not have any smoking prevalence estimates available after exhausting all available resources, regional averages were applied in order to have an educated estimate listed in the master smoking prevalence estimates document. Analysis wasn't conducted for the outside sources because the data utilized here is covered by both GSHS and GYTS. Additional estimates found in this data set lack other comparable data estimates therefore they cannot be compared and analyzed.

For GYTS vs. GSHS comparisons, the prevalence variance estimates were derived by subtracting GYTS values from GSHS values.

3.4.2 Data Selection - Protocol and Guidelines

In order to populate data that would capture the best of the estimates available, the following criteria was set in no specific order of importance – in terms of data type, a national sample was preferred over sub-national samples; for sample size, larger sample sizes were selected over smaller ones; for sub-national samples, survey sites with capital cities were preferred followed by administrative capitals, cities with the largest population and finally any city available through the survey that is nationally representative. Samples that were closer to the current year (2012) were preferred over older ones; samples that presented conflicting data were corroborated with the country-specific GYTS Factsheet and the samples matching the factsheet were utilized. In terms of the order of importance, a nationally representative sample is sought to be the gold standard set for the master data set therefore data that reflects as close to or are nationally representative samples have been selected overall. GYTS Online was utilized as the default data choice when presented with homologous options without any other means to distinguish the better sample between the two data sets (Ex: Same year of survey). The rationale behind this was to utilize a data set that can be accessed in real time by anyone seeking information through an official GYTS website. When presented with conflicting and inconsistent data from one data set the other data set was utilized.

While these were the primary criterion set, these rules were not all inclusive and an overarching theme of reliability, representativeness and recent was applied when selecting data. As stated above, the primary goal was to select the best data available in order to create a consistent and reliable master data set that is representative of the current youth smoking rates worldwide.

CHAPTER IV

RESULTS

4.1 GYTS Online vs. Original

4.1.1 GYTS Online vs. Original – By Gender

When comparing the various subsets of GYTS data sets (Original vs. Online), it was established that out of a total of 194 countries, data was available for 161 countries. Of these, 33 countries did not have data available. Out of the 161 countries with available data, 130 countries (80.7%) had matching data in both the GYTS Original and GYTS online data sets. For the 31 countries (19.3%) that contained conflicting smoking estimates, 13 were sourced from the original data set (41.9%) and the remaining 18 (58.1%) were chosen from the data available on official GYTS websites.

Table 3. GYTS Online vs. Original – By Gender

SMOKING PREVALENCE						
Countries	Total	%	Boys	%	Girls	%
No match	**31**	**19.3**	**31**	**16.0**	**31**	**16.0**
SD	*9*	*29.0*	*11*	*35.5*	*9*	*29.0*
NSD	*22*	*71.0*	*20*	*64.5*	*22*	*71.0*
Match	**130**	**80.7**	**130**	**67.0**	**130**	**67.0**
Total	**161**	**100.0**	**161**	**100.0**	**161**	**100.0**

SD: Significantly different
NSD: Not significantly different

Table 3 details nine non-matching countries (29.0%) between GYTS Online and GYTS Original that consisted of significant differences between each other when comparing the total smoking estimates. For the boys' data, 11 countries (35.5%) had significantly different results. Similarly, nine countries (29.0%) were significantly different for the girls. Overall, five countries (16.1%) had significantly different

estimates for all three variables – total, boys and girls. Appendix 1 lists the 31 countries that have varying estimates between the GYTS versions (Online vs. Original) along with results of the comparison between total, boys' and girls' smoking prevalence estimates.

Table 4. GYTS Online vs. Original – Error Classifications

ERROR CLASSIFICATION	DESCRIPTION	COUNTRIES	TOTAL	% (n=31)
Data entry error	Data entry errors found consisted of prevalence estimates that were mistyped by decimal points or digits as well as transposition of confidence intervals and smoking estimates between the three prevalence estimates	Comoros, Costa Rica, *Hungary, Maldives, Montenegro, Palau and *Sierra Leone	**6**	**19.3**
Data omission error	Estimates were available in one version but missing in the other	Benin, Cote D'Ivoire, Guatemala, Honduras, Kosovo, Italy, Niue, Tonga, United Kingdom and United States of America	**10**	**32.3**
Maintenance error	Lack of quality control measures such as one version consisted of estimates from recent years but the other listed older smoking prevalence estimates and data from the same year with entirely different prevalence estimates	Brazil, Cambodia, Chad, Colombia, Cuba, Cyprus, Gambia, Ghana, *Hungary, Lao People's Democratic Republic, Lebanon, Mexico, Pakistan, Saudi Arabia, *Sierra Leone and, Turkey	**15**	**48.4**
TOTAL	-	-	**31**	**100**

*Hungary & Sierra Leone consist of two error types but have only been counted once because only distinct countries have been taken into account when calculating total numbers and percentages

Table 4 lists the countries with varying data between GYTS Original and GYTS Online and classifies the types of discrepancies found during the comparison process. With the information gathered in Table 4, we can surmise the following points regarding the nature of discrepancies and the possible reasons they occurred. A total of six non-matching countries (19.3%) out of 31 total were found to have discrepancies that can be

attributed to data entry errors. The data entry errors could be further isolated into prevalence estimates that were mistyped by decimal points or digits (Ex: Comoros, Hungary, Montenegro, and Sierra Leone) transposition of confidence intervals and smoking prevalence estimates between Total, Boys and Girls (Ex: Costa Rica, Maldives and Palau). A total of ten non-matching countries (32.3%) had data available in one version but not the other thus being classified as a data omission error. For example, 5 countries utilized GYTS Online (Benin, Cote D'Ivoire, Guatemala, Honduras and Kosovo) because GYTS Original did not have any data available. Similarly, an additional five distinct countries utilized GYTS Original (Italy, Niue, Tonga, United Kingdom and United States of America) because GYTS Online did not have any data available. Finally, 48.4% of all non-matching countries (n=31) or a total of 15 distinct countries have been classified as maintenance errors. The maintenance errors could be further isolated into two major sub-errors - completely different smoking prevalence estimates for data listed as the same survey year (Ex: Chad, Columbia, Cyprus, Hungary and Sierra Leone) and one version consisted of smoking prevalence estimates from a more recent survey year than in the other version countries (Ex: Brazil, Cambodia, Cuba, Gambia, Ghana, Lao People's Democratic Republic, Lebanon, Mexico, Pakistan and Saudi Arabia). It is worth noting that Hungary and Sierra Leone were the only two countries that consisted of more than one error types. However, they were only counted once to avoid misrepresenting the total number of distinct countries that consisted of discrepancies between the two documents.

Data entry errors can be resolved by conducting cross-checking and quality control of the different versions of data sets. Data omission errors can be also be resolved by taking the same measure and inserting data from the version that has it available to the one that missing the entry altogether. Similarly, countries that have data available from surveys that were conducted more recently in one version but listed results from older survey years in another version could be reconciled by conducting regular updates, cross-checking and maintenance of database, web pages and documents. Taken together, the three error type can all be classified as quality control errors.

4.1.2 GYTS Online vs. Original – By Region

Table 5. GYTS Online vs. Original – Total smoking prevalence by region

TOTAL SMOKING PREVALENCE														
Countries	**AFRO**	**%**	**AMRO**	**%**	**EMRO**	**%**	**EURO**	**%**	**SEARO**	**%**	**WPRO**	**%**	**TOTAL**	**%**
No match	**7**	**16.3**	**8**	**23.5**	**3**	**14.3**	**7**	**13.0**	**1**	**10.0**	**5**	**23.8**	**31**	**19.3**
SD	*3*	*42.8*	*1*	*12.5*	*1*	*33.3*	*2*	*28.6*	*0*	*0*	*2*	*40.0*	*9*	*5.6*
NSD	*4*	*57.2*	*7*	*87.5*	*2*	*66.7*	*5*	*71.4*	*1*	*100*	*3*	*60.0*	*22*	*13.7*
Match	**36**	**83.7**	**26**	**76.5**	**18**	**85.7**	**25**	**46.3**	**9**	**90.0**	**16**	**76.2**	**130**	**80.7**
Total	**43**	**100**	**34**	**100**	**21**	**100**	**32**	**100**	**10**	**100**	**21**	**100**	**161**	**100**

SD: Significantly different | NSD: Not significantly different

In terms of regional differences in the prevalence estimates between the two data sets, Table 5 details that for all non-matching total smoking prevalence estimates, the AFRO region (42.8%) was found to have the most number of significantly different estimates followed by WPRO (40.0%), EMRO (33.3%), EURO (28.6%) and AMRO (12.5%). The SEARO region (0%) was the lowest among all the regions and did not consist of any significantly different countries.

4.2 GYTS vs. GSHS

4.2.1 GYTS vs. GSHS – By Gender

Smoking prevalence estimates were populated for a total of 194 countries to meet the objectives set in this thesis. Among these 194 countries, we identified 53 countries (27.3%) that had also conducted GYTS surveys. Therefore, the 53 countries were utilized to see how smoking prevalence estimates differed from each other between GYTS and GSHS. GYTS Combined was utilized as the GYTS comparison since the Combined version followed a methodological outline described in section 3.4 and thus provides the best estimate of the GYTS values. As detailed in Table 6, 37 countries of the total 53 countries (69.8%) with both GYTS and GSHS estimates were found to have significant differences between each other when comparing the total smoking estimates. For the boys' estimates, 32 countries (60.4%) had significantly different results. Similarly, 28 countries (52.8%) were significantly different for the girls. Overall, 15 countries (28.3%) of these countries had significantly different estimates for all three smoking prevalence estimates – total, boys and girls. Appendix 2 lists the 53 countries that are in common between GSHS and GYTS, along with results of the comparison between total, boys' and girls' smoking prevalence estimates.

Table 6. GSHS vs. GYTS – By Gender

GYTS vs. GSHS - Smoking Prevalence						
Countries	**Total**	**%**	**Boys**	**%**	**Girls**	**%**
SD	37	**69.8**	32	**60.4**	28	**52.8**
NSD	16	**32.1**	21	**39.6**	25	**47.2**
Total	**53**	**100**	**53**	**100**	**53**	**100**

SD: Significantly different
NSD: Not significantly different

In terms of common survey sites, Table 7A and 7B list the variance between the prevalence estimates of non-matching countries with significantly different estimates for total smoking provided by GSHS and GYTS. For total smoking prevalence estimates, the overall variance range was -10.3% (Cook Islands) to +8.5% (Jamaica). Of the significantly different estimates, Table 7A lists the remaining 16 significantly different countries (43.2%) that had a positive variance indicating that GSHS values were higher than GYTS values.

Table 7A. GYTS vs. GSHS – Countries with significantly different total smoking estimates and a positive prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence				
Country	**GSHS**	**GYTS**	**Variance**	∑
Algeria	9.2	5.2	+4.0*	1
Antigua and Barbuda	7.4	3.6	+3.8*	2
China	8.7	1.7	+7.0*	3
Fiji	11.7	5.0	+6.7*	4
Guyana	12.0	8.1	+3.9*	5
Jamaica	23.9	15.4	+8.5*	6
Kenya	13.9	8.2	+5.7*	7
Kuwait	15.9	10.8	+5.1*	8
Malawi	4.9	2.9	+2.0*	9
Maldives	9.1	3.8	+5.3*	10
Morocco	5.2	3.5	+1.7*	11
Niue	16.1	10.5	+5.6*	12
Pakistan	6.3	2.0	+4.3*	13
Suriname	10.4	6.9	+3.5*	14
United Arab Emirates	9.8	8.0	+1.8*	15
Zimbabwe	5.8	3.2	+2.6*	16

Variance Range: GSHS values – GYTS values

Likewise, Table 7B lists 21 out of 37 (56.8%) significantly different countries where GSHS values that were lower than GYTS values, therefore consisting of a negative prevalence variance.

Table 7B. GYTS vs. GSHS – Countries with significantly different total smoking estimates and a negative prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence				
Country	**GSHS**	**GYTS**	**Variance**	**∑**
Argentina	21.0	24.5	-3.5*	1
Benin	2.8	7.2	-4.4*	2
Botswana	7.0	14.3	-7.3*	3
Chile	29.0	34.2	-5.2*	4
Colombia	20.5	26.2	-5.7*	5
Cook Islands	19.7	30.0	-10.3*	6
Djibouti	3.3	6.1	-2.8*	7
Ecuador	12.6	20.5	-7.9*	8
Grenada	4.7	10.2	-5.5*	9
India	1.2	3.8	-2.6*	10
Mongolia	5.4	6.9	-1.5*	11
Myanmar	2.0	4.9	-2.9*	12
Namibia	16.1	18.8	-2.7*	13
Philippines	11.0	17.5	-6.5*	14
Saint Lucia	7.8	12.7	-4.9*	15
Saint Vincent and Grenadines	8.5	12.0	-3.5*	16
Seychelles	17.2	21.5	-4.3*	17
Thailand	8.8	11.7	-2.9*	18
Tonga	21.6	31.1	-9.5*	19
Trinidad and Tobago	9.3	12.9	-3.6*	20
Uruguay	17.7	20.2	-2.5*	21

Variance Range: GSHS values – GYTS values

4.2.2 GYTS vs. GSHS – By Region

In terms of regional variation in the total smoking prevalence estimates between the two data sets, Table 8A details that WPRO (87.5%) had the largest number of significantly different estimates followed by AMRO (86.5%), SEARO (80.0%), EMRO (55.6%), and AFRO (57.1%). The EURO region did not consist of any significantly different estimates. This can be due to the EURO region missing data on the most number of countries in comparison to all other regions.

Table 8A. GYTS vs. GSHS – Total smoking prevalence by region

GSHS vs. GYTS – TOTAL SMOKING PREVALENCE														
Countries	**AFRO**	**%**	**AMRO**	**%**	**EMRO**	**%**	**EURO**	**%**	**SEARO**	**%**	**WPRO**	**%**	**TOTAL**	**%**
SD	8	57.1	13	86.7	5	55.6	0	0	4	80.0	7	87.5	**37**	**69.8**
NSD	6	42.9	2	13.3	4	44.4	2	100.0	1	20.0	1	12.5	**16**	**30.2**
Total	**14**	**100**	**15**	**100**	**9**	**100**	**2**	**100**	**5**	**100**	**8**	**100**	**53**	**100**

SD: Significantly different
NSD: Not significantly different

- **Africa**

For the AFRO region, Table 8B.1 exemplifies that 50% (n=4) of significantly different estimates for total smoking prevalence consisted of a positive prevalence indicating that GSHS values are higher than GYTS values.

Table 8B.1. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the AFRO region and a positive prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (AFRO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
Algeria	9.2	5.2	+4.0*	1
Kenya	13.9	8.2	+5.7*	2
Malawi	4.9	2.9	+2.0*	3
Zimbabwe	5.8	3.2	+2.6*	4

Variance Range: GSHS values – GYTS values

Likewise, the other half (n=4) as detailed in Table 8B.2 consisted of a negative prevalence variance thus indicating that GSHS values were lower than GYTS.

Table 8B.2. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the AFRO region and a negative prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (AFRO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
Benin	2.8	7.2	-4.4*	1
Botswana	7.0	14.3	-7.3*	2
Namibia	16.1	18.8	-2.7*	3
Seychelles	17.2	21.5	-4.3*	4

Variance Range: GSHS values – GYTS values

- **The Americas**

For AMRO, Table 8C.1 details that 30.8% (n=4) of significantly different estimates for total smoking prevalence consist of a positive prevalence indicating that GSHS values are higher than GYTS values.

Table 8C.1. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the AMRO region and a positive prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (AMRO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
Antigua and Barbuda	7.4	3.6	+3.8*	1
Guyana	12.0	8.1	+3.9*	2
Jamaica	23.9	15.4	+8.5*	3
Suriname	10.4	6.9	+3.5*	4

Variance Range: GSHS values – GYTS values

Likewise, 69.2% (n=9) as detailed in Table 8C.2 consisted of a negative prevalence variance thus indicating that GSHS values were lower than GYTS.

Table 8C.2. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the AMRO region and a negative prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (AMRO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
Argentina	21.0	24.5	-3.5*	1
Chile	29.0	34.2	-5.2*	2
Colombia	20.5	26.2	-5.7*	3
Ecuador	12.6	20.5	-7.9*	4
Grenada	4.7	10.2	-5.5*	5
Saint Lucia	7.8	12.7	-4.9*	6
Saint Vincent and Grenadines	8.5	12.0	-3.5*	7
Trinidad and Tobago	9.3	12.9	-3.6*	8
Uruguay	17.7	20.2	-2.5*	9

Variance Range: GSHS values – GYTS values

- **Eastern-Mediterranean**

For EMRO, Table 8D.1 details that 80.0% (n=4) of significantly different estimates for total smoking prevalence consist of a positive prevalence indicating that GSHS values are higher than GYTS values.

Table 8D.1. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the EMRO region and a positive prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (EMRO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
Kuwait	15.9	10.8	+5.1*	1
Morocco	5.2	3.5	+1.7*	2
Pakistan	6.3	2.0	+4.3*	3
United Arab Emirates	9.8	8.0	+1.8*	4

Variance Range: GSHS values – GYTS values

Likewise, 20.0% (n=1) as detailed in Table 8D.2 consisted of a negative prevalence variance thus indicating that GSHS values were lower than GYTS.

Table 8D.2. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the EMRO region and a negative prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (EMRO)				
Country	GSHS Prevalence	GYTS Prevalence	Prevalence Variance	∑
Djibouti	3.3	6.1	-2.8*	1

Variance Range: GSHS values – GYTS values

Given that EMRO is the only region that consists of GSHS values that are higher than GYTS values, further analysis was conducted to explore gender variation within the EMRO region. Table 8D.3 details all the countries within the EMRO region and indicates 66.7% (n=9) of the boys' estimates and 22.2% (n=9) of the girls' estimates are significantly different respectively.

Table 8D.3. GYTS vs. GSHS – List of significantly different estimates for boys and girls in the EMRO region

Country	Boys Prevalence	Girls Prevalence
Djibouti	SD	NSD
Jordan	SD	NSD
Kuwait	SD	SD
Libyan Arab Jamahriya	NSD	NSD
Morocco	SD	NSD
Pakistan	SD	NSD
Syrian Arab Republic	NSD	NSD
Tunisia	NSD	NSD
United Arab Emirates	SD	SD
∑(SD)	**6/9**	**2/9**
% (SD)	**66.7**	**22.2**

SD: Significantly different |NSD: Not significantly different
∑(SD): Total number of significantly different countries
% (SD): Percentage of significantly different countries

- **South-East Asia**

For SEARO, Table 8E.1 details that 25.0% (n=1) of significantly different estimates for total smoking prevalence consist of a positive prevalence indicating that GSHS values are higher than GYTS values.

Table 8E.1. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the SEARO region and a positive prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (SEARO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
Maldives	9.1	3.8	+5.3*	1

Variance Range: GSHS values – GYTS values

Likewise, 75.0% (n=3) as detailed in Table 8E.2 consisted of a negative prevalence variance thus indicating that GSHS values were lower than GYTS.

Table 8E.2. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the SEARO region and a negative prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (SEARO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
India	1.2	3.8	-2.6*	1
Myanmar	2.0	4.9	-2.9*	2
Thailand	8.8	11.7	-2.9*	3

Variance Range: GSHS values – GYTS values

- **Western-Pacific**

Finally, for WPRO, Table 8F.1 details that 28.6% (n=2) of significantly different estimates for total smoking prevalence consist of a positive prevalence indicating that GSHS values are higher than GYTS values.

Table 8F.1. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the WPRO region and a positive prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (WPRO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	**∑**
Fiji	11.7	5.0	+6.7*	1
Niue	16.1	10.5	+5.6*	2

Variance Range: GSHS values – GYTS values

Likewise, 71.4% (n=5) as detailed in Table 8F.2 consisted of a negative prevalence variance thus indicating that GSHS values were lower than GYTS.

Table 8F.2. GYTS vs. GSHS – Countries with significantly different total smoking estimates in the WPRO region and a negative prevalence variance

GYTS vs. GSHS - Total Smoking Prevalence (WPRO)				
Country	**GSHS Prevalence**	**GYTS Prevalence**	**Prevalence Variance**	∑
Cook Islands	19.7	30.0	-10.3*	1
Mongolia	5.4	6.9	-1.5*	2
Thailand	8.8	11.7	-2.9*	3
Philippines	11.0	17.5	-6.5*	4
Tonga	21.6	31.1	-9.5*	5

Variance Range: GSHS values – GYTS values

4.3 Master Youth Data Set

The master data set was populated by picking the best estimates available from GYTS and GSHS in order to have a consistent and comprehensive youth smoking prevalence data set. 132 countries (68.0%) out of the total 194 countries were selected from GYTS and only 30 countries (15.5%) were selected from GSHS. Similarly, 131 countries (67.5%) consisted of national samples with the remaining 30 (15.5%) being sub-national samples. Even with data from two large-scale youth smoking surveillance projects, there were 33 (17%) countries still without data in the master data set when limited to GYTS and GSHS sources.

By choosing to include additional sources in order to find data for as many missing countries as possible, in the end the master data set consisted of only 18 countries (9.3%) with missing data to 18 countries out of a total of 194 countries. Here, there are

143 national samples (73.8%) and 31 sub-national samples (16%). The breakdown of data sources is listed in Table 9.

Table 9. Master Youth Data Set – Summary of sources

Sources	Counts
GYTS	132
GSHS	30
HBSC	8
Government Agencies	3
Research Studies/Reports	3
Not available	18
Total	194

Table 10. List of 18 countries with regional averages due to missing data

Country	Region
Angola	AFRO
Austria	EURO
Azerbaijan	EURO
Belgium	EURO
Brunei Darussalam	WPRO
Finland	EURO
Gabon	AFRO
Iceland	EURO
Israel	EURO
Kiribati	WPRO
Luxembourg	EURO
Malta	EURO
Marshall Islands	WPRO
Monaco	EURO
Nauru	WPRO
San Marino	EURO
Sao Tome and Principe	AFRO
Turkmenistan	EURO

Table 10 lists 18 countries that had missing data and thus regional averages were used. Eleven of the 18 were from the EURO region. The remaining fall into the AFRO (N=4) and WPRO (N=3) regions. The EMRO and SEARO regions do not consist of any countries with missing data.

4.4 Overall Trends

Based on the data analysis, these systematic trends were established when comparing various estimates between the various subsets of available GYTS data followed by GYTS vs. GSHS. Quality control errors were determined to be the most likely factor for discrepancies within GYTS versions. Differences between boys and girls were found to be negligible in GYTS Combined and GYTS vs. GSHS.

When comparing total smoking prevalence estimates in GYTS vis-a-vis GSHS, AMRO, EMRO, SEARO AND WPRO regions had the highest number of significantly different prevalence estimate. AFRO had the lowest number of significantly different estimates in all regions. The EURO region did not consist of any significantly different estimates. With the exception AFRO and EMRO regions, GSHS values were lower in comparison to GYTS values when comparing total smoking prevalence estimates between GYTS and GSHS. When the gender variation was analyzed in the only region where GSHS values were higher than GYTS values (EMRO), Table 8D.3 details that boys had a higher number of significantly different estimates (66.7%) compared to girls who had (22.2%) significantly different estimates only.

When looking for countries that presented faulty data, Maldives was found to be a common country that presented significantly different data for boys and girls in GYTS Online vs. Original as well as GYTS vs. GSHS. Similarly, in the AFRO region, Benin presented significantly different data both within GYTS Combined and GYTS vs. GSHS. In AMRO, Columbia and Costa Rica consisted of varying data. In the EMRO region, Pakistan presented conflicting data when comparing versions of GYTS, as well as during the GYTS and GSHS comparison. Likewise, Maldives from the SEARO region consisted

of inconsistent data in GYTS Combined and GYTS vs. GSHS. Finally, Niue and Tonga from the WPRO region presented varying data as well in both comparisons.

Countries that consisted of significantly different data for all three smoking rates (Total, Boys and Girls) were found in both data sets. In the GYTS vs. GSHS comparison, a total 15 countries were found with conflicting data for all three estimates – Botswana, Kenya (AFRO); Colombia, Ecuador, Jamaica, Saint Lucia, Suriname (AMRO); Kuwait and United Arab Emirates (EMRO); India and Maldives (SEARO); and China, Cook Islands, Fiji and Philippines (WPRO). Similarly in the GYTS Combined comparison, five countries in total consisted of significantly different data for total, boys and girls smoking prevalence estimates - Ghana and Sierra Leone (AFRO), Mexico (AMRO), Cyprus and Turkey (EURO). However, there weren't any countries that were found to be in common across both GYTS and GSHS data sets.

CHAPTER V

DISCUSSION AND CONCLUSION

5.1 Discussion

The Tobacco Atlas reports that there is greater variation between smoking rates in adults in comparison to young adults aged 13 to 15 years old worldwide (Eriksen, Mackay & Ross, 2012). This means that young adults worldwide are consistently initiating smoking and transitioning into regular smokers. Not only are health agencies worldwide seeking to understand smoking habits and attributes but so are tobacco companies because they understand that young adults are the source of their future sustainability and profits (Eriksen et al., 2012). The covert marketing tactics applied by tobacco companies which portray smoking as a tool for gaining social approval along with affordable pricing schemes make smoking an attractive behavior to adopt for young adults (CDC, 2012.b). Essentially, this is a battle for the minds and lives of young adults between health agencies and tobacco companies and unfortunately tobacco companies are the victors at the moment. This makes it even more imperative to produce consistent and reliable surveillance data so that health agencies can have an advantage in preventing smoking initiation in young adults and improving current cessation programs as well.

This study aimed to identify potential discrepancies between prevalence estimates between two similar tobacco surveillance systems (GYTS vs. GSHS) that run self-

administered surveys in countries worldwide. It also compared the various versions of GYTS to assess the consistency of data sets.

When comparing the various versions of GYTS (Online vs. Original), we established that 67.0% (n= 131) of countries matched in the data they provided. Of the remaining countries with non-matching data, 29.0% (n=31) had significantly different estimates for total smoking rates. Similarly, 35.5% (n=31) and 29.0% (n=31) had significantly different results for the smoking rates for boys and girls. Comparing the various versions of GYTS, the region with the most number of significant differences (AFRO) consisted of 30.3% more discrepancies than the AMRO region which had the lowest number of significant discrepancies. The SEARO region did not consist of any significantly different estimates. In summary, the differences found between boys and girls are equally prevalent. Also, while there were differences found between regions, neither region nor gender could be determined to be the source of the discrepancies.

Among countries with non-matching data, 19.4% (n=31) countries (Comoros, Costa Rica, Maldives, Montenegro, Palau and Sierra Leone) were found to have discrepancies that can be attributed to data entry errors. Furthermore, 32.3% (n=31) of the non-matching countries (Benin, Cote D'Ivoire, Guatemala, Honduras, Italy, Kosovo, Niue, Tonga, United Kingdom and United States of America) had data available in one version of GYTS data set while the other version did not have data available. Additionally, 48.4% (n=31) of the non-matching countries (Brazil, Cambodia, Chad, Colombia, Cuba, Cyprus, Gambia, Ghana, Hungary, Lao People's Democratic Republic, Lebanon, Mexico, Saudi Arabia, Sierra Leone and, Turkey) contained discrepancies that

were a direct result of requiring maintenance errors. Overall, all the discrepancies in GYTS versions can be attributed to a lack of quality control measures. For some countries, one version contained data from more recent years than the other. Also, others countries had only partially matching data. In such scenarios, GYTS fact sheets were utilized in order to determine the best version of GYTS to utilize data for the GYTS master data set when presented with partially matching data. Discrepancies were also found in the GYTS Factsheets when comparing sample sizes provided in the various GYTS versions. In total, 154 countries of the GYTS Factsheets did not match the sample sizes listed in either version of GYTS data sets utilized in this study. While the nature of the discrepancies are different throughout the data sets, the only solution to avoiding all of them is by scheduling regular quality control measures or conducting cross-referencing of data for all versions of GYTS data sets. These minor avoidable and small errors serve as one plausible hypothesis that could explain the significantly different results between GSHS and GYTS. However, these errors aren't significant enough to explain the much larger variation found in results produced by GSHS and GYTS. However, it is evident that stricter quality control standards need to be applied to GYTS data sets during data collection, management and analysis.

When comparing GYTS and GSHS results, a total of 53 countries had conducted nationally representative surveys for both surveillance projects. In these countries, more than half of them had significantly different estimates for total, boys and girls smoking rates. Over half of all estimates being significantly different suggested that the results between the two surveys were not comparable and needed to be further analyzed by

gender and regions to understand the source of discrepancies. Of these countries, ten contained a national sample therefore the differences in estimates cannot be attributed to drawing samples in varying localities. Comparing estimates for Botswana, rates increased by 51% for total smoking, 41% for boys and 65% for girls between 2005 (GSHS) and 2008 (GYTS). Like Botswana, over a short period of time, similar inexplicable boost or reduction in smoking rates can be seen for Kenya, Jamaica, Suriname, Maldives, Cook Islands, Fiji and Philippines.

Between GYTS and GSHS data sets, relative to the girls, the boys had 7.6% more significantly different prevalence estimates which is a negligible gender variation. For the total smoking prevalence estimates between GYTS and GSHS, the WPRO had 87.5% (n=53) more significant discrepancies compared to the EURO region which lacked significant differences in countries altogether. The AMRO, EMRO, SEARO and WPRO regions ranked as the top four regions with significantly different estimates and the AFRO and EURO regions were at the bottom of the list. Similarly, with the exception of the AFRO and EMRO regions, all regions consisted of lower GSHS values in comparison to GYTS. In the AFRO region, exactly half of the countries consisted of GSHS estimates were higher than GYTS and vice-versa. This suggests further that despite utilizing the very similar survey methodologies, the two surveys are producing estimates that are dramatically different from each other. In the only region (EMRO) where GSHS values were higher than GYTS, boys consisted of a larger number of significantly different estimates (66.6%) in comparison to girls (22.2%). This finding adds further weight to the

possibility that response bias maybe responsible for producing varying estimates between the two surveys given that the other regions exhibit the exact opposite trend.

Based on the literature review, it is possible that the variances in data sets can be attributed to the inherent response bias due to misappraisal or response distortion especially when revealing sensitive information, such as illegal tobacco use at a young age. While, the CDC (2008) reports that under-reporting or over-reporting can be a limitation associated with self-administered surveys; reliability studies have shown promising test-retest results for tobacco-related questions such as the ones utilized in GYTS. This was not the case when comparing the results of GYTS and GSHS in this thesis. Given that both surveys are conducted in schools and provided to students of the same age group (aged 13 – 15 years) old utilizing similar methodologies, the results derived from both surveys should not vary by such large percentage points. As discussed earlier, while surveys conducted in schools tend to yield higher results than in other settings due to the privacy provided by anonymous and confidential surveys, they are closer to the results provided by mechanisms such as biochemical validation in comparison to household surveys (Hedges et al., 1998; Gans et al., 1995).

Since the results derived from both surveys should be accurate based on survey setting and tools and they are not, it is plausible to consider that regional variations are causing discrepancies between the results produced by GYTS and GSHS. These variations could be due to many reasons, such as language barriers, economical reasons, education levels, race, religion, social and cultural norms, laws related to tobacco marketing and control or other factors that have not been considered within this thesis

study. The lower estimates found in GSHS in comparison to GYTS, with the exception of the AFRO and EMRO regions along with the gender variation found within the EMRO region suggest that a form of response bias (misappraisal, response distortion, social desirability bias) may be the potential cause for variation within these self-administered surveys (Patrick et al., 1994). In a study comparing gender variation in self-administered surveys, the results between boys and girls were found to be comparable. However, the level of distortion was found to be higher in boys, which could potentially explain boys having more significantly different results in the comparisons conducted for this thesis (Botzet, Winters, & Stinchfield, 2006). The fact that five countries were found to have significantly different for all three estimates (Total, Boys and Girls) in GYTS Online vs. Original and 20 countries displayed all three estimates to be significantly different in GYTS vs. GSHS, lends further credence to this hypothesis.

The discrepancies could also be a result of inconsistencies relating to survey procedures during administration and analysis (Brog & Eril, 1999). Future research efforts should focus on further studying these indications in order to understand whether they play a role in the significant differences in data between the GYTS and GSHS data sets.

5.2 Study Limitations

Both surveys utilized and compared in this study are cross-sectional therefore they only provide a snapshot of cigarette smoking behavior and do not determine nicotine dependence levels observed or studied over a period of time. Also, the surveys were also self-administered and could potentially have resulted in an under-reporting or over-

reporting of smoking rates due to social desirability bias. The comparisons detailed in this thesis are a result of data selected based on criteria set by the author and the thesis committee members detailed in the methods section. Results may vary if a different set of criteria is applied by other researchers.

5.3 Recommendations

In order to develop effective tobacco prevention or cessation programs, consistent and accurate surveillance systems are of the utmost priority so that reliable patterns of tobacco consumption can be derived to curtail the booming global smoking epidemic. Based on the results of this study, the following recommendations can be made in order to move towards accurate, comparable and reliable survey results –

1) Apply strict quality control measures related to survey procedures during survey administration and analysis. After publishing the results, regular maintenance and scheduled updates and cross-checking of all versions of the data, during data collection, management and analysis to avoid common errors cause by data entry, omission, and lack of quality control measures. Examples of such errors based on this study include typos; transposition of confidence intervals and prevalence estimates; missing, inaccurate or lack of recent data in one version of the data and data from the same survey year consisting of completely different estimates. Upon the release and publication of data, an effective and efficient way to continue uphold quality control measures may be to install reporting tools on the websites that house these data sets so that users of the data can flag discrepancies they find.

2) Conduct further research to study the variation in gender prevalence estimates reflected by the EMRO region. Given that all survey methodology applied was identical to the girls, a plausible hypothesis would be that boys utilize response distortion or misappraisal more so than girls during self-administered surveys (Botzet et al., 2006). One way to assess the reason if this is indeed the cause for the discrepancies would be to apply the bogus pipeline method while conducting the surveys. In the bogus pipeline procedure, researchers inform survey participants that their reports may be objectively verified utilizing biochemical tests. This is done in order to create a placebo effect in the minds of the participants so that they are forced to provide an accurate self-report of their smoking status. In actuality, verification does not take place despite taking samples and specimens. Applying this method would not only improve accuracy in self-reports provided by boys but the entire sample altogether. It is a practical, economical, short and efficient method to increase accuracy in self- reported survey administration.
3) Research the reasons for regional variation. Utilize the results of this study to isolate the countries within these regions that are troubled and further explore any methodological, social, cultural, economical, educational, financial patterns that may emerge from doing so.
4) Research the reasons for GSHS estimates being lower than GYTS for total smoking prevalence estimates with the exception of AFRO and EMRO regions.
5) Another recommendation would be for WHO and CDC, along with all partnering governmental and health agencies to consider aligning their monitoring and

surveillance efforts in order to make the results comparable. For example, if surveys were conducted in the same cities and year within the same population then the smoking rates derived would be more analogous and the true cause of the variances in estimates could be easily determined by doing so. It could also be a cost-cutting measure by pooling resources, staff and funds thus allowing a portion of the time and budget for additional components like measure of nicotine dependence levels and patterns that young adults undergo between smoking initiation and addiction. Furthermore, both surveys could be conducted in areas where they hadn't previously and also be able to populate national samples.

6) One of the objectives of this thesis was to compile a master youth smoking data set. The master youth smoking data set can be utilized for future studies requiring up-to-date and reliable youth smoking data. Furthermore, future research could utilize the master youth smoking data set to identify the 18 countries with missing data and prioritize these countries to have a more accurate, complete and global sample of world youth smoking statistics. It can also be used as a resource to be updated as new data is released so that accurate and reliable data can remain accessible going forward through academic, scientific, governmental and national research efforts.

5.4 Conclusion

Accurate surveillance and monitoring of smoking habits and consumption rates are critical in averting smoking initiation and facilitating ormstobacco cessation in young adults. The results form surveillance projects are utilized by individuals from all walks of life, such as health educators, academic institutions, health care professionals, legislative

bodies, law enforcement officials, researchers and scientists, among many others who rely on data derived from tobacco surveillance projects such as GSHS and GYTS to make crucial decisions in combating the diseases and deaths caused by nicotine addiction through consumption of various tobacco products. The results of this thesis show inconsistencies within GYTS versions and between the results produced by two similar and comparable youth tobacco surveillance systems (GYTS and GSHS) further emphasize the need for reliable smoking surveillance reports to prevent young adults being naively lured into a lifetime of addiction at very young ages. Given the addictive nature of nicotine, prevention is cure. By prioritizing generating accurate and consistent smoking rates, we can hope to curb tobacco consumption in adolescents prior to initiation or at its earliest stages. Accurate surveillance reports allow for Doing so could could potentially allow policies and programs to help equip them with the knowledge they require to avoid being preyed upon by companies who are in the business to critically maim or kill their customers slowly over time without breaking any laws and continue doing so generation upon generation.

APPENDIX

Appendix 1. Comparison of countries with varying data between GYTS Original and Online

GYTS ORIGINAL ---------- GYTS ONLINE															
Country	**Region**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**
Benin	AFRO	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A	2003	**7.2**	5.1 – 10.1	**11.2**	7.4 – 16.5	**1.8**	0.9 – 3.6
Brazil-	AMRO	2009	**11.6**	8.3 – 16.1	**9.2**	6.8 – 12.3	**13.2**	8.5 – 19.9	2005	**12.3**	10.0 – 15.1	**9.1**	6.5 -12.5	**12.9**	9.6 – 17.1
Cambodia[o]	WPRO	2009	**0.2**	0 – 1.8	**0.5**	0.1 – 4.0	**N/A**	N/A	2003	**2.5**	1.3 – 4.6*	**4.6**	2.4 – 8.6*	**0.2**	0 – 1.6
Chad[o]	AFRO	2008	**14.2**	N/A	**15.7**	N/A	**9.4**	N/A	2008	**7.5**	N/A	**8.4**	N/A	**4.3**	N/A
Columbia-	AMRO	2007	**29.9**	25.8 – 34.5	**28.6**	22.1 – 36.0	**30.7**	24.3 – 37.8	2007	**26.2**	22.5 – 30.3	**25.4**	21.0 – 30.3	**26.6**	20.9 – 33.1
Comoros[o]-	AFRO	2007	**9.6**	6.8 – 13.2	**13.5**	8.3 – 21.3	**6.9**	3.7 – 12.6	2007	**9.6**	6.8 – 13.4	**13.5**	8.3 – 21.3	**6.9**	3.7 – 12.6
Costa Rica[o]-	AMRO	2008	**9.6**	7.9 – 11.7	**9.7**	7.8 – 12.1	**9.4**	7.2 – 12.0	2008	**9.6**	7.9 – 11.7	**9.4**	7.2 – 12.0	**9.7**	7.8 – 12.1
Cote D'Ivoire	AFRO	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A	2003	**13.6**	11.4 – 16.2	**19.3**	16.1 – 23.0	**7.1**	5.1 – 9.9
Cuba[o]	AMRO	2010	**10.6**	8.9 – 12.6	**8.7**	7.1 – 10.7*	**13.1**	9.8 – 17.3*	2004	**10.0**	7.6 – 13.1	**11.2**	8.3 – 15.1	**8.8**	6.5 – 11.9
Cyprus[ox]	EURO	2005	**3.9**	3.0 – 5.1	**3.7**	2.7 – 5.1	**4.2**	3.1 – 5.7	2005	**10.3**	9.7 – 10.8*	**12.3**	11.5 – 13.2*	**8.2**	7.5 – 8.9*
Gambia	AFRO	2007	**14.8**	10.0 – 21.0	**15.0**	10.2 – 21.6	**10.6**	5.4 – 19.6	2008	**10.8**	8.5 – 13.6*	**12.7**	9.6 – 16.5	**8.6**	5.8 – 12.6
Ghana[ox]	AFRO	2009	**8.9**	6.4 – 12.3*	**10.1**	7.0 – 14.3*	**7.4**	5.3 – 10.1*	2006	**2.7**	1.9 – 4.0	**2.8**	1.7 – 4.7	**2.3**	1.4 – 3.5
Guatemala[o]	AMRO	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A	2008	**11.4**	9.5 – 13.6	**13.7**	10.9 – 17.0	**9.1**	7.0 – 11.6
Honduras	AMRO	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A	2003	**14.2**	10.6 – 18.8	**14.4**	10.9 – 18.8	**14.1**	9.8 – 19.9
Hungary[o]-	EURO	2008	**23.2**	19.2 – 27.7	**21.5**	16.6 – 27.4	**23.6**	19.4 – 28.3	2008	**23.4**	19.8 – 27.5	**21.6**	17.4 – 26.4	**23.9**	19.9 – 28.4
Italy[o]	EURO	2010	**20.7**	16.8 – 25.2	**19.4**	15.8 – 23.7	**21.6**	15.8 – 28.6	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A
Kosovo	EURO	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A	2004	**6.5**	5.3 – 8.0	**7.7**	5.6 – 10.4	**5.4**	4.1 – 7.2
Laos (DPR)	WPRO	2003	**5.5**	4.2 – 7.2	**10.2**	7.1 – 14.3	**0.7**	0.2 – 2.3	2007	**3.0**	1.9 – 4.6*	**4.9**	2.7 – 8.6*	**1.3**	0.7 – 2.5
Lebanon[o]	EMRO	2008	**10.6**	7.0 – 15.6	**16.6**	11.1 – 24.0*	**5.5**	3.3 – 9.0	2005	**8.6**	6.8 – 10.8	**11.8**	8.5 – 16.3	**5.6**	4.2 – 7.5
Maldives[o]	SEARO	2007	**3.8**	2.7 – 5.3	**6.6**	4.6 – 9.6*	**0.9**	0.4 – 2.0*	2007	**3.8**	2.7 – 5.3	**0.9**	0.4 – 2.0	**6.6**	4.6 – 9.6
Mexico[x]	AMRO	2008	**5.4**	4.3 – 6.9	**6.2**	4.6 – 8.4	**4.3**	3.2 – 5.7	2006	**27.1**	23.8 – 30.8*	**26.3**	22.0 – 31.0*	**27.1**	23.7 – 30.8*
Montenegro[o]	EURO	2008	**5.1**	4.0 – 6.4	**5.7**	0.3 – 7.6	**4.4**	3.1 – 6.1	2008	**5.1**	4.0 – 6.4	**5.7**	4.3 – 7.6	**4.4**	3.1 – 6.1
Niue[o]	WPRO	2009	**10.5**	5.1 – 20.5	**N/A**	N/A	**N/A**	N/A	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A
Pakistan-	EMRO	2008	**2.0**	0.7 – 5.4	**3.3**	1.3 – 7.7	**0.3**	0.0 – 1.9	2003	**1.4**	0.6 – 3.3	**2.3**	0.9 – 5.4	**0.6**	0.2 – 1.9

GYTS ORIGINAL ---------- GYTS ONLINE															
Country	**Region**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**
Palau°	WPRO	2005	**26.7**	23.3 – 30.3	**22.6**	18.1 – 27.8	**31.0**	26.9 – 35.5	2005	**26.7**	23.3 – 30.3	**31.0**	26.9 – 35.5*	**22.6**	18.1 – 27.8*
Saudi Arabia°	EMRO	2010	**8.9**	6.4 – 12.3*	**13.0**	8.3 – 19.9	**5.0**	3.0 – 8.3*	2007	**6.7**	5.2 – 8.7	**10.2**	7.9 – 13.2	**2.6**	1.3 – 5.4
Sierra Leone[x]	AFRO	2008	**14.0**	9.1 – 203.8	**11.1**	7.2 – 16.8	**13.1**	6.9 – 23.6	2008	**5.8**	3.7 – 9.1*	**6.6**	3.8 – 11.3*	**5.0**	3.0 – 8.0*
Tonga°	WPRO	2010	**31.1**	24.0 – 39.2	**37.5**	28.1 – 48.1	**21.1**	13.7 – 31.1	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A
Turkey°[x]	EURO	2005	**23.0**	18.9 – 27.6	**22.1**	16.3 – 29.4	**16.6**	12.5 – 21.7	2003	**6.9**	6.1 – 7.9*	**9.4**	8.2 – 10.9*	**3.5**	2.9 – 4.3*
United Kingdom	EURO	2009	**8.1**	7.0 – 9.4	**3.7**	2.8 – 4.9	**14.3**	11.8 – 17.2	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A
United States of America°	AMRO	2009	**8.8**	7.4 – 10.4	**9.7**	7.8 – 11.9	**7.9**	6.7 – 9.2	N/A	**N/A**	N/A	**N/A**	N/A	**N/A**	N/A

X: All 3 smoking estimates (total, boys and girls) for the country are significantly different between the two data sets

Significance is denoted by * beside confidence interval estimates | National data is symbolized as ° next to countries | N/A: Not Available | [x]- denotes all three estimates that aren't significantly different | Red font indicates utilization in Master GYTS data set

Appendix 2. Comparison of countries with youth smoking estimates from both GSHS and GYTS

GSHS ---------- GYTS															
Country	**Region**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**
Algeria[o]	AFRO	2011	**9.2**	7.0 – 12.0*	**18.0**	13.9 – 23.0*	**1.4**	0.7 – 2.7	2007	**5.2**	3.4 – 7.8	**8.9**	5.6 – 14.0	**1.0**	0.6 – 1.7
Antigua and Barbuda[o]	AMRO	2009	**7.4**	5.8 – 9.4*	**8.2**	6.2 – 10.8*	**6.1**	4.2 – 8.8	2004	**3.6**	2.4 – 5.4	**2.7**	1.7 – 4.3	**4.4**	2.3 – 8.2
Argentina[o]	AMRO	2007	**21.0**	17.6 – 24.8*	**19.8**	15.2 – 25.4	**21.9**	18.1 – 26.4*	2007	**24.5**	22.2–27.0	**21.1**	18.5 – 23.8	**27.3**	23.4 – 31.6
Benin[o]	AFRO	2009	**2.8**	2.1 – 3.8*	**3.3**	2.1 – 5.2*	**1.6**	0.5 – 5.8	2003	**7.2**	5.1 – 10.1	**11.2**	7.4 – 16.5	**1.8**	0.9 – 3.6
Botswana[xo]	AFRO	2005	**7.0**	5.6-8.7*	**10.7**	8.2 – 13.9*	**3.8**	2.5 – 5.8*	2008	**14.3**	11.2 – 18.1	**18.1**	13.4 – 23.9	**10.9**	7.8 – 15.0
Chile	AMRO	2005	**29.0**	24.7 – 33.6*	**24.7**	18.6 – 32.0	**33.5**	28.1 – 39.4*	2008	**34.2**	31.3 – 37.3	**28.0**	24.3 – 32.0	**39.9**	36.0 – 43.9
China×	WPRO	2003	**8.7**	6.9 – 10.9*	**15.3**	12.1 – 19.0*	**2.4**	1.4 – 4.0*	2005	**1.7**	1.0 – 3.0	**2.7**	1.4 – 5.2	**0.8**	0.3 – 1.8
Colombia×	AMRO	2007	**20.5**	16.5 – 24.3*	**20.8**	17.2 – 24.9*	**20.3**	14.5 – 27.6*	2007	**26.2**	22.5 – 30.3	**25.4**	21.0 – 30.3	**26.6**	20.9 – 33.1
Cook Islands×[o]	WPRO	2011	**19.7**	19.7 – 19.7*	**19.9**	19.9 – 19.9*	**19.4**	19.4 – 19.4*	2008	**30.0**	28.9 – 31.2	**28.2**	26.5 – 29.9	**31.5**	29.9 – 33.1
Costa Rica[o]-	AMRO	2009	**9.5**	7.8 – 11.4	**10.4**	8.1 – 13.2	**8.4**	6.5 – 10.9	2008	**9.6**	7.9 – 11.7	**9.4**	7.2 – 12.0	**9.7**	7.8 – 12.1
Djibouti	EMRO	2007	**3.3**	2.2 – 5.0*	**3.7**	2.1 – 6.2*	**2.8**	1.2 – 6.6	2003	**6.1**	4.0 – 9.0	**8.6**	5.3 – 13.6	**2.6**	1.3 – 5.4
Ecuador×	AMRO	2007	**12.6**	10.3 – 15.2*	**14.5**	11.4 – 18.2*	**10.6**	6.9 – 15.9*	2007	**20.5**	15.6 – 26.6	**23.2**	19.4 – 27.6	**18.1**	11.1 – 28.0
Fiji×[o]	WPRO	2010	**11.7**	9.7 – 14.1*	**16.2**	12.9 – 20.2*	**7.4**	5.7 – 9.5*	2005	**5.0**	2.9 – 8.5	**6.7**	3.8 – 11.6	**3.1**	1.6 – 6.0
Grenada[o]	AMRO	2008	**4.7**	3.6 – 6.2*	**7.0**	4.9 – 10.0	**3.0**	1.9 – 4.9*	2004	**10.2**	8.2 – 12.8	**10.9**	7.4 – 15.8	**9.5**	7.4 – 12.2
Guyana[o]	AMRO	2010	**12.0**	9.3 – 15.4*	**17.4**	13.6 – 22.1*	**6.8**	4.8 – 9.6	2004	**8.1**	5.3 – 12.3	**11.0**	7.4 – 16.0	**5.4**	3.1 – 9.3
India×	SEARO	2007	**1.2**	0.8 – 1.7*	**1.9**	1.3 – 2.7*	**0.2**	0.1 – 0.5*	2006	**3.8**	3.1 – 4.7	**5.4**	4.3 – 6.7	**1.6**	1.0 – 2.6
Indonesia[o]	SEARO	2007	**11.1**	8.5 – 14.5	**22.1**	17.4 – 27.7	**0.9**	0.5 – 1.7*	2006	**11.8**	9.5 – 14.5	**23.9**	18.5 – 30.3	**1.9**	1.2 – 2.8
Jamaica×[o]	AMRO	2010	**23.9**	18.5 – 30.3*	**31.0**	20.9 –30.3*	**16.9**	12.0-23.3*	2006	**15.4**	10.2 – 22.6	**20.6**	14.1 – 29.3	**10.9**	6.5 – 17.7
Jordan	EMRO	2007	**12.3**	8.7 – 17.1	**17.7**	13.5 – 22.8*	**7.6**	5.2 – 10.9	2007	**10.3**	7.9 – 13.3	**13.2**	9.9 – 17.5	**7.1**	4.9 – 10.3
Kenya×[o]	AFRO	2003	**13.9**	10.8 – 17.6*	**17.3**	13.4 – 22.0*	**10.7**	7.5 – 14.9*	2007	**8.2**	6.1 – 11.1	**11.2**	8.9 – 14.0	**5.2**	3.5 – 7.6
Kuwait×	EMRO	2011	**15.9**	12.8 – 19.6*	**23.7**	18.4 – 30.0*	**7.5**	4.9 – 11.3*	2005	**10.8**	7.7 – 15.1	**17.7**	14.2 – 21.7	**4.5**	3.0 – 6.9
Libyan Arab Jamahiriya-	EMRO	2007	**4.2**	3.1 – 5.5	**7.1**	5.3 – 9.4	**1.1**	0.5 – 2.6	2007	**4.6**	2.9 – 7.2	**7.7**	4.9 – 11.9	**0.9**	0.3 – 2.5
Macedonia (TFYR)[o]-	EURO	2007	**10.5**	8.2 – 13.4	**8.8**	6.4 – 11.9	**12.3**	9.1 – 16.5	2008	**9.8**	7.4 – 12.7	**9.7**	7.3 – 12.9	**9.8**	7.2 – 13.1

GSHS ---------- GYTS															
Country	**Region**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**
Malawi[0]	AFRO	2009	**4.9**	3.1 – 7.5*	**5.9**	3.8 – 9.0	**3.8**	2.1 – 6.7*	2005	**2.9**	1.8 – 4.7	**3.8**	2.2 – 6.4	**2.2**	1.3 – 3.6
Maldives×[0]	SEARO	2009	**9.1**	6.8 – 12.0*	**15.0**	10.0 – 21.9*	**3.6**	2.1 – 6.2*	2007	**3.8**	2.7 – 5.3	**6.6**	4.6 – 9.6	**0.9**	0.4 – 2.0
Mali[0]	AFRO	2009	**8.5**	6.4 – 11.2	**11.7**	8.0 – 16.7*	**5.8**	3.8 – 8.6*	2008	**10.4**	7.3 – 14.6	**17.4**	12.2 – 24.3	**2.5**	1.4 – 4.5
Mauritania[0]	AFRO	2010	**17.3**	12.7 – 23.0	**17.2**	13.3 – 22.0*	**16.8**	10.9 – 25.0	2006	**19.5**	16.3 – 23.2	**20.3**	17.5 – 23.4	**18.3**	13.4 – 24.5
Mauritius[0]-	AFRO	2007	**15.4**	11.8 – 19.8	**23.1**	19.1 – 27.7	**8.5**	5.6 – 12.7	2008	**13.7**	9.3 – 19.8	**20.3**	13.9 – 28.6	**7.7**	4.1 – 14.0
Mongolia[0]	WPRO	2010	**5.4**	4.7 – 6.3*	**9.2**	7.8 – 11.0	**2.0**	1.3 – 3.1*	2007	**6.9**	4.4 – 10.5	**11.0**	7.6 – 15.6	**3.3**	1.4 – 7.3
Morocco	EMRO	2010	**5.2**	3.8 – 7.0*	**7.4**	5.1 – 10.6*	**2.3**	1.4 – 3.8	2006	**3.5**	2.7 – 4.6	**4.3**	2.9 – 6.4	**2.1**	1.1 – 3.9
Myanmar[0]	SEARO	2007	**2.0**	1.3 – 3.0*	**3.4**	2.4 – 5.0*	**0.6**	0.2 – 1.8	2007	**4.9**	3.6 – 6.5	**8.5**	6.2 – 11.6	**1.3**	0.6 – 2.6
Namibia[0]	AFRO	2004	**16.1**	13.6 – 18.9*	**18.2**	14.9 – 22.1*	**14.2**	11.5 – 17.4	2004	**18.8**	16.5 – 21.4	**21.9**	18.9 – 25.2	**16.1**	13.3 - 19.3
Niue[0]	WPRO	2010	**16.1**	16.1 – 16.1*	**23.3**	23.3 – 23.3	**N/A**	N/A	2009	**10.5**	5.1 – 20.5	**N/A**	N/A	**N/A**	N/A
Pakistan	EMRO	2009	**6.3**	4.5- 8.9*	**9.9**	7.8 – 12.3*	**1.0**	0.3 – 2.6	2008	**2.0**	0.7 – 5.4	**3.3**	1.3 – 7.7	**0.3**	0.0 – 1.9
Peru[0]	AMRO	2010	**17.3**	15.3 – 19.5	**22.9**	19.8 – 26.2*	**11.9**	9.2 – 15.3*	2007	**15.7**	13.5 – 18.1	**12.9**	10.5 – 15.7	**17.7**	15.2 – 20.6
Philippines×[0]	WPRO	2011	**11.0**	8.9 – 13.6*	**14.4**	11.4 – 18.2*	**6.4**	4.1 – 9.9*	2007	**17.5**	14.7 – 20.6	**23.4**	19.7 – 27.7	**12.0**	9.4 – 15.1
Saint Lucia×[0]	AMRO	2007	**7.8**	5.9 – 10.3*	**9.8**	6.5 – 14.6*	**6.2**	4.4 – 8.7*	2007	**12.7**	10.4 – 15.3	**17.0**	12.2 – 23.1	**9.5**	7.5 – 12.4
Saint Vincent and Grenadines[0]	AMRO	2007	**8.5**	6.7 – 10.9*	**12.0**	9.2 – 15.3	**5.1**	3.3 – 8.0*	2007	**12.0**	9.0 – 15.9	**14.8**	9.8 – 21.7	**9.5**	6.6 – 13.4
Senegal[0]-	AFRO	2005	**6.5**	3.3 – 12.3	**9.1**	4.6 – 17.2	**2.7**	0.7 – 9.8	2007	**7.5**	4.6 – 12.1	**12.1**	7.6 – 18.9	**2.7**	1.3 – 5.4
Seychelles[0]	AFRO	2007	**17.2**	16.3- 18.2*	**24.1**	22.8 – 25.4	**10.8**	8.5 – 13.7*	2007	**21.5**	16.7 – 27.2	**23.2**	17.4 – 30.2	**20.0**	15.0 – 26.2
Solomon Islands[0]-	WPRO	2011	**24.0**	19.2 – 29.6	**28.3**	21.9 – 35.8	**18.4**	13.7 – 24.3	2008	**24.2**	18.1 – 31.6	**24.3**	17.2 – 33.3	**23.4**	16.3 – 32.3
Suriname×[0]	AMRO	2009	**10.4**	8.4 – 12.7*	**12.5**	9.4 – 16.5*	**8.6**	6.0 – 12.2*	2004	**6.9**	5.2 – 9.1	**9.3**	6.3 – 13.5	**4.7**	2.7 – 8.2
Syrian Arab Republic-	EMRO	2010	**10.6**	8.7 – 12.7	**16.2**	12.9 – 20.0	**4.8**	3.4 – 6.7	2007	**12.3**	9.3 – 16.1	**19.1**	14.6 – 24.7	**5.9**	4.3 – 8.2
Tajikistan[0]-	EURO	2006	**0.9**	0.6 – 1.4	**1.1**	0.7 – 1.7	**0.6**	0.3 – 1.2	2004	**1.1**	0.7 – 1.7	**1.5**	0.9 – 2.5	**0.5**	0.3 – 0.9
Tanzania[0]	AFRO	2006	**3.8**	2.3 – 6.2	**5.3**	3.0 – 9.1	**2.0**	1.1 – 3.6*	2008	**2.6**	1.1 – 5.8	**4.6**	1.9 – 10.8	**0.7**	0.2 – 3.0
Thailand[0]	SEARO	2008	**8.8**	7.3 – 10.6*	**15.8**	12.9 – 19.3	**2.4**	1.4 – 4.1*	2005	**11.7**	10.0 – 13.7	**17.4**	15.2 – 20.0	**4.8**	3.6 – 6.4
Tonga[0]	WPRO	2010	**21.6**	18.8 – 24.6*	**19.2**	15.8 - 23.0*	**23.8**	20.3 – 27.7	2010	**31.1**	24.0 – 39.2	**37.5**	28.1 – 48.1	**21.1**	13.7 – 31.1

GSHS ---------- GYTS															
Country	**Region**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**	**Year**	**Total**	**Total CI**	**Boys**	**Boys CI**	**Girls**	**Girls CI**
Trinidad and Tobago°	AMRO	2007	**9.3**	6.9 – 12.4*	**9.7**	7.2 – 13.0*	**8.7**	6.0 – 12.4	2007	**12.9**	9.9 – 16.7	**14.7**	10.9 – 19.6	**10.3**	6.9 – 15.1
Tunisia-	EMRO	2008	**7.5**	6.1 – 9.1	**12.7**	9.5 – 16.8	**2.7**	1.4 – 5.1	2007	**8.3**	6.6 – 10.4	**15.1**	12.3 – 18.4	**1.6**	0.8 – 3.1
Uganda°	AFRO	2003	**4.3**	3.1 – 5.9	**6.2**	4.6 – 8.5	**2.6**	1.2 – 5.2*	2007	**5.5**	4.2 – 7.1	**6.6**	5.2 – 8.5	**4.0**	2.7 – 5.8
United Arab Emirates×°	EMRO	2010	**9.8**	7.5 – 12.7*	**15.6**	12.7 – 19.0*	**5.8**	4.0 – 8.3*	2005	**8.0**	6.6 – 9.7	**12.1**	10.3 – 14.1	**3.6**	2.9 – 4.4
Uruguay°	AMRO	2006	**17.7**	15.7 – 19.9*	**13.3**	10.8 – 16.3*	**21.4**	18.8 – 24.2	2007	**20.2**	18.0 – 22.6	**16.4**	13.5 – 19.8	**22.9**	20.1 – 26.0
Zimbabwe°	AFRO	2003	**5.8**	4.8 – 6.9*	**9.6**	7.7 – 11.9*	**2.2**	1.3 – 3.7	2008	**3.2**	1.7 – 5.7	**4.8**	2.6 – 9.0	**1.5**	0.5 – 4.6

X: All 3 smoking estimates (total, boys and girls) for the country are significantly different between the two data sets

Significance is denoted by * beside confidence interval estimates | National data is symbolized as ° next to countries | N/A: Not Available | ^{x}- denotes all three estimates that aren't significantly different

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