ASSESSMENT OF ORAL HEALTH KNOWLEDGE, BEHAVIORS, ATTITUDE, BARRIERS TOWARD PROFESSIONAL DENTAL CARE, ORAL HEALTH AMONG RURAL PEOPLE IN INDIA AND COMPARISON OF ORAL HYGIENE BEHAVIORS, DAILY HABITS AND OVERALL CARIES EXPERIENCE BETWEEN RURAL POPULATIONS OF THE DOMINICAN REPUBLIC AND INDIA

A Dissertation

by

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ABSTRACT

This dissertation presents three separate studies designed to provide empirical and anecdotal information on the topic of oral health among rural populations in middle-income countries of India and Dominican Republic.

First, utilizing the conceptual framework of risk-factor approach model proposed by the World Health Organization, the study assesses oral health knowledge levels, attitude toward professional dental care and dental attendance and discusses self-management approaches in an event of oral condition as well as some of the perceived barriers that prevent rural populations from seeking regular or timely dental care in a rural community of district Chhindwara, Madhya Pradesh, India. Additionally, the study presents the levels of caries experience in this rural community. Employing a cross-sectional study design, the data collection procedure encompassed face-to-face interviews and intra-oral examinations. The final sample comprised of 202 adult participants. Furthermore, facilitated discussions with 10 women provided some anecdotal information on their knowledge, oral hygiene behaviors and management of oral diseases.

Secondly, a quantitative study examining oral hygiene behaviors, daily habits by various socio-demographic variables is presented and discussed. Several socio-behavioral factors existing in a broader cultural and environmental context affect the prevalence of oral diseases. This study further examined if various modifiable risk factors and demographic variables predicted the levels of caries experienced among rural

participants. While several oral hygiene behaviors such as use of toothpaste, toothbrush and frequency of tooth cleaning and daily habits such as use of tobacco differed by age, educational levels and gender; increasing age was found to be the single predictor of overall caries experienced among adult rural population.

Lastly, drawing upon the theoretical framework of the risk-factor approach model proposed by World Health Organization and the empirical findings with respect to modifiable oral hygiene behaviors and daily habits, the differences and similarities in the behaviors and oral health outcomes in two geographically and culturally different nations, India and Dominican Republic will be presented and discussed. This study presents the first step toward addressing the gaps in knowledge with respect to the topic of oral health in lesser known populations of middle income countries.

DEDICATION

To my father and mother for their unconditional love and support

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CHAPTER I

INTRODUCTION

Oral diseases, such as dental caries and periodontal diseases, are major public health problems worldwide affecting both the young and the adults (Peterson, Bourgeois, Ogawa, Estupinan-Day, & Ndiaye, 2005). The burden of oral diseases varies among countries and also differs regionally within a country with the underprivileged sections of a region disproportionately affected (Peterson et al., 2005). The impacts of oral diseases on the individual and the society in physical, psychological and fiscal terms are profound.

MORBIDITY AND MORTALITY

An efficient dentition plays an important role in mastication, phonation, deglutition, maintaining a balanced diet, esthetic considerations and facial expressions (Guiglia et al., 2010). The number of teeth in the arches is considered as a measure of oral health status. Retaining less than 20 teeth causes difficulties in chewing, speaking and swallowing. The chronic oro-facial pain arising from untreated oral diseases such as dental caries and periodontal diseases limits one's ability to function, socialize and for the overall well-being of a person (Guiglia et al., 2010; Sheiham, 2005). Oral conditions such as tooth-alveolar abscess arising from untreated dental caries, chronic periodontitis and teeth fractures can result in impairment of functions, spread of infections through muscles and facial planes and can sometimes lead to fatal systemic infections (Sheiham, 2005). Psychological distress has been linked with oral conditions that mainly affect

appearance or result in extensive tooth loss (Geirdal et al., 2015). One of the studies concluded that children with facial deformities may have introvert personality styles and lesser expectations for success in social interactions (Pillemer & Cook, 1989). In developing nations, limited resources and lack of access to dental care result in untreated oral diseases, extractions and premature loss of teeth (Peterson et al., 2005).

COSTS

While the impacts of oral diseases are multifold, the economic impacts of oral diseases in both developing and developed nations are huge. Treatment of oral diseases especially caries is one of the most expensive treatments in the developed nations and can surpass the total health budget in developing countries if all the carious teeth were to be treated using advanced systems of restorative or curative care (Sheiham, 2005; Yee & Sheiham, 2002). Loss of school days or work due to pain or dental visits is some of the economic impacts of oral diseases. In terms of disability-adjusted life years (DALYs) lost, oral diseases represent a significant amount of a country's total disease burden and are projected to increase in the next decade, particularly in developing countries (Richards, 2013).

COMMON ORAL DISEASES AFFECTING A MAJORITY OF POPULATIONS

Dental caries is the most prevalent oral disease that affects a majority of the adult population in both developing and developed countries. The caries experience is measured by the number of permanent teeth that are affected i.e. teeth that have been decayed, restored or lost as a result of caries. This measure of overall caries experience is known as the Decayed Missing Filled Teeth (DMFT) index (Peterson & Baez, 2013).

The DMFT index not only gives information of the present caries condition but also about the past caries experience. The DMF teeth index score can range from 0 to 32; 0 indicating no sign of caries and 32 implying all the permanent teeth are affected by caries. According to the World Oral Health Report (2003), the caries experience levels among 35-44 year olds are moderate to high in north and south American countries (DMFT scores > 9) and very low to low in developing nations of Africa and most parts of Asia (DMFT scores ranging from 0-8.9).

Periodontal diseases are the second most common oral health condition (Peterson et al., 2005). Globally, most children have signs of gingivitis and among adults, the initial stages of periodontal diseases are prevalent. Severe periodontitis, which may result in tooth loss, is found in 5% - 15% of most populations (Peterson et al., 2005). Periodontal status is assessed by two indicators: (a) presence of bleeding and (b) depths of periodontal pockets measured using a periodontal probe. Gingivae surrounding all the 32 permanent teeth are probed to check for gingival bleeding and to measure pocket depths. If gingival bleeding occurs on probing the gingiva surrounding a permanent tooth, that particular tooth is given a value of 1 indicating the presence of gingival bleeding. In absence of bleeding response, a score of 0 is given to that particular tooth. The gingival sulcus surrounding a tooth is probed to measure periodontal pockets: a score of 0 is assigned if there is no pocket detectable, a value of 1 indicates a pocket depth of 4-5 mm and a value of 2 suggests a pocket depth of 6mm or more surrounding a tooth. With all the 32 permanent teeth examined, gingival bleeding scores can take a value from 0-32 while pocket scores can take a value from 0-64 (Peterson & Baez,

2013). In cases, where a tooth is missing or absent while recording periodontal status, that particular tooth is marked as X (Peterson & Baez, 2013).

GENERAL HEALTH AFFECTS ORAL HEALTH

Oral health had been previously viewed as a separate entity from general health but the fact that chronic diseases can affect oral health and functioning cannot be overlooked (Sheiham, 2005). Non-communicable diseases such as diabetes have been linked to periodontal diseases and tooth loss while conditions such as HIV/AIDS have many oral manifestations such as oral ulcers, gingival bleeding, candida infections, leukoplakia, necrotizing periodontitis and kaposi's sarcoma (Oliver & Tervonen, 1994; Szpunar, Ismail, & Eklund, 1989). In addition, some medications and therapies used to treat systemic conditions impact oral health and functioning as well (Ghezzi & Ship, 2000). For example, calcium channel blockers used to treat hypertension can cause gingival enlargements or salivary dysfunctions and use of antibiotics can result in oral candidiasis (Ghezzi & Ship, 2000). On the other hand, untreated oral diseases can have serious consequences on general health. Oral infections can result in spread of bacteria in the body causing or aggravating systemic health conditions such as diabetes and cardiovascular diseases. Systemic spread of oral infections can sometimes be fatal resulting in death (Peterson, 2003).

Oral diseases share common preventable risk factors with four most common non-communicable diseases- cardiovascular diseases, diabetes, cancer and chronic obstructive pulmonary diseases. For example, dietary habits not only influence the development of chronic conditions but are also significant to the development of dental

caries as well. Similarly, tobacco use has been documented to cause cancers and is also associated with development of periodontal diseases and premature loss of teeth (Peterson, 2003).

RISK FACTORS DETERMINING ORAL HEALTH

Risk is defined as the probability of an adverse outcome, or a factor that increases this probability (World Health Organization, 2002). No risk occurs in isolation and many have roots in complex chains of events spanning over long periods of time. Appropriate policies, strategies, and approaches to disease prevention can be generated only if a range of risk factors is assessed (Peterson, 2005). Risk factors such as diet, nutrition, and tobacco and alcohol use not only determine the occurrence of chronic conditions, such as diabetes, cardiovascular diseases, or respiratory conditions such as lung cancers or chronic obstructive pulmonary diseases but also affect the conditions of teeth and gums. In other words, chronic diseases and oral diseases share many of the same risk factors. The following is a brief overview of the various risk factors associated with oral health:

Diet and nutrition. Several studies have shown diets high in refined carbohydrates and sugar-content result in high incidences of dental caries (Maru & Narendran, 2012; Peterson, 2003). The World Health Organization world report on oral health (2003) states increasing trends of dental caries in parts of Asia and Africa because of changing living conditions particularly as a result of increasing consumption of sugars. As a country becomes wealthier, there is increased exposure to or greater preference for “westernized” diet that is rich in refined carbohydrates (Goldman, Yee,

Holmgren, & Benzian, 2008). Furthermore, in the past few years due to globalization and easy access to sugary foods and drinks, dental caries show an increasing trend in developing nations (Peterson et al., 2005).

Tobacco use. Prevalence of tobacco use in various forms is widespread in low- and middle-income group countries where the socially marginalized have higher rates of tobacco consumption (Mackay & Eriksen, 2003). In developing countries, tobacco used in several forms such as cigarette, pipe, cigar and bidi smoking, betel quid chewing (paan), gutka use and other traditional forms have several effects in the mouth (Reibel, 2003). Tobacco use undoubtedly affects physical health as well as the oral health. Tobacco is a risk factor for oral cancers, periodontal diseases in adults and congenital defects such as cleft lip and palate in children. The risks of tobacco use increase prominently when used in combination with areca nut or alcohol (Reibel, 2003).

Oral hygiene behaviors. Oral hygiene behaviors have significant effects on oral health outcomes. Oral hygiene behavior involves the skill to carry out a simple brushing routine which can be shaped through a simple training program (Bandura, 1979). Brushing, flossing and use of mechanical or chemical oral hygiene aids remove dental plaque (white film at gum line and tooth surfaces) containing bacteria. Over 90% of dental diseases that are known today are caused by plaque accumulation alone (World Health Organization, 1978). For example, premature tooth loss that occurs as a consequence of periodontal conditions is seen in a majority of people who have poor oral hygiene behaviors (Peterson, 2003). Oral health largely depends on optimal oral hygiene behaviors practiced throughout the lifespan and studies have shown that good

oral hygiene behaviors such as brushing twice daily and using interdental aids have good oral health outcomes (Chen, Anderson, Barmes, Leclerq, & Lyttle, 1997; Peterson, 2003).

Culture. Culture affects health and oral health significantly. Cultural factors such as prevailing myths and beliefs may deter or encourage oral hygiene behaviors and influence attitudes toward seeking professional dental care (Peterson, 2003). Prevailing traditional cultural beliefs and myths pertaining to oral hygiene may act as barriers to adapting to good oral hygiene behaviors for optimal oral health. For example, prevailing misconceptions that tobacco is good for the teeth results in higher use of tobacco containing toothpowders among older adults among rural populations in South Asia and prevents them from using fluoridated toothpaste (David, 1997). Dental fear, resulting from widespread community beliefs or personal negative dental experiences, largely affects attitude toward seeking preventive care (Sakki, Knuuttila, Vimpari, & Kivela, 1994). Cultural taboos such as fear of loss of vision following dental extractions or loosening of teeth following cleaning may also act as barriers to seeking professional dental care (Garcha, Shetiya, & Kakodkar, 2010).

Gender. Gender is an important aspect for consideration when planning dental health education or other interventions at community levels. Women perceive oral health to have a greater impact on their quality of life than men (Al-Ansari & Honkala, 2007). Furthermore, studies have demonstrated women to possess high oral health knowledge and more positive oral health attitudes and behaviors when compared to males (Kateeb,

2010). Women also reported higher percentage of dental restorations (Biradar, Hiremath, Puranik, R, & G, 2013).

Socioeconomic factors. Socioeconomic factors such as income, education and occupation influence oral health to a large extent worldwide. The burden of oral diseases in terms of dental caries and periodontal diseases is often on the socio-economically disadvantaged individuals or groups because of several reasons such as lack of knowledge about maintaining optimal oral health hygiene or having limited or no resources to seek dental care (Chen, 1995). Studies have shown that people with high poverty rates, low educational levels and unskilled workers have poor oral health while individuals with high levels of education are more likely to engage in oral health promoting behaviors (Chen et al., 1997).

Existing oral health infrastructure. Dental treatment in most of the developing countries is offered in regional or central medical centers and private dental offices in urban regions where most of the payments are made out-of-pockets (World Health Organization, 2015). Availing restorative or endodontic treatment is expensive and the systems' capacity in developing nations to meet the entire restorative needs fall short. In addition, unequal distribution of dental workforce and underutilization of auxiliary dental professionals contribute to the existing problem of dental workforce (Tandon, 2004). Nation-wide oral health education and prevention programs embedded in non-communicable national health programs still remain to be seen in most of the developing nations. In such countries, the challenge is to stimulate training programs for different

types of dental personnel which would match the oral health needs and the infrastructure of the country (Peterson, 2003).

Oral health and fluorides. Water fluoridation has undeniably been one of the greatest triumphs of public health that has reduced the caries experience among children (Centers for Disease Control and Prevention, 1999; World Health Organization, 1994). While increased consumption of refined sugars has increased the dental caries experience; review of literature shows that exposure of fluorides can mitigate the effects of poor oral hygiene or excessive intake of refined foods (Bali, Mathur, Talwar, & Chanana, 2004). Despite several industrialized nations and Latin American countries such as Jamaica, Chile, Dominican Republic implementing salt, milk or water fluoridation, the effects have not permeated to all areas within the nations (Estupiñán-Day, 2005). Use of fluoridated toothpastes and intake of fluorides in several forms will reduce incidences of dental decay among young and adults alike (Peterson, 2003). Affordable fluoridated toothpaste is effective in reducing caries prevalence and should be made available for use by health authorities in developing countries (Adyatmaka, Sutopa, Carlsson, Pakhomov, & Bratthall, 1998).

HEALTH PROMOTION AND ORAL HEALTH

The Global Oral Health Program introduced by the World Health Organization (WHO) encompassing oral health prevention and promotion programs aims at controlling modifiable risk factors for dental diseases. The Global Oral Health program emphasizes both oral health prevention and treatment strategies with a greater emphasis on oral health promotion programs targeting modifiable risk factors for caries. Changing

behaviors form the crux of oral preventive and health education programs that have been used extensively in the past few decades (World Health Organization, 2014a). One of the most important prerequisite for developing community based oral health education and promotion programs is generating data and determining existing knowledge, behaviors, attitudes and factors for seeking professional dental care.

WHO has proposed an operational model for use by investigators while considering an appropriate oral health intervention (Peterson & Baez, 2013). This model aims to collect data by focusing on socio-environmental determinants and modifiable risk factors of oral health such as diet/nutrition, tobacco use and excessive alcohol consumption. In addition, collecting information on proximal risk factors such as environmental exposure to fluoride, oral hygiene practices and use of available health services is also vital to planning oral health prevention program. Quality of life, oral health and systemic health are considered important outcomes of the specified distal and proximal factors (Figure 1.1).

Dental caries, one of the most prevalent infectious diseases, is caused by a complex chain of events occurring over a period of time (Figure 1.2). Not only do socio-economic causes determine the levels and severity of caries experience, several other factors such as daily habits, oral hygiene behaviors, access to dental care services, frequency of visits to dentists, access to restorative or preventive care, fluoride exposure etc. result in varying levels of dental caries (Peterson, 2005). The WHO International Collaborative studies compared the various distal and proximal factors affecting caries levels in several industrialized nations (Chen et al., 1997). Across developed countries

such as Japan, Poland and USA, socioeconomic status largely influenced prevalence of dental caries. The effect of educational background on measures of dental caries was observed for all countries especially with high levels of caries prevalence. Low scores of Decayed Teeth (DT) and Missing Teeth (MT) were found in adults with preventive dental care habits and flossing of teeth on a regular basis (Chen et al., 1997). Further analyses showed clinical outcome measures being affected by several occupational and behavioral factors. Dental pain, discomfort, inability to chew were some of the clinical measures assessed while social and emotional perceptions such as avoiding laughing or smiling, self-assessment of poor oral health, dislike of appearance of teeth were some of the non-clinical measures evaluated. It was found that women, urban residents, individuals with low income and unskilled workers scored low on the clinical and non-clinical outcomes (Chen et al., 1997). Furthermore, persons with irregular dental visits and perceived barriers to care had low scores on both the clinical and non-clinical outcomes. The primary purpose of WHO International Collaborative studies (ICS-I or II) was to compare existing oral health care systems and their impacts on oral health status. Social inequality in oral health appeared to be prevalent even in countries with widespread oral health promotion programs, outreach dental health services, preventive oral care and high utilization rates. The analyses of behavioral and socio-environmental risks in several countries act as part of initiative to strengthen or promote oral health prevention and promotion programs.

ORAL HEALTH IN DEVELOPING NATIONS

Epidemiological surveys indicate increasing incidences of oral diseases in developing nations. The caries prevalence increased by over 20% in children from year 1999 to 2000 in Mexico with percentage of children affected by new dental caries increasing from 14.2% to 34.7% (Vallejos-Sanchez et al., 2006). Similarly, a longitudinal study in Brazil among children aged 12-30 months showed an increase of caries by threefold during the study period of one year (Scavuzzi et al., 2007). National health survey in India showed increasing prevalence of caries with 63.1% of 15 year-old teenagers, 80.2% of adults aged 35-44 years old and 85.0% of adults aged 65-74 years being affected (Dental Council of India, 2004). Increased consumption of refined and sugary foods coupled with changing lifestyles in developing nations has led to more caries experience in both children and adults (Peterson et al., 2005). Furthermore, existing dental infrastructure, limited resources and capacity of systems to provide only emergency treatment has resulted in more people losing teeth as a result of caries (Peterson & Yamamoto, 2005). Data from developing nations that have increased in the recent few years still lack information on comprehensive assessment of risk factors and the status of oral health among rural population in low and middle-income group countries.

DATA ON ORAL HEALTH IN RURAL REGIONS OF DEVELOPING NATIONS

There is little epidemiological data on oral health among the adult population in India and less information when it comes to rural populations. Most of the studies conducted in India have either targeted children or are limited to adult urban populations

of certain age groups (Mandal, Tewari, Chawla, & Gauba, 2001; Patro, Kumar, Goswami, Mathur, & Nongkynrih, 2008; Rajaratnam, Devi, Asirvatham, & Abel, 1995; Shah & Sundaram, 2004). Of the few studies that involved rural populations, none of the studies were focused among rural population in the south west region of the central state of Madhya Pradesh (Kumar et al., 2011; Maru & Narendran, 2012). Based on published literature, in fact, little is known at this point in time about the topic of oral health in rural adult population of central India. No such community study has been conducted so far that looks at oral health knowledge, attitude, practices and barriers as well as assesses caries experience among rural adult population in central Indian region of District Chhindwara.

India, occupying a major portion of south Asian subcontinent, is the second most populous country in the world with around two-thirds of the population residing in rural regions (India.gov, 2014; The World Bank, 2015). Most rural families live on subsistence levels, enough only to meet their basic requirements of food, shelter and clothing. Predominantly an agricultural nation, primary health care is still in its nascent stages barely providing essential health services in rural regions in India. The state of Madhya Pradesh lies in central India; it is the second largest state by area and sixth largest state by population in the country (Censusindia.gov, 2011). While dentist to population ratio in rural India can be 1:250,000, there is less than one dentist per 1000 population in the state of Madhya Pradesh and almost all the dentists are concentrated in the urban regions of the state (Tandon, 2004; World Health Organization, 2006). Only 2% of the dentists in India are trained in community dentistry (Tandon, 2004). District

Chhindwara, one of the towns in Madhya Pradesh, has nearly 1900 inhabited villages (Google Maps, 2001; Thakur, Singh, Singh, & Bhaghel, 2013). The study that is being conducted is in one of the villages called Ramgarh, which is located east to the urban agglomeration of Chhindwara.

The Dominican Republic occupies the eastern two-thirds of the island of Hispaniola, and is located to the southeast of Cuba, between the Caribbean Sea and the North Atlantic Ocean. The population of Dominican Republic as of 2014 was 10.3 million (Population Reference Bureau, 2014). There are 7,000 dentists, 8 per 10,000; however a majority of the dentists are concentrated in the urban areas of the Dominican Republic. There are several universities for health professionals, recognized by the National Board of Higher Education and seven of those institutions are for dental education (World Health Organization, 2014c). There is existing information on prevalence of caries among 12 year olds in the Dominican Republic (Pan American Health Organization, 2005) and among adults in a few Central American countries (Astroth, Berg, Berkey, McDowell, & Hamman, 1998; Dowsett, Archila, & Kowolik, 2001; Smith & Lang, 1993) but there are fewer data on the caries experience as well as the modifiable risk factors among adults in the Dominican Republic. The study that was conducted in Dominican Republic was in the community of La Esquina in Province Maria Trinidad Sanchez.

This study is a comprehensive assessment of risk factors that includes socio-demographic profile, oral health knowledge, attitudes toward professional dental care, utilization of dental services, perception of barriers to seeking dental care, fluoride

exposure, daily habits and oral hygiene behaviors affecting levels and severity of oral diseases particularly dental caries. While prevalent oral hygiene behaviors in a region determine oral health status, there are profound differences in such behaviors among regions, countries and even within countries. These differences may be related to race/ethnicity, socio-economic status, cultural contexts including beliefs, values and myths to name a few (Buunk-Werkhoven, Dijkstra, Bink, Zanten, & Schans, 2011). Different oral hygiene behaviors result in different oral health outcomes. Comparing two geographically different rural populations of Dominican Republic and India will not only yield information on how oral hygiene behaviors and oral health outcomes differ but also help in development of oral health prevention and promotion programs tailoring to the needs of the target populations.

Given the geographical, socio-cultural and demographic differences between these two nations, modifiable risk factors affecting oral health status differ vastly. For example, use of tobacco and areca nut for recreational and therapeutic purposes is widely prevalent in rural regions of central India resulting in high prevalence of periodontal diseases, attrition and oral lesions while consumption of refined starchy food and sugary drinks is more common in the Dominican Republic leading to high prevalence and severity of dental caries. Despite several differences found between these two populations, some similarities do exist with respect to seeking dental care: one of the main reasons for dental attendance among rural populations is oro-dental pain when dental diseases have progressed in severity. This comparative component of the study will identify some differences and similarities with respect to behaviors pertaining to

oral health that will aid in development of culturally tailored oral health prevention and promotion programs matching the need for care of target populations.

RESEARCH QUESTIONS

1. What are the knowledge levels related to oral health and care, oral hygiene behaviors, daily habits and attitude toward dental care in rural communities in India?
2. How do behaviors and daily habits differ by gender, age and educational levels?
3. What are the barriers and facilitators to the utilization of professional oral health care in rural communities in India?
4. What are the levels of prevalence of dental caries among rural adult participants in India and the Dominican Republic?
5. What are the differences in demographic profiles, oral hygiene behaviors and caries prevalence between two developing nations: India and Dominican Republic?

RESEARCH HYPOTHESES

The study is designed to test the following research hypotheses:

1. Oral hygiene behaviors, daily habits, and overall caries experience do not differ by socio-demographic variables such as gender, age, and educational levels.
2. Overall caries experience is not dependent on demographic variables, oral hygiene behaviors, and other daily habits.

3. Oral health knowledge does not vary by demographic variables; attitude toward professional dental care and perceived barriers from seeking care do not affect dental visits among rural people.
4. There are no regional differences in oral health behaviors that affect caries experience levels differently in India and the Dominican Republic.

DISSERTATION ORGANIZATION

While this first chapter provides a general introduction of the topic on oral health and this study, discussion of the purpose, research questions and hypotheses, the current document is separated into five different chapters. Chapters II-IV were written in manuscript format with the intent of publication in peer-reviewed scientific journals. The details of the four chapters are given below:

The second chapter explores oral health knowledge levels by demographic variables, attitudes toward professional dental care, barriers that prevent rural population to seek dental care, utilization of dental care, and management of certain oral health conditions using both empirical and anecdotal data from rural participants in India

The third chapter presents the results of the cross-sectional study with respect to oral hygiene behaviors, daily habits and the level of caries experience by gender, age and educational levels in adult rural population in India. It also addresses the limitations, strengths of the study and measures taken to address concerns such as validity and reliability.

Chapter IV presents the results of two cross-sectional studies in India and the Dominican Republic providing comparisons between demographic profiles, oral hygiene

behaviors, daily habits and their impact on the levels of caries experience in these two rural communities.

Chapter V offers an overall summary of this research and readdresses the original hypotheses and assumptions of the study. The implications of the findings are discussed, and recommendations for future study are offered. Also provided are recommendations for the application of these findings to oral health interventions at the community levels in India and Dominican Republic.

CHAPTER II

ASSESSMENT OF ORAL HEALTH KNOWLEDGE, ATTITUDE, UTILIZATION AND BARRIERS TOWARD PROFESSIONAL DENTAL CARE AMONG ADULTS IN CENTRAL RURAL INDIA

INTRODUCTION

Oral diseases are major public health problems worldwide affecting a vast majority of adults. While dental problems remain rampant both in urban and rural regions of a nation, the burden of oral diseases is more on the disadvantaged and the socially marginalized groups (Peterson, 2003).

The incidence and prevalence of dental diseases worldwide can be attributed to socio-behavioral and environmental factors (Peterson, 2003). Urbanization and economic development enabling easy access to soft drinks and processed foods, shift in dietary habits with increased consumption of refined foods have contributed to an increase in the incidence of dental diseases in developing nations such as India (Maru & Narendran, 2012; Peterson et al., 2005). Furthermore, determinants such as poor living conditions, low education level, prevalent myths and beliefs related to oral health and modifiable risk behaviors such as oral hygiene practices, tobacco use and dental attendance may also affect oral health outcomes among rural populations in developing nations. Reduction of risks to disease is only possible if services are focused on primary health care and prevention (Peterson, 2003). Changing behaviors form the core of oral preventive and health education programs that have been used extensively in the past

few decades. One of the most important aspects for developing community based oral health education and promotion programs is generating data and determining existing knowledge, behaviors, attitudes and factors for seeking professional dental care (World Health Organization, 2014a). Within the framework for the WHO STEPwise approach (i.e., where acquisition of data begins with self-reported information followed by clinical data and biochemical analysis), the risk-factor approach model guides data collection on socio-environmental determinants, modifiable risk factors, hygiene habits and use of oral health services affecting oral health (Peterson & Baez, 2013).

Even though 70% of the 1.2 billion population of India resides in villages, data on oral health remain scarce in rural communities (India.gov, 2014). There is a paucity of data on modifiable risk factors that influence oral health status among rural populations in India. Studies assessing such variables are limited to either adolescents or urban populations and are usually concentrated in more developed regions of India (Rajaratnam et al., 1995; Shah & Sundaram, 2004). The rural health mission initiated in 2005 aimed to improve health status of rural populations does not include dental care or services; oral health is not considered as important as other general health issues that plaque rural communities (Nandan, 2010).

While most of the oral health studies employ WHO pathfinder methodology that aims to include only the most important population subgroups, usually 12 year olds or 35-44 year age group likely to have different disease levels, this is the first among the studies that includes comprehensive assessment of modifiable risk factors determining

oral health status across lifespan among adult population in this rural region of central India. The objectives of the study were:

1. To assess oral knowledge levels, attitudes, barriers versus facilitators toward seeking professional dental care and utilization of dental care through empirical and anecdotal data.
2. To determine the oral health status of the sample population.

The information gathered will help in understanding the socio-cultural and environmental contexts in which attitudes and behaviors are shaped and how they affect oral health outcomes in a lesser known population. This will also assist in assessing some of the barriers and facilitators that prevent rural people from seeking dental care.

METHODS

Setting. The study took place in a small rural community called Ramgarh east of District Chhindwara in the central state of Madhya Pradesh in India. The population of this village is about 800 adults with a larger number of people above the age of 40 years and females. Individuals are engaged in agricultural related activities, self-employed as small business owners or employed for wages in the local schools. The sample size for the study was 202 participants, which was fairly representative of the target population. The Institutional Review Board at a large Texas university approved the survey questions and study procedures. All participants were read and provided a written informed consent.

Research design and procedure. The study was a cross-sectional study design conducted in the months of July to December 2014. The research protocol was approved

by the Institutional Review Board at Texas A&M University (IRB2014-0346D). Individuals older than 18 years residing in the village were eligible to be included in the study. Exclusion criteria included pregnant women, children and other individuals whose chronic health conditions did not allow them to participate in the study. Interview protocol was read to the community members and only after having their permission through a written consent were they allowed to participate in the study. The community gatekeeper (village priest) and primary author approached individuals door-to-door to recruit individuals into the study. The participants were ensured anonymity and were told the information collected would be used for statistical purposes only. Once enrolled, each participant answered the survey questions in a face-to-face interview and underwent an intra-oral examination. Due to low literacy levels, the close ended questions were read to the participants the research personnel recorded the responses.

The primary author administered the questionnaire to those who were eligible and agreed to participate. The interview took placed in the participants' front yards and/or porches. Participants willing to participate underwent intra-oral examinations that were performed by a single trained dentist/primary author.

Measures. The survey questionnaire measured knowledge levels with respect to oral health, in addition to questions that collected information on demographics, participants' management of certain oral health conditions, attitude toward professional dental care, utilization of dental care, prevalence of caries and barriers toward seeking professional oral health care. Age was noted down as age at last birthday. While age or

birth year was not known by a majority of participants, age in those cases was estimated based on major life events such as their wedding year or the birth years of their children.

Description of the survey. Many knowledge, self-practice and barrier questions were adapted from previous questionnaires and used in this study (Al-Omiri, Al-Wahadni, & Saeed, 2006; Garcha et al., 2010; Petersen, Aleksejuniene, Christensen, Eriksen, & Kalo, 2000). The knowledge related questions were adapted from the structured questionnaire that had thirty-three items formulated to assess knowledge, attitudes and behavior of young school children regarding their oral health and dental treatment in North Jordan (Al-Omiri et al., 2006).

Questions related to attitude toward dental health, management of oral conditions, utilization of dental services were adapted from the original structured questionnaire designed to evaluate the following variables: (i) self-reported dental status and evaluation of teeth and gums; (ii) attitudes toward dental health, dental care, and dentists; (iii) frequency of dental visits and services received at last visit; (iv) satisfaction with oral health services; (v) oral hygiene habits; (vi) sex and urbanization, and (vii) education and occupation. The questionnaire was originally created in English and later translated into Lithuanian language to assess oral health behavior and attitudes of adults in Lithuania (Petersen et al., 2000).

The barriers related questions adapted from the original questionnaire, available both in English and Hindi were based on social factors such as social class, attitude and government policy and cultural factors such as traditional beliefs, misconceptions, preferences and taboos. The comparative study assessed various social and cultural

factors determining barriers to oral care among different social classes in India (Garcha et al., 2010).

While questions were adapted from previous structured questionnaires, validity and reliability of the questionnaire used for this study were evaluated using several tests. The questionnaire prior to data collection was translated to Hindi and evaluated for cultural relevance. Content validity of the questionnaire was checked by a public health professional who was not associated with our study but was familiar with the socioeconomic and cultural contexts of rural populations in central India. A few terminologies that were unheard of or unfamiliar were eliminated or rephrased.

The knowledge level scale included nine items that tested participants' awareness on various aspects related to oral health. Each question had four answer choices; each correct response was assigned a value of 1 and incorrect response was given a value of 0. The sum of the knowledge score was calculated by adding the number of correct responses for a participant and the total score could vary from 0 to 9. The Cronbach's alpha for the knowledge level questions was found to be .74 indicating good reliability.

There were 5 questions pertaining to attitudes and utilization of dental care services. Participants were asked whether or not they believed going to the dentist was necessary in absence of dental pain, did they ever visit a dentist, if yes, when and where did they go, and what treatment did they seek. Questions on management of oral health conditions included how participants managed in an event of dental pain or gum bleeding.

There were 12 questions related to the barriers toward professional dental care. Participants were asked whether they disagreed or agreed to a set of questions assessing factors that prevented the sample population from seeking early or regular dental care. The Cronbach's alpha for the barriers scale was .53 after removal of 2 items from the 12 item scale; however the low alpha still indicated that the items had poor internal consistency.

Clinical examination. The decayed, missing and filled teeth index (DMFT), commonly used to determine the overall experience of dental caries can range from 0-32, 0 indicating no caries and 32 suggesting that all teeth are affected by caries. The WHO oral assessment form (1997) was used to record the results of intra-oral examinations.

To ensure intra-examiner reproducibility and reliability when applied to recording dental caries at tooth level, a total of 25 participants were re-examined and perfect agreement was found with a value of kappa statistics to be 1.

Data analysis. The data were entered into SPSS statistics 22. First, descriptive statistics were calculated for demographics and all study variables. Secondly, ANOVA was used to compare knowledge by age, gender and educational levels. Some of the missing data in the study were either due to failure to reach participants in two attempts or response failure because of limited understanding of questions. Missing data in those cases were omitted and analyses were carried out with what remained.

RESULTS

Table 2.1 shows the distribution of sample population by gender, age and educational levels. There were more females (56%) than males (44%) in our sample. Younger participants of age group 18-34 years comprised a larger proportion (49%) of the sample followed by 25.8% of 45 years and higher age group and 21.8% of 35-44 years age group. A majority of the sample population (43.6%) had more than 8 years of formal education. About 39% had less than 8 years of education and 11.4% had no education at all. While this survey did not collect information on economic background and levels, the average household income of a family of 4-5 members is about $200 per month.

Table 2.2 shows the comparisons of mean DMFT scores by gender, age and educational levels. While males had a slightly higher mean score, the difference in the mean DMFT scores was not statistically significant between the gender groups. There was an increase in the mean DMFT scores with increasing age with age group 55 years and above showing the highest mean score (Standard deviation) of 10.7(9.8). This difference in the mean DMFT scores across age groups was statistically significant ($F=16.8$; p value $< .05$). While with increasing educational levels, there was a decrease in the mean DMFT scores, and the decrease was statistically significant ($F =2.72$; p value .046).

Table 2.3 shows the comparison of knowledge scores by gender, age and educational levels. To calculate the knowledge score, correct response to each knowledge level question was given a value of 1 and incorrect answer was given a value

of 0. The sum of the knowledge score for each participant was computed by adding the number of correct responses. Each participant could score from 0 and 9. The mean knowledge score in this sample population was 3.0(2.3).The mean knowledge scores for males and females were nearly the same, 3.1(2.4) versus 3.0 (2.2) and the difference in the mean knowledge scores by gender was not statistically significant. Participants who had more than 8 years of formal education had higher mean knowledge score 4.0 (2.5) than participants having 8 years or less of formal education or no education at all. The difference in the knowledge scores by educational levels was statistically significant (F= 17.24; p <.05).Similarly, younger participants between the age group 18-34 years had higher mean knowledge scores 3.5 (2.4) than older age cohorts 35-44 years and 45 years and higher and this difference in the mean score was statistically significant (F=3.92; p .01).

Table 2.4 shows the attitude of participants toward professional dental care. On being asked whether or not going to the dentist was necessary in absence of dental pain, half of the participants said it was not while 31% said it was necessary. Only 17% of the sample participants had dental visits out of which nearly 39% went to the dentist in the last year. Dental visits for rest of the participants (61%) was anywhere between more than a year to five years. A majority (60%) sought professional treatment in private dental offices followed by 23% in government hospitals. Other individuals from whom participants sought dental care were unqualified dental care providers (quacks). Approximately a fourth of the sample went to the dentist for tooth removal. In addition, about 24% sought multiple treatments that included checking teeth, prescription

medications for pain relief or tooth removal. Only 10% went to the dentist for teeth cleaning.

Participants in this rural community managed their gum bleeding and dental pain through various ways (Table 2.5). In an event of gum bleeding, 36.1% of the participants self-cared using home remedies, 15.3% of the participants did nothing, and 22.8% said they sought professional help and 13% reported having no gum bleeding. In cases of dental pain, nearly 33% used home remedies. About 17% did nothing and nearly 27.2% reported going to a health care professional or a dentist for prescription medications or pain relief. No dental pain was reported by 9.4% of the sample population.

Table 2.6 shows the frequency distributions of the factors that prevented participants from seeking regular professional dental care. Among the several reasons that were listed, going to the dentist only when participants had unbearable pain, fear of loss of vision following tooth extraction and use of home remedies were among the top reasons preventing the sample population for seeking professional care.

DISCUSSION

This study collected information on the specified proximal and distal oral health risk factors determining oral health outcomes among rural adult population in central India as guided by the WHO risk-factor approach model.

Questions assessing knowledge levels were based on decay, gum disease, use of tobacco, dental visits and brushing. On an average, participants answered 33% of the questions correctly with about 40-50% of the sample population giving correct responses to questions pertaining to brushing, gum disease, and effects of tobacco use. While 29%

gave correct response to the question on an element they believed prevents decay, a majority of the sample population have never heard of fluorides. Participants with more than 8 years of education and younger participants had statistically significant higher mean knowledge scores than less literate and older adults respectively. This indicates not only younger adults have more years of formal education but they were more informed about the topic of oral health. In addition, the low knowledge scores among older adults reflected their traditional beliefs and myths with respect to maintaining oral hygiene (S. V. Singh, Tripathi, Akbar, Chandra, & Tripathi, 2012). Most of the knowledge that relates to oral health is received through television and through casual conservations with other community members (Ramachandran, Jaggarajamma, Muniyandi, & Balasubramanian, 2006). While television has emerged to be one of the most influential media that affects peoples' opinions and introduces new ways of life, national or state wide health plans do not address the topic of oral health in villages (S. Singh et al., 2015). Furthermore, even though small studies have shown the impact of training community health workers such as anganwadi workers on positive outcomes in the oral health of children, rural health workers or anganwadi workers have not been trained in creating awareness on the topic of oral health in villages (Raj, Goel, Sharma, & Goel, 2013; Sandhya, Shanthi, Fareed, & kumar, 2014).

The sample population had several ways of managing their oral conditions. Gum bleeding management included several self-care techniques such as massaging salt on the gums, using warm saline rinses, avoiding the use of toothbrush and using herbal based or tobacco containing toothpowders. Use of "nas", which is a locally available

tobacco containing toothpowder, is prevalent beacuse participants believe it alleviates oro-dental pain while getting addicted to the product (Agrawal & Ray, 2012; David, 1997; Gupta, 2013). Going to the dentist for gum bleeding problems was not common. About 10% of participants reported having no gum bleeding at all. On examinations, 8% of the sample population had periodontal pockets, 58% had gingivitis and 13% showed attrition in both anterior and posterior teeth.

In an event of dental pain, some participants used pain relief medications, toothpowders containing tobacco or herbal additives and avoided foods they believed aggravated pain and swelling. Anecdotal information suggested that eating "Bhaareyi cheez" can either cause or increase pain and swelling ("Bhaareyi" is a word in colloquial Hindi that indicates to food items that aggravate pain and swelling; Red lentils, eggplant, cauliflower are believed to be some of the food items in this category).Taking medicines for pain relief was a common practice. Relatively more individuals preferred seeking professional help in cases of dental pain rather than in gum bleeding.

Nearly 76% of the sample population had some caries experience with DMFT score of 1 or greater than 1. The overall caries experience increased with age and decreased with higher educational levels. Caries is age related and number of teeth affected as a result of decay is more among older adults thus contributing to high DMFT index than their younger counterparts. Similarly, younger participants had more years of formal education and had fewer teeth affected by caries as compared to older participants who had no or less years of formal education.

While 31.2% of the sample population felt the need of regular dental visits, this attitude was not translated to utilization of dental services with only 17% seeking help in the past few years. The majority of the sample (i.e., approximately 64% out of the few dental care seekers) went to the dentist in an event of dental pain where they either got the tooth removed or were prescribed medication for pain relief. Utilization of dental care services was based on emergency needs and was curative rather than preventive or restorative in nature. Treatment, if sought, is usually in private dental clinics or government owned hospitals that are several kilometers (35) away from this rural region. Almost all of the dental payments are out-of-pocket payments and this demonstrates a need for affordable and accessible dental care in villages (Garcha et al., 2010).

Several barriers exist that prevent rural population from seeking preventive or regular dental care. Of several barriers that were listed, going to the dentist only in unbearable pain, using self-care approaches to treat oral conditions and beliefs such as fear of loss of vision following tooth removal were the most commonly reported which were also documented by a study conducted in India (Garcha et al., 2010). While several interpersonal and intrapersonal factors influence dental attendance, an essential aspect for consideration is the dental care infrastructure and unequal distribution of dental workforce in India. Qualified and trained dental professionals prefer working in urban areas further preventing rural populations from seeking professional help even if they had the means and motivation for dental check-ups (Halappa, H, Kumar, & H, 2014; S. Singh et al., 2015). Therefore, it is very common for rural people to seek advice or help

from unqualified dental practitioners called ‘quacks’ and traditional healers (Garcha et al., 2010).

This is one of the first studies that has explored variables among rural people in this area. The data greatly increases the existing knowledge with respect to the oral health beliefs, dental care utilization and barriers among rural population in central India.

Our study included more females than males because during the day time hours of data collection, most men were out for work at fields. While the results of the study can be generalized to other surrounding villages in the district, inferences should be drawn with caution. Low levels of literacy may have acted as impediments in comprehension of questions while collecting information. Social desirability with respect to utilization of dental services and barrier questions may have incorporated some information bias to the study results. Although the research personnel tried to ask questions in private, privacy in the rural India is viewed in a different way than in some other cultures; extended family members or neighbors are gathered together in most houses during the day. However, this was not an issue as oral health is not considered a very private matter or a sensitive issue in India.

More studies at multiple villages with large sample sizes are recommended to corroborate the study findings. Integrating oral health education and prevention programs at local schools and in national or state-wide health plans where older adults may be approached door-to-door may help increasing oral health knowledge and in reducing the risks to oral diseases. Communities at large should be educated about the

negative of tobacco and tobacco containing products including dentifrices that are sometimes used as a self-management approach in dental pain or gingivitis. Laws preventing manufacturers to add tobacco to dentifrices passed in 1992 must be strictly enforced (David, 1997). While prevalent myths and beliefs may interfere with participants' willingness to seek dental care, individuals should be made aware of the positive results of early and regular dental treatment. The unmet treatment needs among the sample population cannot be overlooked. While the traditional approaches in preventing and treating common oral diseases with limited resources may not help in meeting the needs of the population, integrating feasible and affordable treatment plans may aid in addressing the unmet treatment needs of the rural population. The most important challenge is to offer essential oral health care and oral health education programs within the existing primary health programs in rural areas involving auxiliary dental professionals or grass root level community workers.

CONCLUSIONS

The findings of the study indicate that due to low literacy levels and traditional beliefs, rural populations have low oral health knowledge and their behaviors of seeking dental care are impaired by prevailing myths, seeking help only in pain and resorting to self-care approaches in an event of an oral condition. Not only should the young and the adults be made aware of dental disease prevention and seeking professional help, they should also be educated about maintaining optimal oral hygiene behaviors throughout their lives. In addition, offering essential dental services within the existing health

infrastructure that involves auxiliary dental professionals and other rural health workers will help meet some of the unmet dental needs.

CHAPTER III

PREVALENCE OF CARIES AND DISTRIBUTION OF ORAL HYGIENE BEHAVIORS AND DAILY HABITS BY GENDER, AGE AND EDUCATIONAL LEVELS

INTRODUCTION

Oral diseases such as dental caries, periodontal diseases, oral mucosal lesions and cancers are major public health problems worldwide (Peterson et al., 2005). Dental caries is considered one of the most ubiquitous non-communicable diseases that affects nearly 100% of the population in both developing and developed countries and contributes to the global burden of diseases (Peterson, 2003; Peterson et al., 2005). Several factors such as the recent trend in increase of caries experience in developing countries, shortage in dental professionals and the systems' capacity to deliver only emergency care have resulted in more adults experiencing tooth loss as a result of caries throughout their lifespan (Peterson et al., 2005). One of the global oral health targets developed by World Health Organization, World Dental Federation (FDI) and the International Association for Dental Research (IADR) is to reduce the number of teeth extracted due to caries at ages 18, 35-44 years and 65-74 years by 2020 (Hobdell, Peterson, Clarkson, & Johnson, 2003).

Oral diseases are strongly age-related and exist in all populations, varying only in prevalence and severity. Based on published literature, in fact, little is known at this point in time about the topic of oral health in rural adult population of central India.

While there is increasing number of studies assessing prevalence and severity among children and urban populations, there is paucity of socio-epidemiological information on levels of oral diseases found across lifespan among rural communities (Mandal et al., 2001; Patro et al., 2008). Most of the studies conducted in India have either focused on children or are limited to adult urban population of certain age groups (Mandal et al., 2001; Patro et al., 2008; Rajaratnam et al., 1995; Shah & Sundaram, 2004).

India, occupying a major portion of south Asian subcontinent, is the second most populous country in the world with 70% (851 million) of the population residing in rural regions (India.gov, 2014; Rajaratnam et al., 1995). Primary health care in rural regions barely provides essential health services in rural regions, let alone oral health care delivery. There is less than one dentist per 1000 population in the central state of Madhya Pradesh and almost all the dentists prefer working in the urban regions of the sixth most populous state in India (Censusindia.gov, 2011).

Behaviors such as tobacco use, consumption of alcohol, dietary and brushing habits, and dental care attendance influence oral health to a large extent. Oral health promotion programs aim at controlling such modifiable risk factors. Furthermore, primary prevention in the form of health education programs are cost effective in developing nations such as India, which allocates less than 5% of the gross domestic product (GDP) toward health care expenditures (World Health Organization, 2012). Madhya Pradesh's per capita gross domestic product is the fourth lowest in the country (Planning Commission of India, 2012). Primary health care usually offered in rural communities does not include oral health care. Delivery of restorative dental care service

is more expensive and less feasible with limited resources and does not exist in rural communities (World Health Organization, 2014b). .

The clinical assessments as well as findings on oral hygiene behaviors and daily habits in this study greatly increased the existing body of literature on oral health in developing nations and determine the nature and urgency of health intervention required in rural communities. The community based oral health screenings, using a simple and inexpensive intra-oral examination, not only provided empirical evidence on the prevalence of dental caries but also helped in identifying individuals for dental referrals.

The objectives of this study were to:

1. Determine the prevalence and severity of dental caries by assessing the Decayed Missing Filled teeth (DMFT) index by gender, age and educational levels.
2. Study the association between oral hygiene behaviors, daily habits and dental caries.

METHODS

Setting. The cross-sectional study recruited participants from Ramgarh, a small rural community located in the state of Madhya Pradesh, India. Potential participants were eligible if they were aged 18 years and older and resided in the village. Potential participants were ineligible if they were women, younger than 18 years of age, and self-reported a chronic health condition.

Research design and procedure. Participants willing to participate underwent intra-oral examinations that were done by a single trained dentist and answered a few

questions pertaining to their oral hygiene behaviors that were read to them in their native language of Hindi.

The oral examinations were carried out using mouth mirror, explorer and community periodontal probe (CPI Probe) during daylight in participants' front yards or porches. To ensure intra-examiner reproducibility and reliability when applied to recording dental caries at tooth level, a total of 25 participants were re-examined and perfect agreement was found with a value of kappa statistics to be 1.

Measures. The face-to-face interviews and intra-oral examinations collected information on demographics such as gender, age and educational levels, oral hygiene behaviors such as frequency of teeth cleaning in a day, type of dentifrice used, whether or not participants used toothpaste and whether or not their toothpaste was fluoridated. Furthermore, information was also collected on daily habits such as use of tobacco, drinking alcohol, sweetened tea and snacking habit. The clinical measures included the number of teeth that were decayed, missing and filled as a result of caries experience.

Age was noted as age at last birthday. While age or birth year was not recalled accurately by a majority of participants, age in those cases was estimated based on major life events such as their wedding year or the birth years of their children.

Description of the survey and the oral health. The decayed, missing and filled teeth index (DMFT), commonly used to determine the prevalence of dental caries can take a value from 0-32, 0 indicating no caries and 32 implying that all teeth are affected by caries. The WHO oral assessment form (1997) was used to record the results of intra-oral examinations. Questions pertaining to oral hygiene behaviors and daily habits were

adapted from the WHO Oral Health Questionnaire for adults (Peterson & Baez, 2013). Due to low levels of literacy, the questions along with their answer choices were read out to the participants and their responses were recorded by the research personnel.

Data analysis. The data were entered into SPSS Statistics 22. Frequency distributions of the various demographics and caries prevalence (mean DMFT scores and percentage of adults with caries) were obtained. Chi-square statistics were obtained to examine the distributions of oral hygiene behaviors and daily habits by age, gender and educational levels. Binary logistic regression was also carried out to find out whether caries experience could be predicted by demographic variables, oral hygiene behaviors and daily habits.

RESULTS

The sample population consisted of 56% females and 44% males. The average age of the participants was 35.5± 15.1 years. About a third of the sample was between the ages of 18-24 years, 19% of the 25-34 years age category, 22% of the study population of the 35-44 years age category followed by 12% of 45-54 years age category and 13% of ages 55 years and above. About 11% of the study population, mostly females, had no formal education. Slightly over three fourth of the sample had some kind of formal education in the form of elementary or secondary school education (39%) or high school education, college or a post-graduate degree (43.6%) (Table 3.1). While a majority of the participants engaged in cultivation, animal husbandry, fishery and other agricultural activities, other participants included in the sample were small business

owners or salaried employees in the school. The average income of a family engaged in agriculture in this rural community is about $200 per month.

The degree of caries experience in the sample population is also shown in Table 3.1. Nearly 90% of the population had very low to low levels of caries followed by 7% of the sample population with high levels of caries experience and 3.5% of the sample had moderate levels of caries experience.

Table 3.2 shows the percentage of the sample population affected with caries and the percent with unmet dental needs. Females had a higher percentage (%) of total lifetime decay (77.9) and also had a higher percentage (%) of untreated decay (66.4) as compared to their male counterparts. While the percentage of total caries experience increased with the increase in age, age group 35-44 years comprised the highest percent with untreated decay (70.5). The overall prevalence of caries decreased with the increasing educational levels, however, the same pattern was not observed with untreated decay. Participants having more years of formal education had more untreated decay than participants with no formal education or less than 8 years of education.

Table 3.3 shows the mean DMFT scores by the three demographic variables. The decayed teeth (DT) and missing teeth (MT) indices indicate the unmet treatment needs while the filled teeth (FT) index is the number of teeth filled indicating access to dental care. The DMFT score indicates the lifetime caries experience. The mean number of filled teeth across all categories was less than 1 indicating lack of access to professional dental care. With respect to gender, males had higher DMFT (4.6±6.6), missing (2.6±6.7) and filled teeth (.03±.24) indices than females. The mean number of decayed

teeth decreased with increasing age while the overall caries experience increased with an increase in age. Participants older than 55 years of age had a mean DMFT score of 10.7±9.8 in comparison to DMFT score of 2.2±2.1 for participants between the ages 18-24 years. Study participants with more than 8 years of education had lower mean DMFT indices than participants with no formal education or less than 8 years of education, however, they had slightly higher mean decayed score (2.1±2.1) when compared to other educational categories.

Table 3.4 shows the distribution of several oral hygiene behaviors and daily habits by age categories. Questions on oral hygiene behaviors included whether or not participants used a toothbrush, what kind of dentifrice they used, how frequently they cleaned their teeth in a day and whether or not their toothpaste was fluoridated. In addition, participants were asked about daily habits that affected oral health such as use of tobacco in any form, snacking in between meals habit, drinking tea with sugar or drinking alcohol. Younger participants between the ages 18-34 years used toothbrushes (72.7%) and toothpaste (55.6%) more than their older counterparts and the difference in the use of toothbrushes (χ^2=42.1; $p < .05$) and toothpaste (χ^2=28.4; $p <.05$) was found to be statistically significant across age groups. Use of toothpowder was more prevalent among 35-44 year olds (70.5%) and among participants older than 45 years (71.2%). Approximately 59% and 65.4% of age groups 35-44 years and above 45 years used fingers or chew sticks for cleaning purposes. Similarly, higher percent (%) (34.3) of younger people between the ages 18-34 years used fluoridated toothpaste, and the difference was statistically significant across the age categories (χ^2 =16.8; p .010)

Table 3.5 shows the distribution of oral hygiene behaviors and daily habits with respect to educational levels. Higher percent of participants with more than 8 years of education brushed twice daily (43.2), used toothbrushes (70.5) and toothpaste (52.3) for cleaning than participants with no formal education or less than 8 years of education. These differences were found to be statistically significant across educational categories with chi square values (χ^2) of 9.53 (p .05); 35.4 (p <.05) and 28 (p <.05) respectively. Use of tobacco was more common among participants with no formal education (43.5%) followed by people having less than 8 years of education (43%). This pattern of usage was found to be statistically significant (χ^2 =11.7; p .02). Similarly, the use of fluoridated toothpaste was more common among participants with higher educational levels and this difference by educational levels was found to be significant (χ^2=21.7; p <0.05).

Table 3.6 shows distribution of oral hygiene behaviors and daily habits by gender. The only daily habit that showed a statistically significant difference in the bivariate analysis was the use of tobacco. More males used tobacco than females and this difference in behavior was found to be statistically significant (χ^2=23.6; p <.05). While more number of females than males brushed twice daily, used toothbrushes and toothpaste for cleaning, these differences in oral hygiene behaviors were not found to be statistically significant.

Binary logistic regression was carried out with the DMFT score (overall caries experience) as the dependent variable (Table 3.7). Independent variables included demographic variables such as age, gender, and educational levels, oral hygiene behaviors such as frequency of cleaning teeth, use of toothbrush, and type of dentifrice

and daily habits affecting oral health outcomes such as drinking tea with sugar, use of tobacco, snacking in-between meals habit, use of fluoridated toothpaste and use of alcohol. Participants aged 45 years and above had 3.2 times higher odds of having DMFT scores greater than 1 than the younger age groups.

DISCUSSION

With the increasing trend of adopting unhealthy lifestyles including but not limited to consumption of sugar-rich diet, use of tobacco, poor oral hygiene traditions, rise in chronic diseases and limited availability and accessibility of oral health services and preventive measures, oral diseases such as dental caries show an increasing incidence and prevalence in low income countries such as India (Peterson & Baez, 2013). This study is the first that looks at dental caries prevalence and its associated factors in this rural community of central India. While a higher percentage of females had untreated decay and overall caries experience, males had higher mean DMFT scores, missing and filled teeth indices than females. Previous studies have documented a higher prevalence of untreated decay and overall caries experience among females (Ferraro & Vieira, 2010; Shah, 2003). While several risk factors contribute to caries prevalence, inadequate access to dental care is an important aspect to consider. A very limited percentage (17%) of participants in this village had dental visits in the past few years with females having fewer dental visits than males. Women in the majority of cases managed their dental pain through alternative treatments and pain relief medications. A large proportion of females avoided seeking dental treatment even if they had excruciating pain due to time constraints or financial reasons. Females had additional

responsibilities of care giving and were mostly dependent on their spouses for their financial needs. Males, on the other hand had higher mean DMFT and missing teeth indices mostly due to their lifestyle factors such as use of tobacco, lesser frequency of teeth cleaning and lesser use of toothbrush.

The prevalence of tobacco use was more among males and this difference was found to be statistically significant. The national cross-sectional study conducted in India showed tobacco chewing and smoking to be high in the state of Madhya Pradesh (35.4-40.4% of males smoking tobacco ; 36.3 to 45% of males chewing tobacco) (Rani, Bonu, Nguyen, & Jamjoum, 2003). Results of our study show a higher percentage 51.7% of the male subgroup using tobacco in one form or the other. Tobacco is used in several forms: it is chewed in combination with catechu, lime and areca nut or smoked in the form of beedis and cigarettes. People in the village commonly consumed betel leaf wrapped in spices, lime, catechu and occasionally, tobacco which is known as betel quid or paan (Gupta; Rani et al., 2003). People believe paan aids digestion and the spices help get rid of bad breath. While use of tobacco was common, use of other commercial products such as paan masala was also widespread in this rural community.

The mean DMFT index for this sample was 3.99±5.70 with missing teeth comprising a higher percentage of the total DMFT score. Tooth loss, like elsewhere in the world was seen as a natural consequence of ageing. The mean DMFT of 2.9± 2.9 for age group 35-44 years in our study was lower than the mean DMFT of 5-8.9 reported by the WHO global review of oral health among the same age category in India (Peterson et al., 2005). Dental caries is irreversible and the information on current status not only

provides data on the amount of disease present but also on previous disease experience (Peterson & Baez, 2013)**.** The odds of having a DMFT greater than 1 increased with increasing age with the age group 45 years and above having 3.2 times higher odds than younger age cohorts. The overall caries experience increased with age and less educational levels. While caries prevalence was high among participants with lower educational levels, the decayed teeth index was highest among participants having more than 8 years of formal education. The age group 35-44 years followed by 18-24 years had a higher percentage of untreated decay when compared to other age groups. This difference implies not only that younger people attain high levels of education when compared to the older generation but a shift in dietary habits with increased consumption of refined sugars resulted in more incidence of dental caries among these subgroups.

The filled teeth index was less than 1 in the study sample indicating that access to dental care was almost non-existential. The nearest dental clinic is about 35 kilometers from this village. Anecdotal information suggested that time and financial constraints in addition to limited access to public transportation that was cost prohibitive to a majority of participants prevented them from seeking dental care. Of the very few who sought dental care, the main reason for seeking professional help was for tooth pain. In an event of tooth pain, most of the participants sought alternative treatments such as use of herbal toothpowder, used home remedies, avoided foods they believed aggravated their present conditions or went to a local general physician for pain relief medications.

The caries experience in the study sample was very low to moderate in accordance to the WHO classification of caries severity index. Several factors can contribute to such levels of caries prevalence in this rural community.

Areca nut consumed alone or with other ingredients has been documented to cause dental attrition and staining of teeth, however it provides protection against dental caries (Trivedy, Craig, & Warnakulasuriya, 2002). While this study did not collect data on the prevalence of areca nut chewing, it was commonly chewed among both males and females in combination with paan or paan masala.

Use of fluroidated toothpaste was seen more in younger age groups and among people with higher educational levels. Milk consumed was locally produced and it may be speculated that the fluoride levels found in cows' or goats' milk are minimal. The levels of fluorides in salt are unknown in this community. However, water fluoride levels are known to be higher (>10mg/l) in Chhindwara district and its surrounding villages than national and international water quality standards (Thakur et al., 2013) mitigating the effects of poor oral hygiene behaviors, use of tobacco and less dental attendance.

While a typical diet of a participant was rich in carbohydrates and consisted of whole wheat rotis (tortillas), vegetables, lentils or rice, snacking in between meals was uncommon. Drinking sweetened tea was prevalent but the frequency of consumption was only once daily for a majority of participants. With easy access to refined carbohydrates and increased consumption of packaged food among younger people, more percentage of them had untreated decay (Maru & Narendran, 2012). On the other

hand, rural people have limited monetary resources, hence their food choices are limited and most older people eat staple foods only twice a day with no snacking in between meals habit.

The oral hygiene behaviors seemed insufficient in preventing oral diseases in this sample population. Only 38% of the sample brushed twice daily and slightly more than 50% used toothbrushes for cleaning purposes. Others used their fingers or chew sticks for cleaning purposes. Toothpowder containing high amounts of abrasives was also used by slightly more than half of the participants. Toothpowders commonly used in this region are usually locally manufactured and herbal in nature containing plant derivatives and other additives. These toothpowders act as medication for toothpain, swollen gums and bleeding (Saini, Sharma, & Saini, 2011). Other toothpowder used contained tobacco that people claim to have a sedating effect on their gums and teeth and provides temporary relief from oro-dental pain (Agrawal & Ray, 2012; Sinha, Gupta, & Pednekar, 2003). None of the participants incorporated other aides such as mouth wash or dental floss for cleaning purposes.

This was the first study assessing oral health status and associated factors in this region of central state of India. The study explored the caries prevalence and severity levels and identified the associations between oral hygiene and daily habits to the presence of decay. The results of the study can be generalized to other surrounding villages in the District Chhindwara. However, inferences warrant some caution. There were more females and younger participants in this study sample. Self-report biases may have been incorporated when participants were asked about oral hygiene behaviors and

other habits. While participants were asked for the reason of tooth loss, low levels of literacy and limited understanding of questions may have overestimated the DMFT index when tooth loss could have been due to periodontal diseases or other reasons.

CONCLUSIONS

Participants in this study had varying levels of caries experience by age categories and unmet treatment needs . Poor oral hygiene behaviors found among older adults (45 years and more), males and participants with less than 8 years of education resulted in higher overall caries experience and missing teeth as a result of caries. The community should be made aware of the importance of good oral hygiene behaviors and early dental visits. Oral health prevention programs targeted at this sample population will prevent the onset of dental diseases and significantly reduce the burden of dental diseases both in terms of cost and quality of life.

CHAPTER IV

COMPARISONS OF ORAL HYGIENE BEHAVIORS, DAILY HABITS, AND CARIES PREVALENCE BETWEEN INDIA AND THE DOMINICAN REPUBLIC

INTRODUCTION

Oral hygiene behaviors differ greatly among regions, countries and even within countries. These differences, may be related to race/ethnicity, socio-economic status, cultural contexts including beliefs, values and myths (Buunk-Werkhoven et al., 2011). Different oral hygiene behaviors result in different oral health outcomes across the globe. For example, high levels of caries experience (i.e. 14 teeth or more) are seen in developed countries and some countries of Latin America whereas prevalence of caries is much lower in the developing countries of Africa and Asia (Peterson et al., 2005). Cancers of the oral cavity and pharynx are more common in developing than developed countries (Peterson et al., 2005).

Oral diseases such as dental caries are linked to complex chain of socio-behavioral risk factors existing within the broader socio-environmental contexts (Peterson, 2005). There have been many studies observing the associations between dental caries and socio-behavioral risk factors in industrialized nations but data from developing nations have only been published recently with a paucity of information still existing in socially marginalized groups in low and middle income countries (Chen, 1995; Manuc, Bulgaru, & Iancu, 2006; Peterson, 2005). Comparing two geographically different rural populations of Dominican Republic and India will not only add to the

existing knowledge on socio-behavioral risk factors of dental caries in lesser known populations in middle income countries but also give an insight on how socio-behavioral and environment risk factors result in different levels of caries experience.

The Dominican Republic occupies the eastern two-thirds of the island of Hispaniola, and is located to the southeast of Cuba, between the Caribbean Sea and the North Atlantic Ocean. The population of Dominican Republic, as of 2014 was 10.3 million (Population Reference Bureau, 2014). There are 7,000 dentists, 8 per 10,000; mostly practicing in the urban areas of the Dominican Republic (World Health Organization, 2014c).

India occupying a major portion of south Asian subcontinent is the second most populous country in the world with 70% (851 million) of the population residing in rural regions (India.gov, 2014; Rajaratnam et al., 1995). Predominantly an agricultural nation, primary health care is still in its nascent stages barely providing essential health services in rural regions, let alone oral health care delivery. There is less than one dentist per 1000 population in the state of Madhya Pradesh and almost all the dentists are concentrated in the urban regions of the state (World Health Organization, 2006).

Given the geographical, socio-cultural and demographic differences between these two nations, oral hygiene behaviors affecting oral health status differ vastly. For example, use of tobacco and areca nut for recreational and therapeutic purposes is widely prevalent in rural regions of central India resulting in high prevalence of abrasions, dental caries, periodontal diseases and oral lesions.

On the other hand, consumption of refined starchy food and sugary drinks is more common in Dominican Republic leading to high prevalence and severity of dental caries (Peterson et al., 2005; Tisone, 2004). Despite several differences found between these two populations, some similarities do exist with respect to seeking dental care: one of the main reasons for seeking dental care among rural populations is oro-dental pain when dental diseases have progressed in severity. This comparative component of the project will identify some differences and similarities with respect to behaviors pertaining to oral health that will aid in the development of culturally tailored oral health prevention and promotion programs matching the need for care of target populations.

The WHO has proposed a risk factor model for use by investigators as an instrument in planning oral health promotion and intervention programs (Peterson & Baez, 2013) . This model aims to collect data by focusing on socio-economic and environmental determinants, modifiable behavioral causes of oral health such as diet/nutrition, tobacco use and excessive alcohol consumption. Quality of life, oral health and systemic health are considered important outcomes of the specified distal and proximal factors.

Utilization of this model will help us answer the following research questions:

1. What is the prevalence of dental caries among rural adult participants?
2. What are the differences in oral hygiene behaviors and oral health outcomes (DMFT index) between two developing nations: India and Dominican Republic?

The purpose of the study was to gain integrative knowledge on oral hygiene behaviors affecting the levels of caries experience that will aid in the development of oral health

interventions for specific groups of people in India and the Dominican Republic who are culturally different.

METHODS

Setting. The participants for the study were recruited in two countries: La Esquina community, Province Maria Trinidad Sanchez in the Dominican Republic and in Ramgarh, district Chhindwara in the state of Madhya Pradesh in India. There were a total of 104 participants aged 18-80 years in the Dominican Republic sample while a total of 202 participants aged 18-85 years were in the Indian sample. Prior to conducting this study, approval was obtained from institutional review board of Texas A&M University.

Research design and procedure. This cross-sectional study invited residents older than 18 years to take part. Only after having signed their informed written consent were they allowed to answer survey questions on their oral hygiene behaviors, daily habits and dental visits through face-to-face interviews as well as participate in screening or intra-oral examinations. The questionnaire was administered by a research team who went door-to-door and respondents answered the questions or underwent screening in their front yards or porches. While Spanish is spoken by the Caribbean participants, Hindi was the native language of the rural sub-group in India. The questionnaire was translated into the Spanish and Hindi respectively.

Measures. The study collected information on a few demographic variables such as gender, age, and educational levels. Age was noted down as age at last birthday. While age or birth year was not recalled accurately by a majority of participants in rural

India, age in those cases was estimated based on major life events such as their wedding year or the birth years of their children. Educational level was categorized as having some elementary school education, having more than elementary school education including some years in college and having no formal education at all.

While the study collected information on several variables, 4 questions on oral hygiene behaviors, 3 questions on daily habits and 2 questions on dental visits and attitudes toward professional dental care were included for the comparison between the two different samples. Survey questions pertaining to oral hygiene behaviors, daily habits and past dental visits were adapted from WHO oral health questionnaire for adults (Peterson & Baez, 2013). The questions were in multiple choice questions format and participants had to choose the best possible answer. Due to low literacy levels, questions were read out to them and their responses were recorded by the research team. In addition, the participants were also examined to determine the number of teeth that were missing, filled, and decayed as well as the overall caries experience.

Data analysis. The data were entered into statistical package for Social Sciences 22 (SPSS, Chicago, IL, USA). Frequency distributions of the various demographics in each sample were obtained. Chi-square statistics were obtained to examine the distributions and differences in oral hygiene behaviors and daily habits by the two countries. A one way analysis of variance was performed to determine differences in the mean scores in the overall caries experience (DMFT score) between the Dominican Republic and India samples.

RESULTS

Table 4.1 shows the distribution of the study populations according to gender, age and educational levels. The samples in rural India and Dominican Republic had fewer males than females. Males comprised 44.9% and 44.1% of the samples respectively while females constituted 55.9% and 52.9% of the total participants. The age distribution was statistically significant (χ^2= 9.03, p = .011). The majority of the sample in India was between the ages 18-34 years (50.8%), followed by 45 years and above (26.7%) and 22.6% between the ages of 35-44 years. The Dominican Republic sample had more participants above the ages of 45 years (44%) followed by participants between the ages of 18-34 years (40.8%). Only 15.3% of the sample was between the ages 35-44 years. While all of the participants in the Dominican Republic had some level of formal education, 8.2% of the Indian participants were illiterate. Of the participants that had some form of formal education, there were nearly equal numbers of participants with less than 8 years or more than 8 years of education in India. However, a majority, 60% had 8 years or less than 8 years of education and 40% had more than 8 years of education in the Dominican Republic . The difference in the educational levels was statistically significant across the two samples (χ^2=16.24; p <.001).

The differences in the oral hygiene behaviors in India and Dominican Republic are shown in Table 4.2. While about 94% of the Caribbean sample brushed more than twice daily, brushing twice daily was not as common among Indian participants with only 42% practicing this oral hygiene behavior. More than half (58.2%) of the Indian sub-group brushed only once a day and this difference in brushing habit was statistically

significant between the two geographically different samples (χ^2=76.5; p <.001). Greater proportion of both the Latin Caribbean and the Indian participants brushed for 2 minutes or more; however, this difference was not statistically significant. Use of toothbrush had marked difference by the samples examined. All of the participants in the Dominican Republic used toothbrush for teeth cleaning purposes while only 55% of the Indian sub-group used toothbrush. Other Indian participants used chew sticks or fingers for cleaning. This difference in oral hygiene behaviors was found to be statistically significant by the two samples (χ^2=65.2; p <.001). Use of fluoridated toothpaste was more prevalent in the Dominican Republic sample with this difference being statistically significant by the two countries (χ^2=94.04; p <.001). Nearly 75% of the Indian sub-group did not use fluoridated toothpaste or was not knowledgeable that their toothpaste was fluoridated. Use of tobacco was more prevalent in the rural Indian sub-group where people used tobacco in more than one form. About 38% reported either chewing tobacco or smoking while use of tobacco in the Dominican Republic sample was only in the form of cigarettes with only 7% reported doing so. This daily habit was statistically significant by the two groups (χ^2=32.4; p <.001). Drinking sweetened tea or coffee was widespread in both the groups with 91%-93% reported consuming them at least once a day. This difference was statistically not significant. Daily alcohol consumption was not very common in both the samples with only 5% of the Dominican Republic participants and 2.7% of the Indian sub-group reported drinking alcohol daily; the difference in this daily habit was not found to be statistically significant between the two countries.

Table 4.3 illustrates the attitude of the participants toward seeking professional dental care and the utilization of dental services in the past one year. On being asked if going to the dentist was necessary despite the absence of dental pain, about 95% of the Latin Caribbean sample said yes while only 39% of the Indian sub-group agreed to the statement. This difference in the attitude toward professional dental care was statistically significant across the two groups (χ^2=85.07; p <.001). The dental visits in the past one year for the rural Indian participants were very few with only 12 participants reported doing so while 29 of the 104 Dominican Republic participants visited the dentist in the last year. This difference in the utilization of dental care and services was statistically significant between the two samples (χ^2=24.84; p <.001)

Intra-oral examinations of the participants to determine the prevalence of caries was carried out in the two sub-groups. The overall caries experience is calculated by summing up the number of teeth decayed, missing and filled as a result of caries. The caries experience, denoted by DMFT index was much higher in the Dominicans with a DMFT score of 9.6±8.0 than in the rural Indian cohort which had a mean score of 4.0±5.7. This difference in the mean was statistically significant across the two groups (F= 13.3; p<.001). Similarly, the numbers of teeth decayed, missing and filled were higher in the Latin Caribbean group than the South Asian group and the differences in the mean scores were found to be statistically significant across the two groups (Table 4.4).

DISCUSSION

This study explores various modifiable risk factors, socio-environmental determinants, exposure to fluorides and use of dental services and compares the oral health outcomes in India and the Dominican Republic. There were marked differences in ways through which the Latin Caribbean and the South Asian groups maintained their oral hygiene. Brushing twice was more prevalent in the Dominican Republic sample but the frequency of teeth cleaning was once a day for nearly 60% of the Indian sub-group. Cleaning teeth in the evenings for the Dominicans was usually before taking showers and not necessarily after meals. A majority in both the samples brushed for 2 minutes or more. While direct observations suggest more individuals were less likely to brush over two minutes, self-reporting may have overestimated the duration of teeth cleaning. Toothbrush and toothpaste were used by all the Dominican Republic participants for cleaning purposes while some Indian participants used fingers and chew sticks instead of toothbrush (Madden et al., 2004; S. V. Singh, Akbar, Tripathi, Chandra, & Tripathi, 2013). Dentifrices especially local toothpowders that were herbal based or contained tobacco and high in abrasives were commonly used by rural folks in India (Yadav, Saxena, Reddy, Deshpande, & Deshpande, 2012). Villagers used their fingers and toothpowder to massage the gums and clean their teeth (Mohire, Yadav, & Gaikwad, 2009). Use of interdental aids such as toothpicks was not very common in Indian sub-group. Use of fluoridated toothpaste was more widespread in the Dominican Republic than in India. While small proportion of the Dominican participants knew the role fluorides had on teeth, a majority of Caribbean participants knew whether or not their

toothpaste was fluoridated. On the contrary, only one fourth of the Indian participants were knowledgeable about their toothpaste being fluoridated of which many may have answered in a socially desirable way without actually being aware of their toothpaste being fluoridated. Previous studies have also documented that individuals were not knowledgeable about the effects of fluorides on oral health (Schwarz & Lo, 1994; Tewari, Gauba, & Goyal, 1991).

Of the daily habits that affect oral health outcomes, use of tobacco either in the form of beedis or cigarettes or chewing tobacco mixed with lime, catechu and areca nut was prevalent in the Indian sample with more males reported using tobacco in one form or the other. Tobacco was also present in indigenously manufactured dentifrices that were used by both males and females alike. People believe that tobacco containing dentifrices aid in alleviating tooth pain and become addicted to tobacco (Agrawal & Ray, 2012; David, 1997; Gupta, 2013). Tobacco was used only as cigarettes in the Dominican Republic sample and a small proportion of the sample smoked.

Consumption of sweetened tea was widespread in India while consumption of sweetened coffee was prevalent in the Dominican sample. While the frequency was not very high with slightly more than 90% reported drinking only once daily in both the samples. One of the studies showed higher prevalence of sweetened tea in rural India and associations of dental caries levels with higher tea consumption frequency (Maru & Narendran, 2012). Alcohol consumption on a daily basis was not a common daily habit in both the sample with less than 5% of the sub-groups reported using alcohol.

There were more Caribbean participants who visited the dentist in the last one year. While fewer participants sought professional dental in rural India, the main reason for dental attendance in both the sample was dental pain. Even though the Caribbeans held favorable attitude toward professional dental care, this attitude did not result in regular dental attendance. It has been documented that people usually seek dental treatment either when the disease has progressed in severity or when pain becomes unbearable. Furthermore, restorative treatments are expensive for rural folks where almost all of the dental payments are out-of-pocket. Treatment is sought in private dental offices where they are charged more if undergoing restorative treatment in the initial stages of dental caries than for tooth removal that remains the only inexpensive option in advanced stages of dental decay. Government owned hospitals where charges are low are not equipped with resources or dental professionals for restorative treatment. Dental care is usually private service offered in urban or semi-urban areas; traveling to seek treatment is cost prohibitive to a majority of participants in both the countries. Furthermore, oral health is perceived not as important as general health; oral conditions are usually not life threatening so people usually self-manage their conditions before seeking any professional help. Losing teeth is seen by many in both the rural communities as a natural consequence of the aging process.

The overall caries experience was higher among Dominicans with both the missing and decayed teeth component also being higher than the Indian participants. However, the mean number of teeth filled was higher in the Latin Caribbean sub-group indicating that access and affordability to some forms of restorative treatment was more

commonplace in rural Dominican Republic than in India. The unmet treatment needs demonstrate limited access to dental health care and a need for provision of dental health services within the existing health infrastructure in the rural communities.

The oral hygiene behaviors in the Indian sub group were not optimal for good oral health yet the caries experience was lower than the Dominican Republic sample. It can be attributed to the high fluoride levels that are found in potable water. These naturally occurring fluorides are above the permissible amounts and are estimated to be above 10 ppm (parts per million) (Thakur et al., 2013). Use of toothpowder is more prevalent than the use of fluoridated toothpaste while all the Dominican Republic participants used fluoridated toothpaste. Salt fluoridation that has begun in the Dominican Republic has not yet permeated into this small rural community of 300 people (Estupiñán-Day, 2005).

Primary health centers do not address the topic of oral health and there are no dental professionals that work in rural areas in this region of India. Anganwadi workers and helpers or other rural health workers such as ASHA in India are not trained in providing any kind of oral health education in Indian villages (Ministry of Women and Child Development, 2009; NRHM.gov, 2014). Similarly, oral health education is not a part of health education programs in the Dominican Republic which usually focus on zoonotic and chronic diseases. Oral health education and essential oral health delivery in developing nations should become a part of the existing primary health care in rural communities where rural health workers should be trained to deliver oral health

education programs and dental auxiliary professionals be utilized more in offering essential dental services in rural regions.

While this is first among the studies comparing oral hygiene behaviors, dental attendance and oral health status between two culturally and geographically different countries, sample sizes are small limiting some of the implications that can be drawn from the study. Nonetheless, an insight into oral hygiene behaviors and daily habits will help in tailoring oral health education and promotion programs to the populations' needs. Anti-tobacco health education programs in addition to promotion of use of toothbrush and paste will help improve the oral health status of the Indian target population while ways to improve oral hygiene to achieve optimal oral health through the lives should be the focus for oral health education programs in the Dominican Republic. While all the questions pertaining to oral hygiene, daily habits and dental visits were self-reported, some information bias may have been incorporated as self-reports are imperfect indicators of behaviors. Social desirability may have played a role in ways in which participants answered certain oral hygiene behaviors. The cross-sectional study design does not explain the cause and effect between modifiable risk factors and levels of caries. More comparative studies are needed to build upon the study findings.

CONCLUSIONS

There were significant differences in a few oral hygiene behaviors, daily habits and levels of caries experience between the Dominican and Indian sub-groups. The integrative knowledge on oral hygiene behaviors affecting the levels of oral diseases in these two different countries will aid in the development of oral health interventions for

specific groups of people in India and Dominican Republic who are different in several ways.

CHAPTER V

CONCLUSIONS

The overall purpose of this research study was to assess oral health knowledge, oral hygiene behaviors, daily habits, management of oral conditions, exposure to fluorides, attitudes toward professional dental care and utilization of professional dental care among adult rural population in Central India. Furthermore, this study determined the oral health status of individuals in this community by examining the caries experience and prevalence of other oral conditions. The third component of this study compared the oral hygiene behaviors found in rural central India to that in the rural Dominican Republic and how these differences in behaviors and daily habits resulted in varying levels of caries experience.

There is an increasing body of work that addresses the topic of oral health in developing nations. However, the data become scarce on rural adult populations. Most of the studies that have been conducted in developing countries such as India have either focused on adults of certain age groups or on children in urban regions. A very few population based studies that have been conducted looked at the beliefs, practices and barriers with respect to oral health and dental health care in both urban and rural regions of India. This is first among the studies that look at the topic of oral health in a rural community of central India. Additionally, the comparative component between India and Dominican Republic gives insights on how oral hygiene behaviors as well as daily habits differ geographically and culturally and how these differences affect oral health

outcomes particularly with overall caries experience among rural populations. In order to examine these gaps in the scientific literature, the author conducted face-to-face interviews and intra-oral examinations among rural populations in India and the Dominican Republic.

The findings of the study showed the mean oral health knowledge scores for males and females were nearly the same, 3.1(2.4) versus 3.0 (2.2) and the difference in the mean knowledge scores by gender was not statistically significant. Participants who had more than 8 years of formal education had higher mean knowledge score 4.0 (2.5) than participants having 8 years or less of formal education or no education at all. This difference in the knowledge scores by educational levels was statistically significant ($F = 17.24$; $p < .05$). Similarly, younger participants between the age group 18-34 years had higher mean knowledge scores 3.5 (2.4) than older age cohorts 35-44 years and 45 years and higher and this difference in the mean score was statistically significant ($F = 3.92$; p .01).

In an event of gum bleeding, 36.1% of the participants used home remedies, 15.3% of the participants did nothing, and 22.8% said they sought professional help and 13% reported having no gum bleeding. In cases of dental pain, nearly 33% used home remedies. About 17% did nothing and nearly 27.2% reported going to a health care professional for prescription medications or pain relief. On being asked whether they considered going to the dentist necessary even if they had no dental pain, half of the participants said it was not while 31% said it was necessary. Only 17% of the sample participants had dental visits in the past few years. Among the several barriers that

prevented people from seeking professional dental care, going to the dentist only when participants had unbearable pain, fear of loss of vision following tooth extraction and use of home remedies were among the top reasons.

While higher percentage of females had untreated decay (66.4%) and overall caries experience (78%), males had higher mean DMFT scores 4.6 (6.6), missing 2.6 (6.7) and filled .03 (.24) teeth indices than females. The mean DMFT index for this sample was 3.99 (5.70) with missing teeth comprising higher percentage of the total DMFT score. The odds of having a DMFT greater than 1 increased with increasing age with age group 45 years and above having 3.2 times more odds of having more than one tooth affected by caries than younger age cohorts.

Use of fluoridated toothpaste (χ^2 =16.8; p <.05), type of dentifrice used (χ^2= 28.4; p <.05) and use of toothbrush (χ^2= 42.1; p < .05) differed significantly by age groups with older age groups 45 years and above using toothpowders and fingers or chew sticks for cleaning purposes. Participants with more educational levels brushed more than once daily (χ2=9.53; p .05), used toothbrushes (χ^2 =35.4; p <.05) and toothpaste (χ^2 =28; p <.05), knew their toothpaste was fluoridated (χ^2 =21.7; p <0.05) and used less tobacco (χ^2 =11.7; p <.05) than people with less than elementary school education and these difference were found to be statistically significant. The prevalence of tobacco use was more among males and this difference was found to be statistically significant (χ^2= 23.6; p <.05).

The results of the third study show that Latin Caribbean sample brushed more than Indian sub population, their usage of toothbrush (χ^2= 65.2; p <.001) and fluoridated

toothpaste (χ^2= 94.04; p <.001) was more while use of tobacco (χ^2=32.4; p <.001) was lesser than the Indian sample; the differences being statistically significant. On being asked if going to the dentist was necessary despite the absence of dental pain, about 95% of the Latin Caribbean sample said yes while only 39% of the Indian sub-group agreed to the statement. This difference in the attitude toward professional dental care was statistically significant across the two groups (χ^2= 85.07; p <.001). The dental visits in the past one year for the rural Indian participants were very few with only 12 out of the 202 participants reported doing so while 29 of the 104 Dominican Republic participants visited the dentist in the last year. This difference in the utilization of dental care and services was also statistically significant between the two samples (χ^2= 24.84; p <.001). However, the mean DMFT of the Dominican Republic sample was much higher than the caries experience found in Indian sub-population and the difference in the overall caries experience was found to statistically significant (F= 13.3; p <.001). Even though the Dominican Republic sample reportedly had better oral hygiene behaviors, favorable attitudes and more dental visits, participants had higher overall caries experience. It can be speculated that high levels of naturally occurring fluorides in potable water in rural region of India may have mitigated the effects of poor hygiene behaviors and daily habits such as tobacco use.

Nonetheless, there seems to be a general lack of awareness about oral health problems and their preventative measures which are further complicated by unfavorable attitudes toward professional dental care and perceived barriers resulting in fewer visits to the dentist among rural populations in the rural region of central India. Lack of

optimal oral hygiene behaviors coupled with prevalent use of tobacco and systemic deficiencies in dental infrastructure resulted in varying levels of caries experience across age groups in the sample population.

This report is a valuable asset to the literature as it is one of the few studies assessing oral health status and associated risk factors in this region. This study looks at the caries prevalence and severity levels and identifies the unmet treatment needs in this community. The results of the study can be generalized to other surrounding villages in the District Chhindwara in the central state of Madhya Pradesh in India.

However, drawing inferences warrants some caution from the study sample. There were more number of females and younger participants in this study sample. Our study included more females than males because during day time hours of data collection, most men were out for work at fields. Self-reported biases may have been incorporated when participants were asked about oral hygiene behaviors and other habits. Social desirability with respect to utilization of dental services and barrier questions may have incorporated some information bias to the study results as well (Fadnes, Taube, & Tylleskär, 2008). The cross-sectional study design does not explain the cause and effect of low knowledge scores, unfavorable attitude toward dental care and modifiable risk factors on prevalence of caries and other oral conditions.

While participants were asked for the reason of tooth loss, low levels of literacy and limited understanding of questions may have overestimated the DMFT index when tooth loss could have been due to periodontal diseases or other reasons. However, on the other hand, DMF Teeth index is known to underestimate the levels and severity of caries

experience (Becker, Levin, Shochat, & Einy, 2007). Low levels of literacy may have acted as impediments in comprehension of questions while collecting information.

Missing data in the sample were due to failure to reach individuals in two attempts either because of time conflicts or participants traveling out of village at the time of data collection. In addition, a few participants with lesser/no literacy levels had limited comprehension of questions and difficulties in giving appropriate responses; in those cases, questions were not asked further as they were less likely to answer questions about their oral health.

Reliability refers to a measure's ability to distinguish precisely one person from another (Roberts, Priest, & Michael, 2006). While a reliable measure will be consistent, consistency is seen as a by-product of reliability, and in an instance of perfect consistency (where everyone scores the same and gets the same score repeatedly) (Joppe, 2000); reliability coefficients are affected if little or no variance/covariance exists. While answering the barrier questions, participants had very similar scores that resulted in poor reliability score of 0.53. While there was considerable variability in the sample population, however, this population was not representative of a full range of perceived barriers preventing them from seeking dental care. Future studies should include a finer-grained barrier measure that is easy to understand among the less educated rural populations.

While this study attempts to fill the gaps in literature about the topic of oral health in lesser known populations, the study samples are small. More studies at multiple

rural communities with large sample size are recommended to corroborate the study findings.

Prevention of oral diseases can occur at various levels. Primary prevention in the form of oral health education programs should be targeted at both the young and the adults. Grass root level workers such as Anganwadi and ASHA or dental auxiliary professionals can educate younger rural populations at schools or go door-to-door making older adults aware of dental disease prevention and maintaining optimal oral hygiene behaviors throughout their lives. Oral health education programs should be tailored toward curbing tobacco use, maintaining optimal oral hygiene behaviors and developing positive attitudes toward seeking professional dental care. In addition, secondary and tertiary prevention efforts such as offering oral health screenings, dental referrals and providing essential and affordable dental services within the existing health infrastructure involving auxiliary dental professionals will help meet some of the unmet dental needs.

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APPENDIX A

Figure 1.1

WHO Risk-Factor approach model in promotion of oral health (Peterson &Baez, 2013)*

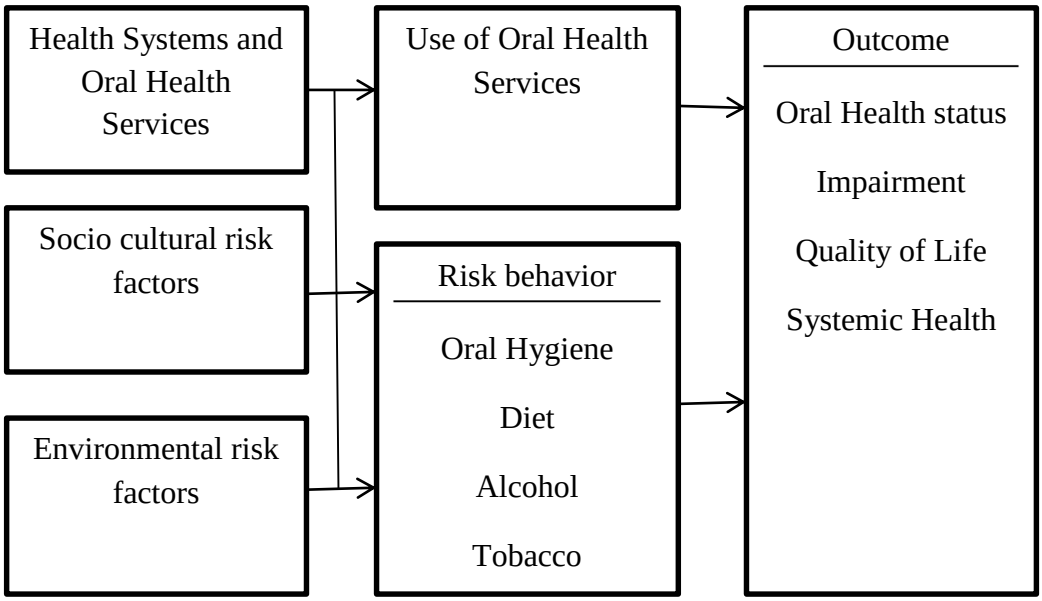

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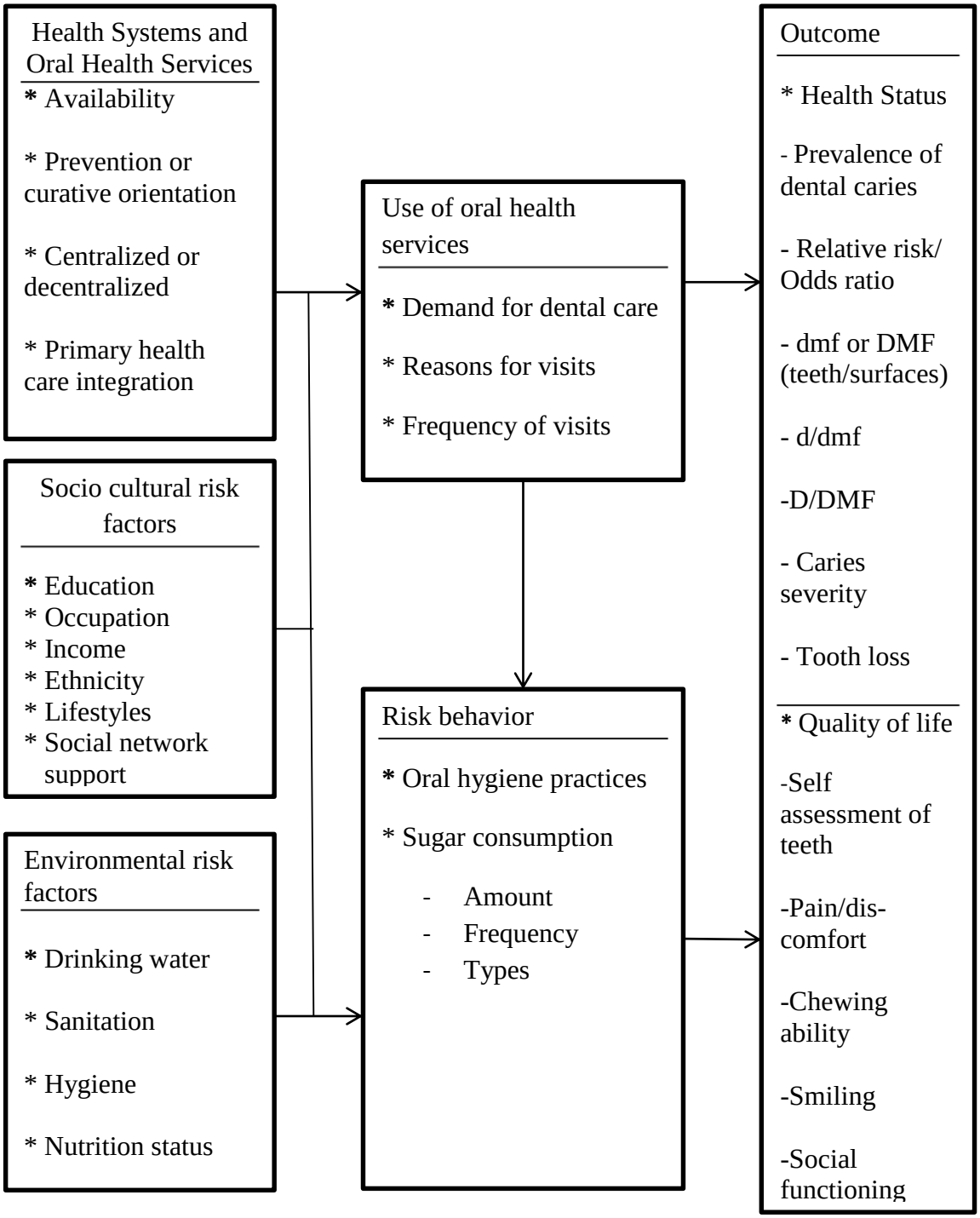
Figure 1.2

Risk factor model for analysis of dental caries (Peterson, 2005)*



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APPENDIX B

Table 2.1

Demographics

Variable	N	%
Gender		
Male	89	44.1
Female	113	55.9
Total	202	100
Age		
18-34 years	99	49
35-44 years	44	21.8
45 years and Higher	52	25.8
Missing	7	3.5
Total	202	100
Average	35.5 ± 15.1 years	
Educational level		
No formal education	23	11.4
8 years or less	79	39.1
More than 8 years	88	43.6
Missing	12	5.9
Total	202	100

Note. N Number, % Percent

Table 2.2

Comparison of mean DMFT scores by gender, age and educational levels

Variable		N	Mean	SD	*F*	*p*	Significance
Gender	Male	89	4.6	6.6	1.73	.189	NS
	Female	113	3.5	4.8			
	Total	202	4.0	5.7			
Age	18-34 years	99	2.3	2.3	23.5	.000	S*
	35-44 years	44	2.9	2.9			
	45-54 years	25	5.2	6.8			
	55 years & above	27	10.7	9.8			
	Total	195	4.0	5.6			
	No formal education	23	5.2	7.1			
Educational levels	8 years or less	79	5.0	7.2	2.72	.046	S*
	More than 8 years	88	2.7	3.1			
	Total	190	4.0	5.7			

Note. *Significant at the p< 0.05 level
SD Standard Deviation

Table 2.3

Comparison of mean knowledge scores by gender, age and educational levels

Variable	Mean	SD	*F* statistics	*p*
Gender				
Male	3.1	2.4	.11	.746
Female	3.0	2.2		
Educational levels				
More than 8 years	4.0	2.5	17.24	<.05*
8 or less than 8 years	2.4	1.7		
No formal education	1.0	1.5		
Age (In years)				
18-34	3.5	2.4	3.92	.010*
35-44	2.7	2.3		
45 and Higher	2.5	2.1		

Note. SD Standard Deviation
*Significant at the p<0.05 level

Table 2.4

Attitude toward professional dental care and utilization of dental care and services

Variable	N	%
Did you visit a dentist?	N=202	
Yes	35	17.3
No	148	72.3
Missing	21	10.4
Where did you receive dental treatment?	N=35	
Private dental office	21	60
Hospital	8	22.9
Others	6	17.1
When was the last dental visit?	N=35	
Past one year	12	38.7
1-2 years ago	4	12.9
3-5 years ago	9	29
More than 5 years ago	6	19.4
Treatment sought during your last dental visit	N=35	
Check my teeth	6	20.7
Tooth removal	7	24.1
Cleaning	3	10.3
Pain relief	3	10.3
Prescription	3	10.3
Multiple treatment sought	7	24.1
Going to the dentist is necessary even if you have no dental pain?	N=202	
Yes	63	31.2
No	100	49.5
Missing	39	19.3

Note. N Frequency
% Percent

Table 2.5

Management of oral conditions: Gum bleeding and dental pain

Gum bleeding management	N	%
Use home remedies	73	36.1
Do nothing	31	15.3
Go to the dentist	46	22.8
Others	5	2.5
No gum bleeding	26	12.9
Missing	21	10.4
Dental pain management		
Use home remedies	67	33.2
Do nothing	35	17.3
Go to the dentist	55	27.2
Others	6	3
No dental pain	19	9.4
Missing	20	9.9

Note. N Frequency
% Percent

Table 2.6

Frequency distributions of barriers to professional dental care

		N	%
I go to the dentist only when I have unbearable dental pain	Agree	69	34.2
	Disagree	59	29.2
	Missing	74	36.6
	Total	202	100
I am scared to seek dental treatment because I am afraid of dental instruments	Agree	57	28.2
	Disagree	72	35.6
	Missing	73	36.1
	Total	202	100
I don't go to the dentist as I use home remedies	Agree	64	31.7
	Disagree	63	31.2
	Missing	75	37.1
	Total	202	100
I don't like going to the dentist for tooth removal because of the fear of losing my vision	Agree	85	42.1
	Disagree	70	34.7
	Missing	47	23.3
	Total	202	100
I don't like going to the dentist for teeth cleaning because I feel cleaning makes my teeth loose.	Agree	72	35.6
	Disagree	81	40.1
	Missing	49	24.3
	Total	202	100
I don't go to the dentist because treatment costs are high	Agree	52	25.7
	Disagree	74	36.6
	Missing	76	37.6
	Total	202	100
Seeking dental care is difficult as there are no dental clinics nearby	Agree	51	25.2
	Disagree	74	36.6
	Missing	77	38.1
	Total	202	100
Going to the dentist is difficult because there is no mode of transportation	Agree	53	26.2
	Disagree	74	36.6
	Missing	75	37.1
	Total	202	100

Table 2.6 Continued

Going to the dentist is difficult as there is no family member or friend to accompany me	Agree	52	25.7
	Disagree	74	36.6
	Missing	76	37.6
	Total	202	100
I don't go to the dentist as I have no time	Agree	38	18.8
	Disagree	88	43.6
	Missing	76	37.6
	Total	202	100

Note. N Frequency
% Percent

Table 3.1

Demographics and levels of caries experience according to the WHO severity criteria (N = 202)

Variable	Number	Percent
Gender		
Male	89	44.1
Female	113	55.9
Age		
18-24 years	61	30.2
25-34 years	38	18.8
35-44 years	44	21.8
45-54 years	25	12.4
55 years & above	27	13.4
Missing	7	3.5
Average	35.5 ± 15.1 years	
Educational level		
No formal education	23	11.4
8 years or less	79	39.1
More than 8 years	88	43.6
Missing	12	5.9
Degree of caries experience		
Very low <5.0	149	73.8
Low 5.0-8.9	32	15.8
Moderate 9.0-13.9	7	3.5
High >13.9	14	6.9

Table 3.2

Percent of adults with caries and untreated decay in permanent teeth (Prevalence of caries among adults by gender, age and educational levels) (N = 202)

Characteristic	Percent with caries, missing and filled teeth (DMFT)	Percent with untreated decay (DT)
Gender		
Male	73	62.9
Female	77.9	66.4
Age		
18-24 years	70.5	68.9
25-34 years	65.8	63.2
35-44 years	79.5	70.5
45-54 years	80	68
55 years and above	92.6	48.1
Educational Levels		
No formal education	78.3	60.9
8 years or less	77.2	60.8
More than 8 years	71.6	67

Table 3.3

Mean number of decayed, filled and missing teeth due to decay by gender, age and educational levels, Severity of decay measured by number of permanent teeth affected (N = 202)

Characteristic	Decayed Permanent teeth (DT)		Missing Permanent teeth (MT)		Filled Permanent teeth (FT)		Total decayed, missing or filled permanent teeth (DMFT)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gender								
Male	2.0	2.3	2.6	6.7	.03	.24	4.6	6.6
Female	2.0	2.2	1.5	4.4	.01	.10	3.5	4.8
Age								
18-24 years	2.1	2.1	.07	.36	.03	.26	2.2	2.1
25-34 years	2.0	2.3	.34	.82	.05	.23	2.4	2.7
35-44 years	2.2	2.3	.66	1.5	0	0	2.9	2.9
45-54 years	2.1	2.5	3.0	6.6	0	0	5.2	6.8
55 years and above	1.6	2.3	9.1	10.3	0	0	10.7	9.8
Educational Levels								
No formal education	1.2	2.6	3.3	7.0	0	0	5.2	7.1
8 years or less	1.9	2.4	3.0	7.2	.01	.11	5.0	7.2
More than 8 years	2.1	2.1	.57	2.2	.03	.24	2.7	3.1

Note. SD Standard Deviation

Table 3.4

Distribution of oral hygiene behaviors and daily habits by age groups (N = 202)

Oral hygiene behaviors and daily habits		18-34 years		35-44 years		45 years and higher		Total N (%)		X^2	*p*
		N	%	N	%	N	%	N	%		
Frequency of teeth cleaning in a day	≥1 daily	56	56.6	19	43.2	29	55.8	107	53	3.0	.559
	≤2 daily	37	37.4	21	47.7	18	34.6	77	38.1		
	Missing	6	6.1	4	9.1	5	9.6	18	8.9		
Type of Dentifrice Used	Toothpaste	55	55.6	9	20.5	9	17.3	73	37.4	28.4	<.05*
	Toothpowder	38	38.4	31	70.5	37	71.2	106	54.4		
	Missing	6	6.1	4	9.1	6	11.5	16	8.2		
Use of toothbrush	Yes	72	72.7	14	31.8	12	23.1	101	50	42.1	<.05*
	No	21	21.2	26	59.1	34	65.4	82	40.6		
	Missing	6	6.1	4	9.1	6	11.5	19	9.4		
Use of tobacco in any form	Yes	30	30.3	18	40.9	21	40.4	69	35.2	2.3	.677
	No	59	59.6	22	50	26	50	107	54.9		
	Missing	10	10.1	4	9.1	5	9.6	19	9.7		
Daily Snacking habit in between meals	Yes	34	34.3	16	36.4	15	28.8	65	33.3	1.0	.911
	No	58	58.6	24	54.5	32	61.5	114	58.5		
	Missing	7	7.1	4	9.1	5	9.6	16	8.2		

Table 3.4 Continued

Drink tea with sugar at least once a day	Yes	80	80.8	39	88.6	41	78.8	160	82.1	3.0	.552
	No	9	9.1	1	2.3	6	11.5	16	8.2		
	Missing	10	10.1	4	9.1	5	9.6	19	9.7		
Drink alcohol at least once a day	Yes	0	0	2	4.5	3	5.8	5	2.6	5.5	.244
	No	89	89.9	38	86.4	44	84.6	171	87.7		
	Missing	10	10.1	4	9.1	5	9.6	19	9.7		
Use of fluoridated toothpaste	Yes	34	34.3	5	11.4	6	11.5	45	23.1	16.8	.010*
	No	18	18.2	15	34.1	18	34.6	51	26.2		
	I don’t know	41	41.4	20	45.5	23	44.2	84	43.1		
	Missing	6	6.1	4	9.1	5	9.6	15	7.7		

Note. *Significant at α=.05; % Percent

Table 3.5

Distribution of oral hygiene behaviors and daily habits by educational levels (N = 202)

Oral hygiene behaviors and daily habits		No formal education		8 years or less		More than 8 years		Total		X^2	*p*
		N	%	N	%	N	%	N	%		
Frequency of teeth cleaning in a day	≥1 daily	11	47.8	50	63.3	43	48.9	104	54.7	9.53	.05*
	≤2 daily	7	30.4	25	31.6	38	43.2	70	36.8		
	Missing	5	21.7	4	5.1	7	8	16	8.4		
Type of Dentifrice Used	Toothpaste	1	4.3	24	30.4	46	52.3	71	37.4	28	<.05*
	Toothpowder	16	69.6	51	64.6	35	39.8	102	53.7		
	Missing	6	26.1	4	5.1	7	8	17	8.9		
Use of toothbrush	Yes	4	17.4	32	40.5	62	70.5	98	51.6	35.4	<.05*
	No	13	56.5	43	54.4	19	21.6	75	39.5		
	Missing	6	26.1	4	5.1	7	8	17	8.9		
Use of tobacco in any form	Yes	10	43.5	34	43	23	26.1	67	35.3	11.7	.02*
	No	8	34.8	41	51.9	54	61.4	103	54.2		
	Missing	5	21.7	4	5.1	11	12.5	20	10.5		
Daily Snacking habit in between meals	Yes	4	17.4	28	35.4	33	37.5	65	34.2	7.3	.12
	No	14	60.9	46	58.2	48	54.5	108	56.8		
	Missing	5	21.7	5	6.3	7	8	17	8.9		
Drink tea with sugar at least once a day	Yes	16	69.6	69	87.3	71	80.7	156	82.1	6.1	.19
	No	2	8.7	6	7.6	6	6.8	14	7.4		
	Missing	5	21.7	4	5.1	11	12.5	20	10.5		

Table 3.5 Continued

Drink alcohol at least once a day	Yes	0	0	3	3.8	2	2.3	5	2.6	6.8	.15
	No	18	78.3	72	91.1	75	85.2	165	86.8		
	Missing	5	21.7	4	5.1	11	12.5	20	10.5		
Use of fluoridated toothpaste	Yes	0	0	13	16.5	31	35.2	44	23.4	21.7	<0.05*
	No	7	30.4	24	30.4	18	20.5	49	25.8		
	I don't know	11	47.8	38	48.1	32	36.4	81	42.6		
	Missing	5	21.7	4	5.1	7	8	16	8.4		

Note. *Significant at α =.05
% Perce

Table 3.6

Distribution of oral hygiene behaviors and daily habits by gender (N = 202)

Oral hygiene behaviors and daily habits		Male		Female		Total		X^2	*p*
		N	%	N	%	N	%		
Frequency of teeth cleaning in a day	≥1 daily	49	55.1	58	51.3	107	53	.33	.849
	≤2 daily	32	36	45	39.8	77	38.1		
	Missing	8	9	10	8.8	18	8.9		
Type of Dentifrice Used	Toothpaste	30	33.7	45	39.8	75	37.1	1.0	.616
	Toothpowder	51	57.3	57	50.4	108	53.5		
	Missing	8	9	11	9.7	19	9.4		
Use of toothbrush	Yes	38	42.7	63	55.8	101	50	4.1	.131
	No	43	48.3	39	34.5	82	40.6		
	Missing	8	9	11	9.7	19	9.4		
Use of tobacco in any form	Yes	46	51.7	23	20.4	69	34.2	23.6	<.05*
	No	33	37.1	78	69	111	55		
	Missing	10	11.2	12	10.6	22	10.9		
Daily Snacking habit in between meals	Yes	31	34.8	37	32.7	68	33.7	.25	.884
	No	49	55.1	66	58.4	115	56.9		
	Missing	9	10.1	10	8.8	19	9.4		
Drink tea with sugar at least once a day	Yes	69	77.5	95	84.1	164	81.2	2.5	.288
	No	10	11.2	6	5.3	16	7.9		
	Missing	10	11.2	12	10.6	22	10.9		

Table 3.6 Continued

Drink alcohol at least once a day	Yes	4	4.5	1	0.9	5	2.5	2.7	.254
	No	75	84.3	100	88.5	175	86.6		
	Missing	10	11.2	12	10.6	22	10.9		
Use of fluoridated toothpaste	Yes	20	22.5	27	23.9	47	23.3	.06	.996
	No	23	25.8	29	25.7	52	25.7		
	I don't know	38	42.7	47	41.6	85	42.1		
	Missing	8	9	10	8.8	18	8.9		

*Note.**Significant at α=.05
% Percent

Table 3.7

Logistic regression with DMFT recoded (DMFT= 0 versus DMFT ≥1) as the dependent variable (N = 202)

Variable	Wald	df	*p*	OR	95% CI
Age					
18-34 years	Ref			Ref	
35-44 years	1.3	1	.251	1.7	0.7-3.9
45 years and above	5.5	1	.019	3.2	1.2-8.3

Note. Predictor variables not significant in logistic regression (i.e., forward stepwise, Likelihood ratio) model were gender, educational levels, frequency of cleaning teeth, use of toothbrush, type of dentifrice, drink tea with sugar, use of tobacco, snacking in-between meals habit, use of fluoridated toothpaste and drink alcohol

df Degrees of freedom

Ref Reference category

OR Odds ratio

CI Confidence Interval

Table 4.1

Demographics

Variable	Dominican Republic		India		Chi square	p
	N	%	N	%		
Gender						
Male	49	47.1	89	44.1	.26	.611
Female	55	52.9	113	55.9		
Total	104	100	202	100		
Age						
18-34 years	40	40.8	99	50.8	9.03	.011
35-44 years	15	15.3	44	22.6		
45 years and above	43	43.9	52	26.7		
Total	98	100	176	100		
Educational levels						
No formal education	0	0	23	8.2	16.24	<.001
8 or less than 8 years	55	60.4	79	41.6		
More than 8 years	36	39.6	88	46.3		
Total	91	100	190	100		

Note. N Frequency
% Percent

Table 4.2

Oral Hygiene Behaviors

Variables	Dominican Republic		India		Chi square	*p*
	N	%	N	%		
Frequency of teeth cleaning in a day						
≤1 daily	6	5.8	107	58.2	76.5	<.001*
≥2 daily	98	94.2	77	41.8		
Duration of teeth cleaning						
One minute or less than 1	45	43.3	69	37.5	.93	.336
2 or more than 2 minutes	59	56.7	115	62.5		
Use of toothbrush						
Yes	104	100	101	55.2	65.2	<.001*
No	0	0	82	44.8		
Use of fluoridated toothpaste						
Yes	88	84.6	47	25.5	94.04	<.001*
No	3	2.9	52	28.3		
I don't know	13	12.5	85	46.2		
Use of tobacco in any form						
Yes	7	6.7	69	37.5	32.4	<.001*
No	97	93.3	115	62.5		
Drink tea or coffee with sugar daily	97	93.3	168	91.3		
Yes	7	6.7	16	8.7	.35	.56
No						
Drink alcohol at least once a day	5	4.8	5	2.7		
Yes	99	95.2	179	97.3	.87	.35
No						

*Note.**Significant at α=.05 level
% Percent

Table 4.3

Attitude toward professional dental care and utilization of dental care

Variables	Dominican Republic		India		Chi square	*p*
	N	%	N	%		
Is going to the dentist necessary in absence of dental pain?						
Yes	99	95.2	63	38.7	85.07	<.001
No	5	4.8	100	61.3		
Did you visit a dentist last year?						
Yes	29	27.9	12	19.0	24.84	<.001
No	75	72.1	172	81.0		

Note. Significant at α=.05 level
% Percent

Table 4.4

Prevalence of caries experience

	Dominican Republic		India		F	*p*
	Mean	SD	Mean	SD		
DMFT (Overall caries experience)	9.6	8.0	4.0	5.7	13.3	<.001
Decayed (T)	3	2.7	2	2.2	8.3	.004
Missing (T)	6	8.7	2	5.5	23.3	<.001
Filled (T)	0.6	2	0.02	.2	76.6	<.001

Note. Significant at α=.05 level
SD Standard Deviation

APPENDIX C

Knowledge/awareness questions

Please listen to the following questions and answer you believe is the most correct response:

1. What causes tooth decay?
    a. Age
    b. Combination of bacteria and food
    c. Heredity
    d. Poor general health

2. Which of the following prevents tooth decay?
    a. Ammonia
    b. Nitrogen
    c. Fluorides
    d. Potassium

3. A child should be seen by the dentist at what age?
    a. 7 years
    b. 12 years
    c. 1 year
    d. Whenever problem arises

4. The best way to prevent gum disease is to …
    a. To use toothpaste
    b. Remove plaque
    c. Use salt water rinses
    d. Eat soft food

5. Tooth brush should be replaced every:
    a. 3-4 months
    b. 6-7 months
    c. 1 year
    d. Whenever it breaks

6. How often should you visit the dentist?

a. Once in 2 years
b. Every six months
c. Once every year
d. Whenever problem arises

7. Which of the following usually precedes gum disease?
    a. Gingivitis
    b. Pyorrhea
    c. Dentures
    d. Loose teeth

8. Use of tobacco in the form of bidi or gutka can cause:
    a. Tooth decay
    b. Oral cancers
    c. Loss of teeth
    d. Pyorrhea

9. How many times do you have to brush your teeth?
    a. Every morning
    b. At least twice a day
    c. Every night
    d. After lunch

Utilization of professional dental care

10. Have you ever visited a dentist?
    ☐ Yes
    ☐ No

11. Where did you go to receive dental treatment?
    ☐ Private dentist's office
    ☐ Hospital
    ☐ Primary health clinic

12. Last time you visited the dentist was:
    ☐ Within past 12 months
    ☐ 1-2 years ago
    ☐ 3-5 years ago
    ☐ More than 5 years

13. Why did you go to the dentist? ☐

14. The treatment you sought during your last visit was (were):

		Yes	No
a.	Check my teeth	☐	☐
b.	Tooth removal	☐	☐
c.	Take x-rays	☐	☐
d.	Cleaning	☐	☐
e.	Pain relief	☐	☐
f.	Dentures	☐	☐
g.	Prescription	☐	☐
h.	Fluoride application	☐	☐
i.	Treat my gums	☐	☐
j.	Have filling	☐	☐
k.	Have crown/bridge	☐	☐
l.	Have orthodontic treatment	☐	☐

16. **Attitudes towards professional dental care** Indicate your level of agreement

ITEM	D	A
It is necessary to go to the dentist even if I don't have dental pain.	1	2

17. **Barriers to utilization of professional dental care** Please indicate the level of agreement to the following

ITEM	D	A
I go to the dentist only when I have unbearable dental pain	1	2
I am scared to seek dental treatment because I am afraid of dental instruments	1	2

I don’t like to go to the dentist because I feel the dentist will try to do extra treatment which is not required	1	2
I don’t go to the dentist as I use home remedies	1	2
I don’t like going to the dentist for tooth removal because of the fear of losing my vision	1	2
I don’t like going to the dentist for teeth cleaning because I feel cleaning makes my teeth loose.	1	2
I don’t go to the dentist because of the fear of some serious problem being detected by the dentist	1	2
I don’t go to the dentist because treatment costs are high	1	2
Seeking dental care is difficult as there are no dental clinics nearby	1	2
Going to the dentist is difficult because there is no mode of transportation	1	2
Going to the dentist is difficult as there is no family member or friend to accompany me	1	2
I don’t go to the dentist as I have no time	1	2

Oral hygiene behaviors

18. How often do you brush your teeth?

☐ Once a day or less
☐ Twice per day
☐ More than twice per day

19. For how long do you brush your teeth?

☐ One minute or less
☐ Two or more than two minutes

20. When do you brush your teeth?

Yes No

a. Morning ☐ ☐
b. After meals ☐ ☐
c. Night ☐ ☐

21. Do you use any of the following for cleaning your teeth?

	Yes	No
a. Brush	☐	☐
b. Toothpaste	☐	☐
c. Toothpowder	☐	☐
d. Dental floss	☐	☐
e. Mouthwash	☐	☐
f. Toothpicks	☐	☐

g. Other specify_____

22. If your gum bleeds, which of the following do you do?

	Yes	No
a. Use home remedies	☐	☐
b. Go to the dentist	☐	☐
c. Do nothing about it	☐	☐

d. Other, specify_____

23. If you have dental pain, which of the following do you do?

	Yes	No
a. Go to the dentist	☐	☐
b. Use home remedies	☐	☐
c. Do nothing about it	☐	☐

d. Other specify_____

24. Do you have any of these habits?

	Yes	No
a. Drink sweetened tea/coffee	☐	☐
b. Drink alcohol	☐	☐
c. Drink sodas	☐	☐
d. Smoke cigarettes/bidis	☐	☐
e. Chew tobacco	☐	☐

f. Other specify_____

25. Do you use fluoridated toothpaste?

☐ Yes
☐ No
☐ I do not know

26. Do you snack in between meals?
☐ Yes How often?____times a day
☐ No
☐ I do not know

Self –reported oral health status

27. Do you think you have any of these dental problems?

	Yes	No
Cavities	☐	☐
Loose teeth	☐	☐
Dental pain	☐	☐
Difficulty in chewing	☐	☐
Bleeding gums	☐	☐
None	☐	☐

Other, specify_____

28. How would you describe the condition of your mouth?
☐ Excellent
☐ Good
☐ Fair
☐ Poor
☐ I do not know

Demographic Information

Age (in years):
Gender:
Educational level:

APPENDIX D

You are being asked to be in a research study to help our research team understand what you know about your oral health, your daily oral habits, what drives you to seek dental treatment, and how good or bad you consider your oral health to be.

In addition, you will be asked for a dental examination- a dentist will look for any decayed, missing and filled teeth and examine your gum condition. This will help you in finding out whether or not you should seek dental treatment.

The research team will ask you some questions, and you have to pick the best possible answer. For dental examination, the dentist will ask you to open your mouth for 1-2 minutes.

If you don't want to be a part of this research study, you don't have to. If you decide at first that you want to, and then change your mind, that is okay too.

The information that you give us will not be given to anyone else.

If you have questions about it, you can ask me now or you can ask me later if you don't want anyone else to hear your questions.

IRB NUMBER: IRB2014-0346D
IRB APPROVAL DATE: 07/14/2014
IRB EXPIRATION DATE: 07/01/2015

APPENDIX E

TEXAS A&M UNIVERSITY HUMAN SUBJECTS PROTECTION PROGRAM
CONSENT FORM

Project Title: Assessing knowledge, behaviors, attitudes towards oral health & care and examination of dental health among rural people in Madhya Pradesh, India
You are invited to take part in a research study being conducted by Dr. Christine A. Tisone and Payal Kahar, researcher and doctoral candidate from Texas A&M University. The information in this form is provided to help you decide whether or not to take part. If you decide to take part in the study, you will be asked to sign this consent form. If you decide you do not want to participate, there will be no penalty to you.

The purpose of this study is to assess oral health knowledge, beliefs, and behaviors, self-reported oral health status, as well as attitudes towards professional dental care, among adults in a rural community in India. This study will further explore susceptibility to oral health problems, and barriers and facilitators to the utilization of professional dental care. A visual examination of the oral cavity will determine the prevalence of decayed, missing, and filled teeth (known as the DMF index), and gingival condition (known as community periodontal index) using the World Health Organization (WHO) Oral Health Assessment Form (WHO, 1997).

You are being asked to be in this study because you are 18 years of age or older, and you are not pregnant.

300-350 people (participants) will be invited to participate in this study locally.

The alternative to being in the study is to not participate. Participation is strictly voluntary.

1) You will be asked to answer questions about oral health care knowledge, attitudes, and behaviors, as well as what motivates you to seek or not to seek professional dental treatment. The interview will take place in your native language of Hindi.
2) You will be asked to undergo an extra- and intra-oral examination. Your participation in this study will last up to 15-20 minutes/visit and includes two visits- one for the survey and the other for extra- and intra-oral examination. The interviews and the oral examinations will take place in your front yards or homes. Payal Kahar is a trained dentist with a degree in dental surgery (BDS) from Visakhapatnam, Andhra Pradesh, India.
3) You may also be asked to participate in a focus group with approximately 9 other participants, in which a moderator will facilitate a group discussion about the topics of oral health care knowledge, attitudes, and behaviors in the rural community center.

Oral Interview:
This visit will last about 15-20 minutes which includes face-to-face interviews to collect information on demographics, knowledge about oral health, oral hygiene behaviors, utilization, facilitators and barriers to utilization of dental care, attitudes towards professional dental care and self-reported oral health status.

Version date 7.10.2014

Visual examination:
The second visit will last about 8-10 minutes and include a visual examination of your extra- and intra-oral cavity using a mouth mirror and dental probe.
Focus Group:
This session may last 1 to 2 hours and will consist of a discussion about the same topics of this study. This will take place in the community center.
You have the right to leave the study at any time. If you leave the study early, you will not be asked to do anything else related to this study
The researchers will make an audio recording during the focus group portion of this study so that the researcher gets a deeper insight on oral health knowledge, behaviors and attitudes towards oral health and dental care. If you do not wish to be audio recorded, you will not participate in the focus group. Indicate your decision below by initialing in the space provided.

_____ I give my permission for audio recordings to be made of me during my participation in this research study.
_____ I do not give my permission for audio recordings to be made of me during my participation in this research study.

The researchers will ask permission of some of the study participants to take photographs during the study so that visual documentation of study methods is obtained. You do not have to be photographed if you do not wish to be, and you will only be photographed if you give your permission to do so. Indicate your decision below by initialing in the space provided.
_____ I give my permission for photographs to be made of me during my participation in this research study.
_____ I do not give my permission for photographs to be made of me during my participation in this research study.

The things that you will be doing as a participant in this study carry no more risk than you encounter in everyday life. Although the probing of tissues in the oral cavity will be gentle, there may be slight, short-term gum bleeding.
Although the researchers have tried to avoid risks, you may feel that some questions/procedures that are asked of you will be stressful or upsetting. You do not have to answer anything you do not want to. Furthermore, you do not have to participate in all phases of this study. You can choose to participate in the interview only, the oral inspection only, the focus group only, or any combination of those activities.

TEXAS A&M UNIVERSITY HUMAN SUBJECTS PROTECTION PROGRAM
CONSENT FORM

The direct benefit to you by being in this study includes a personal satisfaction on taking the survey and contributing to the current body of knowledge on this topic. Furthermore, the intra-oral examination can act as a diagnostic tool and may result in a referral for dental treatment. Seeking treatment would not be part of this study, and would be a personal decision on your part.

Aside from your time, there are no costs for taking part in the study.

You will not be paid for being in this study. Refreshments will be served at the focus group.

The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely and only Dr. Christine Tisone and Payal Kahar will have access to the records.
Information about you will be stored in a locked file cabinet in Dr. Christine Tisone's residence during the data collection period, and later in Payal Kahar's office in College Station, Texas; all computer files that are generated for this project will be protected with a password. This consent form will be filed securely in an official area.
People who have access to your information include the Principal Investigator and research study personnel. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the Texas A&M University Human Subjects Protection Program may access your records to make sure the study is being run correctly and that information is collected properly.
Information about you and related to this study will be kept confidential to the extent permitted or required by law.

You may contact the Principal Investigator, Dr. Christine A. Tisone, PhD, MPH to tell her about a concern or complaint about this research at 829.479.3623 (during June, July & August, 2013) or at 979.845.3290 (after August, 20143) or ctisone@hlkn.tamu.edu. You may also contact the Co-investigator, Payal Kahar at 9617406652 713.884.5338 or payal@hlkn.tamu.edu
For questions about your rights as a research participant, or if you have questions, complaints, or concerns about the research, you may call the Texas A&M University Human Subjects Protection Program office at (979) 458-4067 or irb@tamu.edu.

This research is voluntary and you have the choice whether or not to be in this research study. You may decide to not begin or to stop participating at any time. Any new information discovered about the research will be provided to you. This information could affect your willingness to continue your participation.

TEXAS A&M UNIVERSITY HUMAN SUBJECTS PROTECTION PROGRAM
CONSENT FORM

STATEMENT OF CONSENT
I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it becomes available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want. A copy of this entire consent form will be given to me.

_____ _____
Participant's Signature Date

_____ _____
Printed Name Date

INVESTIGATOR'S AFFIDAVIT:
Either I have or my agent has carefully explained to the participant the nature of the above project. I hereby certify that to the best of my knowledge the person who signed this consent form was informed of the nature, demands, benefits, and risks involved in his/her participation.

_____ _____
Signature of Presenter Date

_____ _____
Printed Name Date

APPENDIX F

Knowledge level questions

Questions	Item-Total Correlation	Cronbach's Alpha
1. What causes tooth decay?	.59	.74
2. Which of the following prevents tooth decay?	.33	
3. A child should be seen by the dentist at what age?	.21	
4. The best way to prevent gum disease is to:	.26	
5. Tooth brush should be replaced every:	.40	
6. How often should you visit the dentist?	.38	
7. Which of the following usually precedes gum disease?	.53	
8. Use of tobacco in the form of bidi or gutka can cause:	.47	
9. How many times do you have to brush your teeth?	.51	

APPENDIX G

Perception of barriers towards dental care

Questions	Item-Total Correlation	Cronbach's Alpha
I go to the dentist only when I have unbearable dental pain	.12	.53
I am scared to seek dental treatment because I am afraid of dental instruments	.19	
I don't go to the dentist as I use home remedies	.20	
I don't like going to the dentist for tooth removal because of the fear of losing my vision	.30	
I don't like going to the dentist for teeth cleaning because I feel cleaning makes my teeth loose.	.22	
I don't go to the dentist because treatment costs are high	.28	
Seeking dental care is difficult as there are no dental clinics nearby	.17	
Going to the dentist is difficult because there is no mode of transportation	.23	
Going to the dentist is difficult as there is no family member or friend to accompany me	.23	

I don’t go to the dentist as I have no time	.37

Items removed from the scale

*I don’t like to go to the dentist because I feel the dentist will try to do extra treatment which is not required

*I don’t go to the dentist because of the fear of some serious problem being detected by the dentist