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An Integrated Approach to Malaria Prevention and Control in Rural Cameroon

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This is to certify that the doctoral dissertation by

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2017

Abstract

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MHS, Strayer University 2010

BA, Eastern University, 2006

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Malaria is a life-threatening parasitic disease spread to humans through bites of an infected mosquito. In rural Cameroon, malaria is one of the major causes of morbidity and mortality. Several studies have examined the use of various malaria preventive tools; however, there is insufficient literature available on use of an integrated approach to prevent and control malaria in rural Cameroon. The aim of this study was to provide information necessary for bridging the gap in understanding the proper use of insecticide treated nets (ITNs) and antimalarial drugs and the roles of education and socioeconomic status in malaria prevention and control efforts in rural Cameroon. This quantitative cross-sectional study was guided by the socioecological framework. Secondary data from the 2011 Cameroon Demographic and Health Survey (sample size of 216) was used in this study. The Chi-Square, binary logistic, and multinomial logistic regressions were used to analyze the data. The result revealed that there was a significant association ($p < 0.05$) between proper use of ITNs and malaria prevalence among children under 5 years old, education and proper use of antimalarial drugs, and socioeconomic status and health seeking behavior. There was also a significant association between healthcare preference and malaria treatment outcomes among children under 5 and pregnant women. These findings may contribute to social change by helping public health officials in Cameron to continue to prioritize local needs and enforce the proper use of available malaria tools in rural communities through an integrated approach to prevent and control malaria in rural Cameroon, especially for children under 5 years old and pregnant women, which would lead to improved quality of life.

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Dedication

This dissertation is dedicated in loving memory of my beloved mother Rose Puzenyui Ndimantang who passed away (56yrs old- Cancer) when I just started my doctoral studies. Inspired by her love for family and passion for a healthy community through her work as a nurse in rural Cameroon, working tirelessly with women and helping them achieve better health outcome, I hope to keep that passion alive. To the memory of my great grandmother Nah Wahwo who used her herbal knowledge to treat children with convulsion resulting from severe malaria. To my father, Daniel Ndimantang who made sure that I get an education instead of early marriage and for his constant support and encouragement.

This study is dedicated to all the people in rural areas still suffering from malaria especially children and pregnant women. Finally, to those who are working with these communities to prevent and control malaria.

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Thanks to all my friends, my family, and siblings Silas, Hosea, Victor, and Bernice who have provided encouragements and support throughout especially during the hard times, I am indebted to them for all their love. Special thanks to my dearest friend Stella Nakatudde, who provided tremendous help with statistical analysis and reading through my script.

Finally, I thank God for the wonderful support system from my husband Felix Azunie and our three children Jaden, Janice and Jamiel (due in Oct) who were constantly encouraging through prayers and questions if I have finished my "homework". Their presence in my life throughout this writing process has been invaluable.

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Chapter 1: Introduction

Introduction to the Study

Infectious diseases continue to be the leading cause of disease and death in both developed and developing countries of the world (Griffiths, Tang, & Yeoh, 2014). Globally, researchers are concerned with the increase in malaria prevalence especially in areas where the disease was previously nonexistent, such as in Afghanistan and East Africa (Griffiths, et al., 2014). As noted by Shah (2010), malaria is a difficult disease to fight because it is widespread with about 207 million cases and 627,000 deaths reported in 2012 and because it mostly affects areas of the world with low economic or health-related resources. Malaria remains the biggest threat to human lives, especially the poor and vulnerable (children under 5 and pregnant women), particularly in World Health Organization [WHO] regions; for example, 78% of malaria deaths in 2013 were children under 5 years of age (WHO, 2014). This implies that continuous efforts in promoting proper use of malaria prevention measures using an integrated approach in endemic areas is paramount to curbing malaria.

Globally, it is estimated that about 3.3 billion people in 97 countries are at risk of being infected with malaria and developing malaria (WHO, 2014). Based on the 2014 world malaria report, in sub-Saharan Africa (SSA) where malaria exerts a substantial burden, an estimate of 90% of those who contract malaria in SSA die from it (WHO, 2014). Children and pregnant women are disproportionately affected by malaria; based on the 2012 Malaria World Report. Every 45 seconds, a child dies as a result of malaria (WHO, 2012b). However, recent reports show that preventive measures have greatly

reduced the number of deaths among children under 5 (WHO, 2015b). Malaria is common in pregnant women and infants living in malaria endemic countries (WHO, 2015a). Murray, et al., (2012); found that malaria caused more than 1.2 million deaths in 2010, with more than half of the deaths occurring in children under 5 years; the authors also found that malaria prevalence actually increases with adulthood, especially in endemic areas.

Furthermore, malaria induces some negative outcomes when not properly treated. For example, adverse maternal and fetal outcomes in pregnant women with malaria have been documented in several studies. In studies by Boudová et al. (2014), Bardají et al. (2011), and Pell Straus, Andrew, Meñaca, & Pool (2011), anemia, low birth weight, premature birth, and increased infant mortality were found to be associated with malaria. Furthermore, Desai et al. (2007) and Grantham-McGregor et al., (2007) also found that children suffered impaired growth as a result of malaria. Moreover, poor health-seeking behavior is a huge concern in malaria high risk areas where very often traditional healers or an informal choice of treatment are the first to provide treatment. This is due in part to poverty (Lawal, Balogun, & Bada, 2014; Shah, 2010). In a study by Idro, Marsh, John, & Newton, (2010), improper treatment of malaria was found to lead to further complications in children causing cerebral malaria, a neurological manifestation of severe malaria.

Moreover, poverty is a huge factor that inhibits proper malaria treatment among the most endemic communities (Ricci, 2012). According to Gallup and Sachs (2001), malaria and poverty are intimately connected because poverty heightens the risk of

malaria infection, especially in rural communities where resources to cater to the health needs of the people are scarce. Ricci, (2012) further explained that poverty is a huge hindrance to malaria prevention and control because poverty is multidimensional and therefore consists of lack of access to healthcare, resources, and skills. Poverty makes people become insecure, vulnerable, and as such have no voice or power to demand resources to improve their environment (Ricci, 2012). Malaria threatens socioeconomic development and progress in endemic countries, especially in rural areas (Muganga, 2011). Therefore, it is crucial to focus efforts for malarial reduction on rural communities where malaria prevalence is high through building resilience and robustness in the sustainable management of available malaria preventive tools from an integrated perspective. Shah (2010) suggests that tackling malaria is crucial and considering rural priorities is important to ensure that solutions reflect the local concerns and values to be effective and sustainable.

The WHO recommends the Intermittent Preventive Treatment (IPT) along with *sulfadoxine pyrimethamine* (SP) as an effective malaria prevention option for pregnant women. The insecticide-treated net (ITN) is recommended for use by children under 5 years of age to prevent malaria (Centers for Disease Control and Prevention, [CDC], 2014). ITNs are at the forefront of malaria control programs and even though the percentage of households in SSA that owned nets increased from 3% in 2000 to 53% in 2012 (WHO, 2012b), many children still die from malaria due to inconsistent and improper use of malaria preventive tools. For example, bed nets in most endemic areas are actually used for fishing and drying fish, not preventing mosquitos (Minakawa, Dida,

Sonye, Futami, & Kaneko, 2008). Despite 55% of the households reporting owning at least one bed net, less than 35% of sub-Saharan Africans sleep under bed nets (WHO, 2012).

In the studies by Hill et al. (2013), Lawal et al. (2014), and Ngonghala, Del Valle, Zhao, & Mohammed-Awel, (2014), several factors, including the lack of malaria education and knowledge about malaria transmission, limited access to ITN, weather (for example, people sleeping outside during the dry season when the weather is very hot), and health seeking behavior play a vital role in ITN effectiveness and use of other available malaria treatment options. The potential impact of ITN on reducing malaria transmission is limited due to inconsistent or improper use as well as the physical decay of the nets (Ngonghala et al. 2014). Furthermore, the effectiveness of ITN decreases due to wear, tear, long exposure to direct sunlight, frequent washing, and human behavior such as using the nets for fishing (Atieli, Munga, Ofulla, & Vulule, 2010; Kayedi et al. 2008; WHO, 2011). Understanding the implications of these limitations can help rural communities in Cameroon to access and effectively use ITNs, formulate optimal control strategies, and guide public health policy in Cameroon.

There are few published studies in Cameroon that examine the association between the proper use of ITNs and malaria outcomes among children in rural Cameroon. As a result of the increasing prevalence of malaria and the extent of morbidity caused by the disease, research efforts need to focus on the magnitude of the problem among children under 5 years living in rural Cameroon. Examining the relationship between education and proper use of antimalarial drugs and use of ITNs among rural residents is

important in coordinating effective prevention and treatment options. Examining the relationship between health care preference (traditional or modern) and malaria outcome during pregnancy is also an important initial step in understanding the epidemiology of adverse malaria outcomes as it relates to improper use of ITNs, improper use of antimalarial drugs, and health care preference in rural Cameroon. In this study, ITNs refers to long lasting insecticide nets (LLIN) and conventional nets. The former are factory treated nets and the latter are treated through dipping in insecticide as recommended by the WHO.

This chapter provides the background of the study, problem statement, purpose of the study, research questions and hypotheses, nature of the study, conceptual model, operational definitions, assumptions and limitations of the study, delimitations, significance of the study, and the social change implication. The chapter ends with a summary and transition to the second chapter.

Background of the Study

Malaria constitutes one of the major public health problems worldwide with about 3.4 billion people living in endemic areas of the world (CDC, 2014). In 2013, malaria accounted for 584,000 deaths worldwide; people in sub-Saharan African countries accounted for 90% of these deaths with children being the most vulnerable (Fru-Cho et al., 2014; WHO, 2014). Malaria is the leading cause of death for children under 5, with a fatality recorded every 45 seconds; of the 584,000 malaria deaths in 2013, children accounted for 78% of the deaths (WHO, 2014). Malaria affects the most vulnerable; children under 5 years of age whose immune systems are not fully developed, pregnant

women whose immune systems are weakened as a result of pregnancy, people with HIV, and those living in poor and low resource areas (Cameroon Coalition Against Malaria, [CCAM], 2012).

Recommended prevention, treatment, and vector control interventions to combat malaria include artemisinin-based combination therapy (ACT), intermittent preventive treatment in pregnancy (IPT), indoor residual spraying of insecticide (IRS), and ITNs, (WHO, 2015a). However, according to Roll Back Malaria (RBM; 2015), in 2013 about 278 million people at risk of malaria in SSA lived in households without access to ITNs. Also in 2013, about 15 million of the 35 million pregnant women each year did not receive a single dose of the IPT and about 140 million children with malaria did not receive ACT for treatment (RBM, 2015). Furthermore, malaria treatment constitutes 40% of SSA's public health expenditure and greatly contributes to poor growth and development in Africa, especially in vulnerable communities (Richardson et al., 2011). According to recent WHO estimates, about 60% of malaria cases in Africa and 80% of malaria related deaths go unreported, especially in rural communities (Shah, 2010).

In Cameroon, malaria affects more than 90% of the population and is responsible for about 73% of mortality in the whole country (Antonio-Nkondjio et al., 2012; WHO, 2011). Malaria is the prime cause of morbidity and mortality in Cameroon, responsible for 45% of medical consultations and 30%-47% of hospitalizations, which still result in death for 50% of the children less than 5 years old. Malaria accounts for 26% of workplace absences and 40% of household health expenses (CCAM, 2012; Kimbi et al., 2014a; National Malaria Control Program [NMCP], 2012; Nsagha, et al., 2011b).

According to the Cameroon Ministry of Public Health (2011), children below 5 years of age and pregnant women represented 22% of the total population who are in the most vulnerable group, followed by those with HIV and those living in rural areas, especially those located in the tropical regions of the country.

Cameroon, as is the case with most African countries, is poor, and as such, the government does not allocate any political capital to fight malaria despite the high death toll (Shah, 2010). In recent years, Cameroon and partnering organizations have designed various strategies to control and prevent malaria through mass distribution of bed nets (Ndo, Menze-Djanto, & Antonio-Nkondjo, 2011). Since 2003, the Cameroon government has promoted the free distribution of ITN to pregnant women and children under 5, subsidized the cost of ACT, and provided training to local health officials on how to properly manage both malaria prevention and prevalence among women and children (Ndo et al., 2011). However, Shah (2010) points out that most of these free bed nets do not get to the rural people. Furthermore, based on the observation of two German epidemiologists, only 20% of people in rural communities with malaria went to a clinic, and about 70% of people do not have a medical record of malaria history (Shah, 2010). Moreover, about 20% of people are prescribed the wrong drugs or the wrong dose and 10% do not buy malaria drugs from clinics; 30% do not take the right dose as prescribed by a health professional and only 3% of local people get effective malaria treatment (Shah, 2010).

Many studies have shown that malaria can be prevented and controlled by owning and sleeping under ITNs to avoid mosquito bites (Antonio-Nkondjio, et al, 2012; Kimbi

et al, 2014a; Nsagha et al., 2011a). Based on evidence from trial studies which have shown decreases in children mortality by 18% and in the prevalence of malaria by 13% as a result of routine ITN use among children, many countries have focused on more free distribution of ITNs. However, Rowe et al (2007), and Nahlen and Low-Beer (2007) point out that it is important to ensure that efforts in malaria prevention and control not only focus on measuring ITN coverage but also their impact on the overall health outcome, especially for those in rural areas. This study considers integrated malaria prevention and control approach an efficient model in malaria prevention and, eventually, elimination of malaria in rural Cameroon. According to Musoke et al (2015), an integrated approach in malaria prevention and control involves using holistic methods to reduce malaria. In this integrated approach, individuals and their household members are protected through proper use of ITNs (Musoke et al 2015). Ensuring that mosquito breeding sites are sprayed and properly drained reduces mosquito reproduction; improving home buildings and including ventilation nets prevents mosquitos from entering the home. Studies by CDC (2009), Musoke, Karani, Ssempebwa, and Musoke (2013), and Ng'ang'a et al.(2008), and Walker and Lynch (2007) has shown that using an integrated prevention approach for malaria has drastically reduced the mosquito population and the prevalence of malaria in some rural African communities and therefore reduced malaria morbidity and mortality.

Problem Statement

Malaria constitutes a major public health problem worldwide, with approximately 3.4 billion people living in endemic areas of the world (CDC, 2014). In Cameroon, more

than 90% of the population are at risk of contracting malaria and is responsible for 73% of the country's mortality (Antonio-Nkondjo et al., 2012; WHO, 2011). According to the 2011 Demographic Health Survey-Multiple Indicator Health Survey (DHS-MICS), malaria affects about 54% of rural communities in Cameroon, and the prevalence rate is 37% higher than in urban areas (National Institute of Statistics [NIS], 2012).

The lack of proper public health education and information by policy makers has been shown to be a great contributor to the increased risk of malaria, especially for rural communities. I hope that the findings of this study will lead to the dissemination of malaria educational materials via a variety of means of communication and that people in rural communities in Cameroon will become more proactive in utilizing available malaria prevention methods.

Regardless of the several studies which have shown that proper use of antimalarial drugs can reduce malaria prevalence, minimal attention has been given to the low level of education among rural community members, which impedes the proper use of antimalarial drugs (including taking the right dosage of antimalarial drugs). In view of the lack of in-depth research on the proper use of ITNs and antimalarial drugs, as well as on the effects of education, healthcare service preference, and socioeconomic status on malaria control at the community level, I sought in this study to explore how these factors impact malaria prevention and control in rural Cameroon.

Purpose of the Study

The purpose of this study was to examine the association and relationships between proper use of ITN, level of education, healthcare preference, and socioeconomic

status based on the socioecological framework. The proper use of ITN, level of education, healthcare preference, and socioeconomic status measured according to the wealth index were all independent variables. In this study, malaria prevalence was the dependent variable. Some of the variables in this study that contributed and provided descriptive statistics included age of the child, sex, type and place of residence, and the region of the country.

Research Questions and Hypotheses

This study will be guided by the following research questions (RQs):

RQ1. Is there an association between the proper use of ITNs and the prevalence of malaria among children under 5 years old?

The independent variable is the proper use of ITNs, and the dependent variable is the prevalence of malaria among children under 5 years old. The outcome variable is malaria prevalence.

$H_0$1: There is no association between the proper use of ITNs and the prevalence of malaria among children under 5 years old.

H_a1: There is an association between use of ITNs and the prevalence of malaria among children under 5 years old.

RQ2. Is there an association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon?

The independent variable is education and the proper use of antimalarial drugs is the dependent variable. The outcome variable is the use of antimalarial drugs.

$H_0$2: There is no significant statistical association between education and the proper use of antimalarial drugs for malaria prevention in rural Cameroon.

H_a2: There is a significant statistical association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon.

RQ3. Is there an association between healthcare preference (traditional vs. modern) and malaria outcome in children under 5years and pregnant women?

The independent variable is healthcare preference (traditional vs. modern), and the dependent variable is malaria outcome. The outcome variable is treatment outcome.

$H_0$3: There is no statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

H_a3: There is a statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

RQ4. Is there an association between the socioeconomic status of rural community members and their health-seeking behavior?

The independent variable is socioeconomic status, and the dependent variable is the health-seeking behavior of rural community members. Socioeconomic status is assessed based on educational level, employment, occupation, income, gender, type of housing, and financial assets. Health-seeking behaviors include healthcare preference (traditional vs. modern) and the ability to own and use an ITN as well as to identify malaria signs and symptoms and report them to a health facility for immediate treatment.

$H_0$4: There is no association between the socioeconomic status of rural community members and their health-seeking behavior.

H_a4: There is an association between the socioeconomic status of rural community members and their health-seeking behavior.

Study Framework

This study is based on the socioecological model (SEM), which is a framework credited to Brofenbrenner's ecological systems theory (1979), McLeroy's ecological model of health behaviors (1988), and Stokol's social ecology model of health promotion (1992-2003; as cited in Glanz et al, 2008, pp.468-469). The SEM is a highly adaptable model that demonstrates there are unique yet interrelated factors that influence human behavior in regards to disease prevention and control. Many interventions in malaria prevention and control appear to focus predominantly on individual behavior rather than a broader social ecological framework. According to Moore, Murphy, & Moore, (2011), the SEM encourages holistic interventions that are promoted in settings appropriate to health promotion and also the explicit understanding of how more focused interventions might depend on factors at other levels for their effectiveness and sustainability to be achieved.

As advanced by DiClemente, Salazar, & Crosby (2007), health interventions are most effective when they target multiple levels to support behavior change. An integrated malaria prevention and control approach in rural Cameroon with community members as the key players is uniquely positioned to target multiple levels of an individual's life in order to support changes in their behavior in utilizing proper malaria prevention

measures. For this study, an integrated malaria prevention and control approach is uniquely positioned to adopt a socioecological model approach as many health promotion and prevention programs have utilized this model to target and solve many disease interventions in a holistic and sustainable way.

The SEM supports opportunities to promote participation of rural community members in effective malaria prevention and control measures by recognizing the multiple factors that influence an individual's behavior. Efforts to change behavior such as ensuring proper use of ITNs among children under 5years are more likely to be successful when the multiple level of influences are addressed at the same time. The socioecological model made up of the individual, interpersonal, community, organization, and policy components. Figure. 1 shows the various levels and the cofactors that are associated at each level for a person to engage in effective malaria prevention.

Figure 1: The socioecological model. Adapted from the Centers for Disease Control and Prevention (CDC, 2014), The Social Ecological Model: A Framework for Prevention, http://www.cdc.gov/violenceprevention/overview/social-ecologicalmodel.html

The social-ecological model identifies four major levels of factors that influence behavior. These include: the individual and interpersonal, including the individual's biological make-up and personal history; close personal relationships; aspects of the community, such as the neighborhood or job; and broader societal conditions and policies (CDC, 2013). The SEM was suitable for this study because it provides an explanation of specific, contextual, and multilevel analyses that incorporates social structure, community norms, and biological factors that are important in effective and sustainable malaria prevention and control programs in rural Cameroon. Table 1 provides a list of the various levels and a description of each as it relates to malaria prevention in rural Cameroon.

Table 1

A Description of Social Ecological Model (SEM) Levels.

SEM level	Description
Individual	The SEM is concerned with the intertwined relationship which exists between individuals and their surrounding environment. The individual level includes personal factors that increase or decrease the likelihood of an individual to properly use malaria preventive measures to reduce risk. Individual factors which influence proper use of malaria preventive measures include: knowledge, attitudes, behaviours, beliefs, perceived barriers, age, sex, level of education, socioeconomic status, and marital status. Diala et al, (2013) found in their study that individual women's belief and lack of knowledge about intermittent preventive treatment (IPT) contributed to the low uptake and adherence to malaria treatment during pregnancy. Strategies which bring transformation at the individual level often focus around changing an individual's knowledge, attitudes, behaviour and skills through education and training programs.
Interpersonal	The interpersonal level comprises the relationships, the culture and the community with whom an individual interacts. The interpersonal level has a significant influence on an individual's behavior towards utilizing malaria preventive measures. For example, interpersonal relationship between healthcare professionals and patients influenced the patient's health seeking behavior. Patients who had experienced mistreatment by a health professional were likely not going to seek care at the clinic (Andrew et al, 2014). The interpersonal level consists of social networks and social support systems that can influence individual behaviors, including family, friends, peers, cultural groups, religious groups, customs or traditions. According to Andrew et al, (2014) pregnant women were influenced to attend antenatal care through the encouragement and support they had from their husbands, family members, peers, and women who had previous pregnancies. Strategies at this level should consider the barriers which make it difficult to be consistent in a health behavior, for example if hospitals are always out of stock for preventive medicine, it will be difficult for an individual to adhere to dosage requirement. Therefore, making sure that antimalarial drugs are always in stock is crucial for patients to stay in compliance to required dosage amount to prevent malaria.
Community	This level involves relationships among community organizations, institutions (schools, churches, health clinics) and informational networks within defined boundaries, including the built environment (e.g., health clinic), village associations, community leaders, and transportation network. Other community factors relate to the culture and norms of the community, for example with regard to whether pregnant women are expected to seek care in health facilities, traditional medicine or engage in self-medication (Diala, et al, 2013; Andrew et al, 2014). The issues religion and witchcraft play important roles in women's beliefs and actions (Diala et al, 2013). For example, pregnant women were ashamed to disclose their pregnancy status because they feared that they were going to be bewitched (Andrew et al,2014)
Organization	The organizational level examines the roles that institutions (government and non-governmental) play in promoting effective health strategies to prevent disease. Prevention strategies relate to public policy and resource allocation relating to supporting prevention efforts. Examples of institutional strategies include school malaria preventive programs, policy that promote free distribution of ITN to all household with children under five. Organizations or community association rules and regulations for actions that affect how well, for example, malaria services are provided to an individual or the community.
Policy	Policy refers to legislation, regulatory or policy making actions that have the potential to reduce malaria prevalence among children under five and the general rural population in Cameroon. Policy includes local, national and global laws and policies, including policies regarding the allocation of resources for malaria prevention and access to healthcare services for proper diagnosis and treatment of malaria. Malaria policy can be informal in which local leaders and local partners organize malaria campaigns to encourage ITN use in the community, for example, Bowen (2013) found that there was increase in ITN use after the Ko Palu NightWatch campaign to promote net usage in Cameroon.

Note. Adapted from the Centers for Disease Control and Prevention (CDC, 2014), The Social Ecological Model: A Framework for Prevention, http://www.cdc.gov/violenceprevention/overview/social-ecologicalmodel.html

The SEM provides avenue for understanding malaria prevention and control measures from a broader perspective through the various levels and the factors that contribute to an individual's behavior to properly use or not use available malaria prevention measures such as the ITN and antimalarial drugs. The SEM will be presented and discussed in more depth in Chapter 2.

Nature of the Study

A cross-sectional study design using secondary data was used to examine the relationship between (a) the use of ITNs and the prevalence of malaria in children under 5 years old, (b) education in malaria prevention and the use of antimalarial drugs, (c) healthcare preference (traditional vs. modern) and malaria outcome during pregnancy, and (d) socioeconomic status of rural community members and their health-seeking behavior in rural Cameroon.

Definitions of Key Terms

The research questions for this study provided the independent and dependent variables. The independent variables included proper use of ITNs, education of mothers (no education, primary, and secondary), healthcare preference (traditional/modern), and socioeconomic status. Other variables that were included to provide descriptive statistics in this study were age of the child (0-59months), sex of the child (male or female), number of children living in a household (0-5), household location (coded as 0 = rural and 1 = urban), and region of the country. The dependent variable measure for malaria prevalence was based on the results of rapid detection test conducted during the survey (coded as 1 = yes or 0 = no) for positive or negative malaria. This was a quantitative

study that relied on secondary data from the Cameroon Demographic Health Survey conducted in 2011 from 1/2011 to 8/2011. The scale of measurements included; discrete (age of child 6-59), ordinal (compliance with ITN message), nominal (highest level of education), and continuous. Variables that define gender, region/residence, and proper use of ITN were measured on a nominal scale. Malaria prevalence was measured on a nominal scale.

The following terms and their definition were used in the study to shed more light on the problem of malaria in rural Cameroon.

Infectious disease: Disease that is caused by the invasion of a host by agents whose activities harm the host's tissues, that is, they cause *disease,* and can be transmitted to other individuals, that is, they are *infectious* (National Institute of Health, 2007).

Traditional medicine (TM) and traditional healers (TH): Health care practices, treatments, and providers that are indigenous to the culture and that have historically operated predominantly via traditional healers without any funding from the country's healthcare system as well as beyond the practices and curriculum of the dominant conventional medical profession (Suswardany, Sibbritt, Supardi, Chang, & Adams, 2015).

Cerebral malaria: A clinical syndrome characterized by the following: coma at least 1 hour after termination of a seizure or correction of hypoglycemia, asexual forms of *Plasmodium falciparum* parasites on peripheral blood smears, and no other cause to explain the coma (Idro, et al., 2010; WHO, 2015b).

Socioeconomic status: A measure of a person's education, income, occupation, place of residence, and in the case of this study, socioeconomic assets such as car, televisions, radios, and electricity (Novignon & Nonvignon, 2012). People with secondary level of education are able to identify that a fever is malaria and, if they are wealthy, will seek malaria treatment immediately at a clinic (Novignon & Nonvignon, 2012).

Insecticide treated bed net: A form of personal protection that has been shown to reduce malaria morbidity, severe disease, and mortality due to malaria in endemic regions of the world (CDC, 2014). Studies show that in community-wide experiments in several African settings, ITNs have reduced the death of children under 5 years from all causes by about 20% (CDC, 2014).

Health seeking behavior: Actions undertaken by malaria patients to get the proper treatment for malaria fever to get well after the illness (Lawal, et al., 2014). Instead of seeking care first at a traditional healer or performing self-treatment, patients could seek care at a local clinic.

Health education: Information that helps individuals, community members, and health workers (both professionals and community health workers) to develop a better understanding of what promotes individual and community health and consequently design more effective interventions (Ghahremani, Faryabi & Kaveh, 2014). For instance, using the health belief theory, if people perceived malaria to be a severe health problem, they would ensure proper use of ITN to reduce exposure to mosquito bites. There may be barriers such as inability to purchase ITNs and access to a clinic for treatment; however,

through advocacy and empowerment of local leaders, new healthy policies will be developed to provide these resources.

Assumptions

The assumptions in this study were based on the reviewed articles from studies relating to malaria prevention in rural communities. It is assumed that people in rural communities in Cameroon perceived malaria to be a serious health problem in their community. Therefore, it is assumed that through information obtained from this study, proper measures will be taken by health officials and local leaders to ensure that resources are available and accessible by rural people and that they are taught and encouraged to use these resources properly. Furthermore, it is assumed that through scaled up malaria transmission prevention in rural communities, this could affect decisions by public health officials in Cameroon about how to best deliver malaria treatment in rural communities. Overall, it is also assumed that malaria interventions which have been recognized but less used by rural people such as proper use of ITNs by children under five, IPT, antimalarial drugs during pregnancy, and environmental sanitation have to be given high priority and their use concomitantly with other measures must be encouraged by community health workers and other health professionals within the community (Astatkie, 2010). It is assumed that participants in this study will answer questions truthfully and are willing to participate throughout the duration of the study.

Limitations of the Study

This study has limitations due to its reliance on secondary data use and cross-sectional studies. This study examined the relationship between improper use of ITN and

malaria prevalence among children under five, the relationship between education and proper use of antimalarial drugs, healthcare preference and malaria outcome during pregnancy, and socioeconomic status and health seeking behavior. The primary information used in this study was collected rigorously ensuring quality measures during the study design and data collection methods. Results from selected rural communities will be specific to those communities and will inform the design of interventions that addresses integrated malaria prevention in rural Cameroon. They are not generalizable to populations in urban areas in Cameroon or even applicable to other disease within rural communities. This study targeted children, pregnant women, and other household members of these individuals because of the cultural context. This may have provided optimum response rate; however, this could have affected answers to the research questions. Therefore, results may not have accurately represented every community member since parents were reporting on behalf of the children. Finally, the questionnaire captured self-reported information and relied on respondents to provide the right information. Misreporting by respondents cannot be ruled out.

Delimitation of the Study

This is a quantitative study that relies on secondary data from the Cameroon Demographic Health Survey conducted in 2011 from 1/2011- 8/2011 which is a little old in Cameroon. This study was delimited to improper use of ITNs, education, and healthcare preference as related to malaria prevention in rural Cameroon. All other variables, participants and conditions not addressed in the current study were considered

beyond the scope of the investigation. As such the ultimate impact of this study, which includes; malaria transmission, incidence and mortality were not assessed.

Significance of the Study

This study's findings could identify challenges encountered during the implementation of malaria prevention and control strategies at the rural community level. As reported in the WHO (2012b) report, insecticides resistance incidence has been recorded in SSA and India. Consequently, Cameroon being an endemic country where more than a million cases of clinical malaria are reported annually (Ndong, et al., 2014), there is need to ensure that malaria prevention and control strategies identify and address challenges that prevent effective malaria management. Moreover, based on the findings, recommendations could be made to address shortcomings in Cameroon's malaria prevention and control (diagnosis, treatment and referral) efforts at household and at rural community levels. The knowledge from this study could contribute to the improvement of the malaria prevention, control and treatment activities in rural communities, and thereby help to reduce malaria-related mortality and morbidity rates.

Many research studies have mentioned the effectiveness of ITNs in reducing malaria prevalence when used in conjunction with other preventive measures (Bhatt and Getting 2014; Halliday et al 2014; Lim et al 2011). Accordingly, ownership and use of ITN and other malaria preventive measures in combination with education is important in the fight to reduce malaria incidence (Bhatt and Getting, 2014). In line with this, Pamuk et al (2011) explains that community-level education may increase a child's overall health and equally contribute to the individual effect of maternal and general population

educational attainment through increases in the general empowerment of women, collective community knowledge, or the emulation of healthy behaviors by less-educated individuals. Overall, the results from this study may be an important first step towards a more robust integrated prevention and control strategy for malaria at the community level in rural Cameroon. Cameroon as a whole and the rural community especially, is a great setting with the right population suitable for this study.

Social Change Implications

The underlying social change implication for this study is the recognition and appreciation of local development capacities to deliver optimal malaria control strategies and to engage in researching local solutions to solve local problems. In this way, such local capacity needs would play a prominent role in the long run to better plan a sustainable malaria program in rural Cameroon. Furthermore, with the empowerment of local stakeholders to take charge of planning and devising ways to channel malaria information, local information would facilitate the development and implementation of local solutions. Empowering various stakeholders in the prevention effort for malaria (local districts, traditional leaders, traditional healers, community health workers and health professionals) to collaborate in sharing information on malaria incidence in a timely fashion within the community could ensure that appropriate measures could be taken to ensure proper treatment. In this collaboration, measures could also be taken by locals to investigate that nets are in good conditions and are properly used.

The intent of this study is to benefit health officials in Cameroon to understand that free net distribution is not an end to the malaria prevention efforts and that creating

new malaria health policies that is based on local priorities is crucial in the fight against malaria. Through this study, it is hoped that public health officials in Cameroon would revisit the malaria situation in rural areas so as to refine and re-quantify the commodity needs to include adequate supplies of the correct anti-malaria drugs, ITN, and educational centers where malaria information and education can be provided to locals by trained locals and experts in malaria. Social change can only be realized when a comprehensive malaria prevention plan considers local priorities, values, and cultural aspects in prevention programs to reduce malaria morbidity and mortality.

Summary

Malaria cases continue to rise globally and in rural communities specifically. Various studies have been conducted to examine the association of knowledge, antimalarial drug use, ITN use and malaria outcomes among children under five and pregnant women in Cameroon. However, studies conducted specifically in rural communities using integrated malaria prevention to get some perspective of the region are lacking. This study examined the use of an integrated approach for malaria prevention in rural communities by combining the findings of various studies conducted on a small scale and findings from the demographic data. Examining the magnitude and severity of the relationship between improper use of ITN and malaria prevalence in children under five, education and proper use of antimalarial drugs, and healthcare preference and malaria outcome for pregnant women is a crucial step in developing appropriate interventions to deal with the continuous malaria problem in rural communities among children under five and pregnant women.

Chapter 1 discussed the background of the study, problem statement, and purpose of the study. The research questions were identified along with related hypotheses and conceptual model for the study. A brief overview of assumptions, limitations, delimitation, and social change implication was provided. Finally, the chapter concluded with a brief statement about the significance of the study and implications for positive social change. In Chapter 2 a review of the literature will be presented.

Chapter 2: Literature Review

This chapter includes both published and unpublished malaria related articles that are important to the context of this study. Utilizing these articles enabled me to address the important aspects of malaria with regard to the human health initiatives and programs that have been instituted both by national and international organizations to fight malaria around the world and in Cameroon. This literature review goes as far back as studies have been conducted in Cameroon since the 1980s to the present regarding approaches and strategies used in malaria prevention and control. Cameroon health system is also discussed alongside its role and contribution in the malaria prevention and control efforts.

Articles on some theories and facts regarding malaria burden and incidence in endemic regions of the world, especially in SSA, have been cited to establish and justify the relevance of the study with emphasis on using an integrated malaria prevention and control approach. This approach considers health promotion measures that engage the population at risk in decision making and actions to reduce malaria burden in their communities. Furthermore, the integrated community-based malaria approach engages rural or local leaders, district health officers, healthcare providers (modern and traditional healers), and community health workers from national and international organizations to collaboratively work towards malaria eradication.

This study addressed the gaps in literature regarding the relationship between proper use of ITN and prevalence of malaria in children under 5years old, the relationship between education and proper use of antimalarial drugs, and the relationship between healthcare preference (traditional vs. modern, also referred in this study as informal and

formal) and malaria treatment outcome during pregnancy. Furthermore, an understanding of the relationship between people's socioeconomic status and their health seeking behavior regarding malaria prevention in rural Cameroon is necessary to effectively develop new strategies to improve malaria outcomes in rural Cameroon.

This chapter covers the literature search strategy, conceptual model of the study, global burden of malaria, complications of malaria, and the adverse effects of malaria in pregnancy and children under 5years. This chapter also provides an overview of global malaria, malaria in SSA, and malaria in Cameroon with special attention to rural Cameroon, focusing on their approaches to malaria prevention, control, and treatment to reduce malaria in their communities. The last section of this chapter consists of reviews of the methodology of research and a rationale for using a cross-sectional and quantitative analysis for this study. This is followed by a summary of the chapter and transition to the next.

Literature Search Strategy

Information for this literature review was acquired through books, searching electronic databases, websites, journals, and dissertations found electronically on the Walden University website, and other electronically accessible thesis and dissertations available from other school websites. The electronic databases included *Academic Search Premier*, *CINAHL*, Google Scholar, *PubMed or Medline*, World Health Organization Library database, All-Party Parliamentary Group, and the CDC for relevant information pertaining to the study. The following keywords and terms were used to search the databases: *what is malaria, history of malaria, malaria in pregnancy, malaria in children*

under five years, malaria complications, malaria prevention approaches, and *outcome*. These terms were searched to include global malaria, malaria in Africa, and malaria in Cameroon. Other searches related to malaria prevention and control included: *ITNs use in Cameroon, malaria in rural Africa, malaria in rural Cameroon, malaria, education and use of 'anti-malaria drugs, use of modern versus traditional preventive care, socioeconomic status,* and *malaria outcome*.

The study gathered relevant information from references from published articles in journals such as PMC (*PubMed*), BMC (*BioMed Central*), *Public Health, Academic Journal*, and *Malaria Journal,* which was published from 1981 to present. Websites such as the WHO, CDC, All-Party Parliamentary Group, Roll Back Malaria, UNICIEF, Cameroon Ministry of Public Health, and CCAM were explored for relevant articles. Individual medical journals were searched regarding malaria prevention, and references from unpublished articles; newspaper libraries; policy documents such as from NMCP; research reports; literature relating to malaria prevention initiatives; reports from the Cameroon Ministry of Public Health; literature relating to pregnant women and children under 5 malaria morbidity and mortality in Cameroon; literature regarding the proper use of antimalarial drugs, ITN, and mosquito nets; and literature about knowledge and attitudes towards malaria prevention are included. Thorough literature reviews were conducted on eligible publications and were synthesized to determine the appropriate conceptual model for this study, which is discussed in the next section.

Conceptual Model

The SEM is the theoretical framework that suited this study. The model addresses the complexities and interdependences between socioeconomic, cultural, political, environmental, organizational, psychological, and biological determinants of behavior (Stokols, 1996). It recognizes that whereas individuals are responsible for establishing and retaining life style changes necessary to reduce risk and improve health, individual behavior is influenced by factors at different levels of the SEM (Elder et al, 2007). There are a number of versions of the SEM, which use slightly different classification of these levels. For the purpose of the study, the five levels of the SEM identified by Sallis & Owen (2002) were useful in explaining how individuals in rural Cameroon could achieve better health outcomes through malaria health promotion, practices, and education.

Levels of the Socioecological Model

Individual Level

At the individual level, considering the degree of influence that adults, especially mothers, have over children under 5 years of age, there is arguably no purely individual level of influence for malaria prevalence among children. This level deals with personal factors such as knowledge, attitude, belief, level of education, sex, and socioeconomic status that increase or decrease the likelihood of an individual to engage in the proper use of malaria preventive measures. For example, a recent study by Singh, Musa, Singh, & Ebere, (2014) noted that knowledge of mosquito behavior is important in order to take appropriate malaria preventive actions. However, Singh et al., (2014) pointed out that knowledge alone does not account for proper use of malaria prevention measures due to

the poor socioeconomic status and low level of education that is typical in rural communities.

In another study, Amoran (2013) found that rural nursing mothers who were offered malaria education through training workshops and use of education materials such as posters, story books and malaria post signs that were culturally understood became empowered and more engaged in malaria prevention activities. Furthermore, mothers with education after the training were more effective in using available resources such as ITNs to prevent malaria. This makes the SEM an appropriate framework to guide designs for effective and sustainable malaria intervention. This requires implementing strategies that can promote change at the individual level and in turn change an individual's knowledge, attitude, behavior, and skills. This can be achieved through education and culturally centered programs.

Interpersonal Level

The interpersonal level includes family, friends, spouse, culture, tradition, and caretaker behavior. This level involves relationships and interactions between individuals in a community that has a significant influence on how the individuals engage in proper use of malaria prevention measures. In malaria prevention and control, the family unit is the most common target for interpersonal interventions. According to Amoran (2013), families are the primary context within which most health problems and illnesses occur, and they exert a powerful influence on the person's health outcome. Interpersonal factors influence an individual's proper use of malaria prevention measures including going to the hospital for proper malaria diagnosis, taking a proper dosage of antimalarial drugs,

attending antenatal appointments, and taking proper dosage of IPT (Amoran 2013; Andrew et al., 2014; Diala, Pennas, Marin, & Belay, 2013). These factors depend on family support, relationship with healthcare providers, socioeconomic status, and disclosure of health status (Amoran 2013; Andrew et al., 2014; Diala et al, 2013). For example, pregnant women may need encouragements and support from their husbands who may provide the finances for care, other women with previous pregnancy experience, and parents and in-laws to positively influence their interest in seeking antenatal care throughout their pregnancies.

Another factor that influences individuals' decisions in seeking care is their perception about the disease and what they consider the best treatment for that illness or health issue. In a study by Diala et al, (2013), some pregnant women considered traditional medicine as the appropriate first-line treatment for malaria as opposed to modern or conventional medicine. However, culture, beliefs, and attitudes regarding healthcare professionals' interactions with patients also determines whether or not someone seeks care. Studies (Amoran 2013; Andrew et al, 2014; Diala et al, 2013) show that poor relationships between healthcare providers negatively influenced pregnant women's willingness to seek antenatal care during their pregnancy.

Furthermore, some pregnant women who did not disclose their pregnancy and attend antenatal care expressed their fear of witchcraft, embarrassment when healthcare providers ask about their pregnancy history, gossip from their peers about their pregnancy, and the time to get care (Amoran 2013; Andrew et al, 2014; Clouston Yukich, & Anglewicz, 2015). The SEM provides avenues to fully grasp these multi-interrelated

factors that make it difficult for those vulnerable to malaria to engage in proper malaria prevention and control. Therefore, it is important that program planners and community leaders to seek ways that these challenges can be addressed.

Community Level

The ESM framework further expanded the interpersonal to include other community level factors that incorporate the influence of immediate family, preferences for home births, preferences for traditional medicine, friends, neighbors, peers, and others in the community (Andrew et al, 2014; Clouston et al 2015; Diala et al, 2013). Other community factors relate to the culture and norms of the community, for example with regard to whether pregnant women are expected to seek care in health facilities, with traditional providers, or a combination of the two (Pemunta, 2013). Interpretation of community norms may increase or mitigate the risk level for malaria infection within the community (Andrew et al, 2014; Apinjoh et al, 2013). For example, interventions focused on establishing ITN use norms have demonstrated efficacy in increasing ITN use (Bowen, 2013). Issues of spirituality and witchcraft play important roles in women's beliefs and actions (Amoran, 2013; Andrew et al, 2014; Pemunta, 2013). Availability and location of resources that promote health such as health centers, transportation, skilled health professionals, consistent medication supply, communication using various local media, and community health workers who provide one-on-one information on proper use of medication and ITN are crucial for a community to engage in effective malaria prevention. The SEM is within the scope of integrated community-based malaria prevention in rural Cameroon as evidenced by the core values of integrated community-

based malaria prevention, which are health promotion and prevention through grassroots engagements.

Organizational Level

The organizational level, various community groups can educate members about the proper use of malaria preventive measures like the ITN, antimalarial drug, importance taking the recommended full curative dose of sulphadoxine-pyrimethamine (SP) at least twice during pregnancy, irrespective of whether they have malaria, disseminating information that can be understood and assist them in making better personal choices (Amoran, 2013; Andrew et al, 2014; Diala, et al, 2013). Organizations provide important economic and social resources, for example, village associations provide financial resource to village at an affordable interest rate for villagers to be able to borrow money improve their businesses, pay hospital bills, and build homes that are ventilated. Through organizations social norms and values are transmitted to the general public and therefore great element in the SEM to educate and empower rural people about malaria and to take ownership of the preventive activities within their communities to improve malaria prevention.

Policy Level

This policy level refers to legislation, regulatory or policy making actions that have the potential to affect how malaria preventive tools are properly used to effect change in malaria prevalence. These are often formal legal actions taken by local and national governments but also can be informal local policies or rules in settings such as schools and various community. groups. For example, health workers in rural

communities can cooperate with community leaders to set up days for free distribution of mosquito nets and antimalarial drugs as a way to encourage people in the community about the importance of using these preventive measures to reduce malaria risk and foster trust in the community to seek care at a health clinic instead of going to traditional medicine. Policies should be in place to promote community accessibility of malaria services, promote local understanding and ownership of malaria preventive activities. Furthermore, policy should encourage corporation between health workers and community leaders to ensure that any loop holes in providing malaria services in the community addressed.

According to Glanz, et al, (2008), the SEM provides a guideline for designing effective and sustainable health programs and allows planners; including partners, community leaders, and community members, as in the case of malaria prevention in rural Cameroon, to understand and address the reasons for non-compliance in recommended malaria prevention actions. The treatment for malaria is usually very effective if care is sought in time. The challenge, therefore, is community leaders using available resources to implement on-going programs, which educate community members, community health workers, and health professionals to recognize when to seek care and provide accurate diagnose, which facilitate appropriate care seeking behavior. Additionally, the theory will provide an understanding of how malaria education enables people to engage in the proper usage of anti-malaria drugs and make informed decisions about where to access care to improve malaria outcomes. Finally, the theory will be used to explain the relationship between socioeconomic status and health seeking behavior.

The next section will discuss global malaria burden, malaria burden in rural Cameroon and its complications in children under five and pregnant women.

Burden of Malaria

Epidemiology of Malaria Globally and in Cameroon

Malaria is an ancient disease that has been in existence and recognized for more than 4,000 years (CDC, 2014). The name 'malaria' comes from an Italian word mal'aria meaning "bad air" (CDC, 2014). Malaria is caused by the *Plasmodium* parasites which are transmitted to humans through bites by an infected *Anopheles* mosquito (CDC, 2014 and (WHO, 2014). There are notably five parasite species responsible for malaria in humans; *Plasmodium* falciparum or *P*. falciparum, *Plasmodium* vivax, *Plasmodium* malariae, *Plasmodium* ovale and *Plasmodium Knowlesi* which are most frequently noted for infecting humans and animals (Sinka, et al., 2010). The p. falciparum is the most common malaria parasite around the world, particularly in SSA (WHO, 2014). The P. falciparum and P. vivax are very common species found in many high transmission region; however, the P. falciparum is responsible for the majority of malaria morbidity and mortality (McQueen, Williamson, & McKenzia, 2013; Sinka, et al., 2010). The p. falciparum exacts a heavy mortality toll in SSA and accounts for 90% of the global malaria burden (Fru-Cho, Bumah, Safeukui, et al., 2014; Mbenda & Das, 2014; WHO, 2014).

Globally, the rise in malarial cases in SSA and other tropical regions of the world have been reported (WHO, 2014). Malaria affects about 3.2billion people in 97 countries with many communities at risk for malaria (WHO, 2014). Based on recent malaria

reports, about 198 million malaria cases were identified globally in 2013 (WHO, 2014). Africa still bears the greatest burden, accounting for 90% of all malaria deaths and among children under five, it contributes to 78% of all deaths (WHO, 2013). According to WHO (2013), there are 10 high burden malaria countries identified in Africa, which are responsible for 60% of all malaria deaths in Africa. These countries include Burkina Faso, Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Ghana, Mozambique, Niger, Nigeria, Uganda, and Tanzania (WHO, 2013).

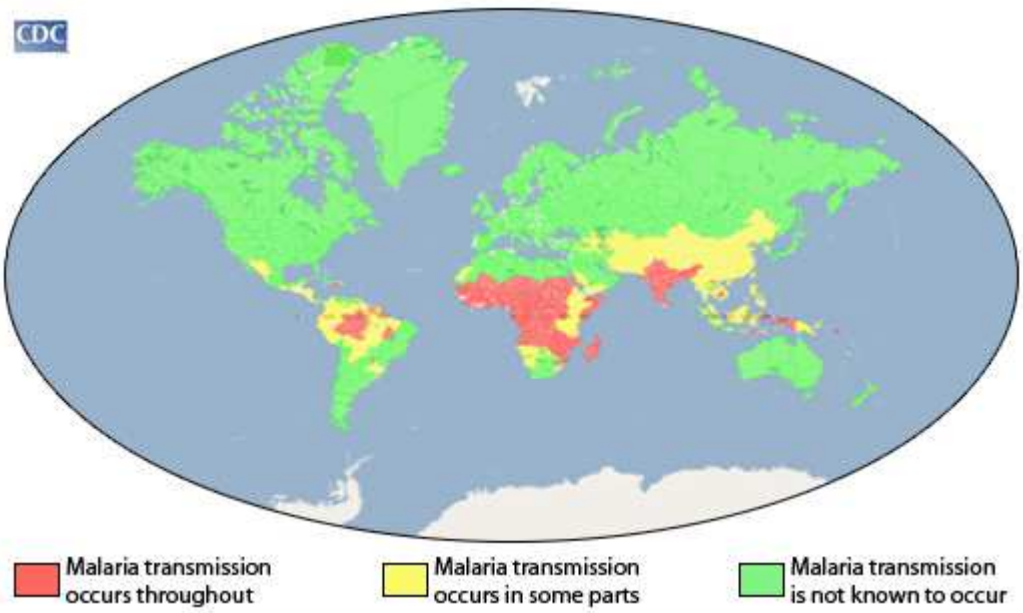

Figure 2. Malaria global estimate burden. This map shows an approximation of the parts of the world where malaria transmission occurs. Source: Centers for Disease Control and Prevention (2014).

About 1.3 billion people globally are exposed to the *Plasmodium falciparum* which are the species responsible for most malaria related deaths (Hay, Guerra, Gething, et al, 2009). The malaria burden in Cameroon like most endemic countries stem from the epidemiological and poverty profiles that are improperly addressed in the design of

national and local strategies to reduce malaria morbidity and mortality (CCAM, 2010). For example, in Cameroon malaria affects about 90% of the population and out of the total population of 20 million, about 8.2 million people suffer from malaria infection every year (Ndo, Menze-Djantio & Antonio-Nkondjio, 2011). According to Ndong, et al., (2014), Cameroon is one of the endemic countries with high transmission of malaria, calculations which are based on the epidemiological, geography and climate of each region. The malaria prevalence rate in Cameroon is 29%, and about a million cases of malaria are reported every year with about 50% of morbidity among children under five, 40-45% of medical consultations, and 30-47% of hospitalizations in the general population (Ndong, et al., 2014). Furthermore, malaria also accounts for 49% of prenatal consultations and 59% of hospitalization during pregnancy which often leads to abortion, premature labor and delivery resulting in low birth weights and often leading to infant and maternal mortality (Ndong, et al., 2014). Figure 4 below shows the progress that has been made to reduce malaria morbidity in 2008 from 41% to 25% in 2012.

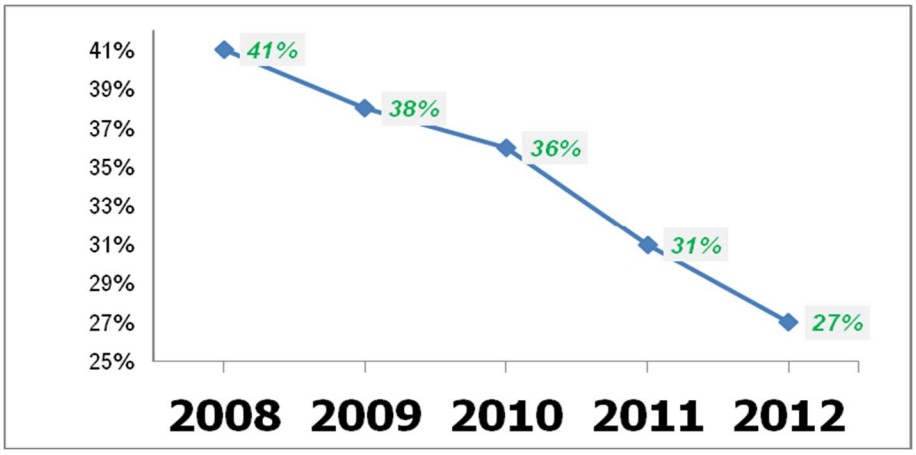

Figure 3: Malaria morbidity in Cameroon from 2008 to 2012. Source: World Health Organization. Consultation on developing a multisectoral approach to malaria: Malaria in Cameroon. (2013). Adapted from World Health Organization by Rollback Malaria. Retrieved

from http://www.rollbackmalaria.org/files/files/about/MultisectoralApproach/Country-brief-Cameroon.pdf. Copyright 2013 by World Health Organization. Reprinted with permission.

According to the United Nations Statistics Division (2011), in 2008 the malaria death rate in Cameroon per 1000 population for children 0-4years was 89, and for all other age groups it was 103. Malaria inflicts economic, social, and educational burdens on individuals, families, communities and the country where transmission is high. There are huge consequences of malaria on the family; for example, the cost of malaria is measured in the lives that are lost due to malaria, time spent while sick or caring for a sick person, lost wages, time away from school and at the national level heavy spending on malaria which reduces the economic development progress (Arrow, Panosian, & Gelband, 2004). Malaney et al., (2004) points out that malaria affects a household's long-term income significantly which impairs educational, economic, and social services of members of households at some point in time. Children under five and women residing in rural communities are at greater risk of suffering from severe malaria complications and death. Malaria and poverty are connected since most countries with high malaria transmission have shown no annual economic growth and Cameroon is reported among the poorest in the world (Sachs, & Malaney, 2002; World Bank, 2000).

Plasmodium falciparum is the most common specie of malaria parasite in Cameroon. Besides the *p. falciparum*, there also other species: *P. vivax, P. ovale, P. malariae, and P.knowlesi* that have been reported in other studies to infect humans either as single or mixed parasitic infections. The *P. falciparum* and *P vivax* malaria species are found in most endemic areas and in patients with severe infection, symptoms are

manifested as respiratory distress, complicated cerebral malaria, severe anemia and even death (McQueen, et al., 2013).

All malaria cases reported in Cameroon are confirmed to be caused by the *p.falciparum* species and transmission occurs all year round (CDC, 2014;WHO, 2014).

Malaria Transmission Cycle

In an effort to effectively prevent and control malaria in rural communities, it important to understand the dynamics of the malaria transmission cycle and why it is crucial that infected persons seek treatment immediately. The malaria transmission cycle involves two components: the female *Anopheles* mosquito (Vector) and the infected human (host) (Kahn, 2008). According to Pimenta et al (2015), malaria is a result of an infection by parasitic protozoa of plasmodium species and these species infect humans and other creatures like birds, reptiles and rodents. Malaria transmission occurs when an infected Anopheles mosquito bites a person. In the process of feeding the infected mosquito injects malaria parasites into the human body (Figure 2). When this happens, the parasites travel to the infected person's blood stream into their liver where they grow and develop (Griffin et al., 2010; Kahn, 2008).

The parasites stay in the liver for about 6-9days and per the WHO (2015) when malaria parasites enter a person's liver, treatment is required immediately to completely cure and reduce further complications. If no treatment is given to the infected person during an incubation period of 15-20days, the parasites leave the liver and enter the blood stream again and they continue to grow and multiply (WHO, 2015a).

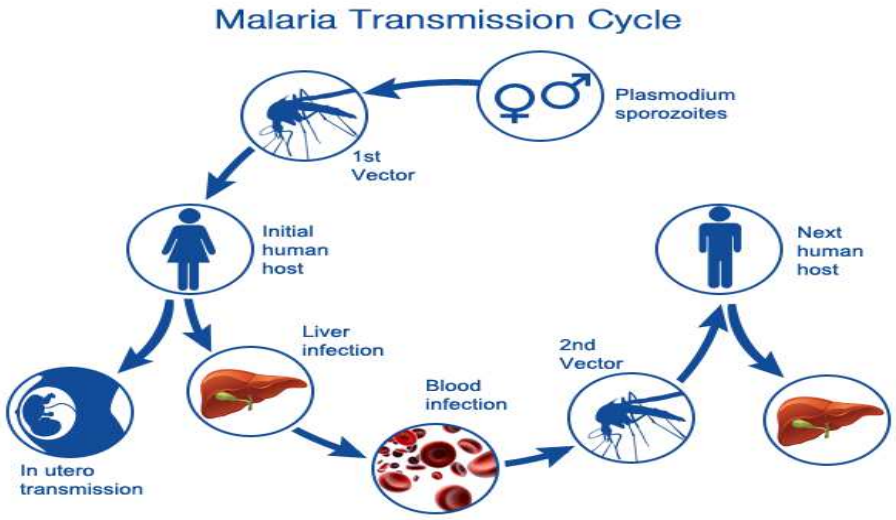

Figure 4. Malaria transmission cycle. Adapted from "Malaria Transmission" by Euroclinix, 2015. Retrieved from https://www.euroclinix.net/en/travel-health/malaria/transmission Copyright © 2016 euroClinix. All rights reserved. Hexpress Healthcare Ltd, 144 Mitcham Road, London, SW17 9NH, United Kingdom. Reprinted with permission.

When a red blood cell breaks, it releases the malaria parasites into the infected person's blood stream causing them to develop fever, headache, and chills (Kahn, 2008 and WHO, 2015). As the cycle repeats itself, further symptoms are presented, infected persons' experience vomiting, anemia, jaundice, convulsions, and bloody stools, which are all severe symptoms of malaria when immediate and proper treatment is not sought as the first symptoms are presented (WHO, 2015). At this point the infected person is likely to die, especially children under five (Kimbi et al. 2013). According to McQueen et al (2013), people in malaria endemic areas develop immunity over time, which reduces their risk of death from infection. This immunity does not occur in children and pregnant women due to their weak immunity, however, they develop severe malaria complications like cerebral malaria, anemia and eventually death.

Malaria may be also transmitted from person to person through contaminated blood transfusion from an infected person to a non-infected person (National Institute of Allergy and Infectious Disease [NIAID] (2009). In most cases, congenital malaria occurs when an infected pregnant woman passes the parasite to the fetus (CDC, 2015; NIAID, 2009). Malaria is recognized and described by its signs and symptoms which are caused by the protozoa parasite called plasmodium (Mueller, et al., 2003). In Cameroon transmission is seasonal and depending on the climatic conditions, for example, in a study in a rural village in Southern Cameroon with equatorial climate, *plasmodium falciparum* was found to be responsible for about 96% of malaria infection with the dominant vector being the *Anopheles gambiae* (Fru-Cho et al 2014). The falciparum species has been identified in Cameroon as the main cause of malaria in the whole country and especially in rural villages (CCAM, 2010; Kimbi et al 2014a; WHO, 2014). Mueller et al (2003) point out that the anophele mosquito mostly engage in biting it victims (humans) during dusk and at night time.

The examination of activities of mosquitos at night time can shed more light on how malaria parasite is transmitted within a community. Through this understanding, it is hoped that rural residents in Cameroon will be educated and become more aware about employing appropriate measures in avoiding mosquito bites and eventually malaria transmission in their communities. Engaging residents in the daily practice of preventing mosquito bites can be a great strategy to reduce malaria prevalence in children and adults. Kahn (2008) points out that those practices such as wearing long sleeve clothes, applying mosquito repellent and proper use of ITN are important in malaria prevention activities in

communities with fewer economic or health-related resources. Nsagha et al (2011a) showed that most communities in rural Cameroon do not employ such practices either due to lack of knowledge, ignorance about consequences of malaria, or lack of resources. There is a need for local understanding of what malaria is, and great way to establish this knowledge is through the dissemination of relevant information to build local knowledge and capacity to engage rural residents in proactive malaria prevention activities. The next section will shed more light on malaria complications in general and complications in pregnancy and children under 5years old.

Malaria Complications

Malaria results in a number of complications due to lack of proper diagnosis and timely treatment to reduce further progress of the disease. The complications may affect the brain leading to brain damage, impaired cognitive function, and generalized convulsions, and the heart and lungs causing circulatory collapse, acute respiratory distress and, finally hypoglycemia (Halliday et al, 2014; Osonuga, Osonuga, Osonuga, and Osonuga, 2012). According to Mishra and Newton (2009) severe malaria complications caused by the Plasmodium falciparum specie is linked to neurological complication termed cerebral malaria, which can be seen as the patient manifests symptoms such as agitation, psychosis, seizures, and coma.

Cerebral malaria accounts for 15-20% of malaria mortality and affects about half of children diagnosed with falciparum malaria; it affects both children and adults living in endemic areas (Mishra and Newton, 2009). In a study by Ketema & Bacha (2013) in two endemic villages in rural Ethiopia, the authors found that there was high incidence of

anemia among children from 0-3years old, and in their study, malaria complications included cerebral malaria, dysfunction of different organs, and renal impairment (Schantz-Dunn & Nour 2009). Pregnant women and children under five years old face some complications as a result of severe malaria. According to the 2011 DHS-MICS report, a combination of about 63.2% of children under five and women in rural Cameroon had anemia due to malaria (NIS, 2012).

Malaria Complications During Pregnancy

In SSA each year, about 30 million pregnant women are exposed to malaria (Dellicour, Tatem, Guerra, Snow, & Kuile, 2010) resulting in severe consequences including miscarriage, premature delivery, low birth weight, placental transmission of the malaria parasite to newborn, and neonatal death (Schantz-Dunn & Nour, 2009; Tonga et al 2013). In a study in Mozambique, 10% of maternal deaths were a result of malaria infection (Schantz-Dunn & Nour, 2009). In a study by Leke et al (2010), in two rural Cameroon villages a high prevalence of placental malaria infection existed among rural women.

Plasmodium falciparum, the most common specie of malaria parasite in Africa cause about 10,000 maternal deaths each year, 8-14% of all low birth weights, and 3-8% of all infant deaths in some parts of Africa (Murthy and Smith, 2010). Malaria exposure is due to a number of factors including women living in endemic areas, lack of malaria knowledge to ensure proper preventive measures like sleeping under ITN, women-especially those in rural areas not disclosing their pregnancy status to health practitioners

and hence missing out on starting sulfadoxine-pyrimethamine (SP) to prevent infection (Leke et al, 2010; Osungbade & Oladunjoye, 2012).

Furthermore, Tonga, et al., (2013) posit that socioeconomic status of women is likely to affect their risk of malaria infection due to their nutrition, family size, interval between birth of their children, and their ability to afford and access both preventive and curative care. Additionally, Murthy and Smith (2010) advance the theory that gender roles and relations are crucial in determining people's exposure to mosquitoes. For example, in most rural communities in Africa, women engage in the following activities, which expose them to mosquito bites: cooking outside, waking up before sunrise and allowing the man of the house to sleep under the ITN if the household has only one (Murthy and Smith, 2010). Based on these risk factors, for women and children, it is important to continue sensitization of communities about the importance of using preventive measures like sleeping under ITN, ensuring its consistent use.

There are proven and cost-effective prevention measures to battle malaria complications in pregnancy so as to save both the woman and child's lives. For example, in Cameroon, the Ministry of Health recommends the use of preventive measures including, IRS, intermittent preventive treatment (IPT), and SP in combination with sleeping under ITN consistently to avoid malaria infection (Bisong & Dongmo, 2013; Kimbi et al 2014a; Tonga et al 2013). Also in an effort to make access to malaria care during pregnancy easier, the Cameroon Ministry of Health mandated that SP be given free of charge when pregnant women visit a healthcare center (Tonga, et al., 2013). However, most pregnant women in the rural areas are not still able to access this free

service due to poor road network. An increase in maternal and perinatal mortality rate is serious especially in rural settings where appropriate malaria care is not accessible to the whole population (Matendo, Engman, Ditekemena, Gado, Tshefu, et al., 2011). Because of poor socioeconomic conditions, most rural communities in Cameroon are not able to provide access to malaria care to a substantial proportion of their population. Thus, it is important to determine the prenatal/neonatal mortality attributed to pregnancy with malaria.

Malaria in Children Under 5 Years

Malaria accounts for about one in six of all childhood deaths in children under five years of age in Africa (UNICEF, 2013). According to WHO (2013b), about 86% of all children under five years died as a result of malaria globally in 2012. In Cameroon malaria accounts for about 30-35% of total deaths and 35% of childhood mortality (Ndo et al 2011). According to the DHS-MIS 2011 report, only about 28% of children under five slept under a mosquito net the night before the survey was given, and in rural Cameroon only 24% of children slept under a mosquito net (NIS, 2012). There has been some progress made in Cameroon to reduce malaria morbidity among children under five as shown in figure 6 below.

According to Steketee, Nahlen, Parise, and Menendez (2001), there are three path ways which malaria affects children under five years and increases their mortality rate. The first of these pathways is severe malaria infection, which leads to cerebral malaria and is likely to result in death if not treated promptly with appropriate medication. Secondly a child with previous exposure to malaria can develop severe anemia which

may also lead to death if not treated properly. Finally, malaria acquired during pregnancy can lead to low-birth weight which if not monitored and treated, may lead to death. The WHO (2013b) report recommends the use of prompt and effective treatment of malaria with artemisinin-based combination therapies (ACTS), insecticide treated nets (ITNs) for the vulnerable and IRS for malaria mosquito control.

Malaria is both preventable and treatable and studies have shown that effective preventive tool like sleeping under ITNs can reduce overall child mortality by 20% (Lim et al 2011; UNICEF 2013). Parents with children under five can protect them from mosquito bites at night by ensuring that they sleep under ITNs every night. For example, in trial studies ITNs use reduced about 13% of malaria infection and about 18% of malaria related deaths among children under five years of age (Lim et al 2011). According to UNICEF (2013), proper use of ITN can save about six child lives per year for every 1,000 children consistently sleeping under ITNs every day. Furthermore, studies (Lim et al 2011) have shown that ownership of at least one ITNs was associated with a 23% reduction in mortality in children under the age of 5. The consistent use of ITNs also reduces the prevalence of malaria infection for all people living in endemic areas. In households that owned at least one ITNs, the risk of children under the age of five becoming infected with the malaria-causing parasite was reduced by 20% (Lim, et al, 2011).

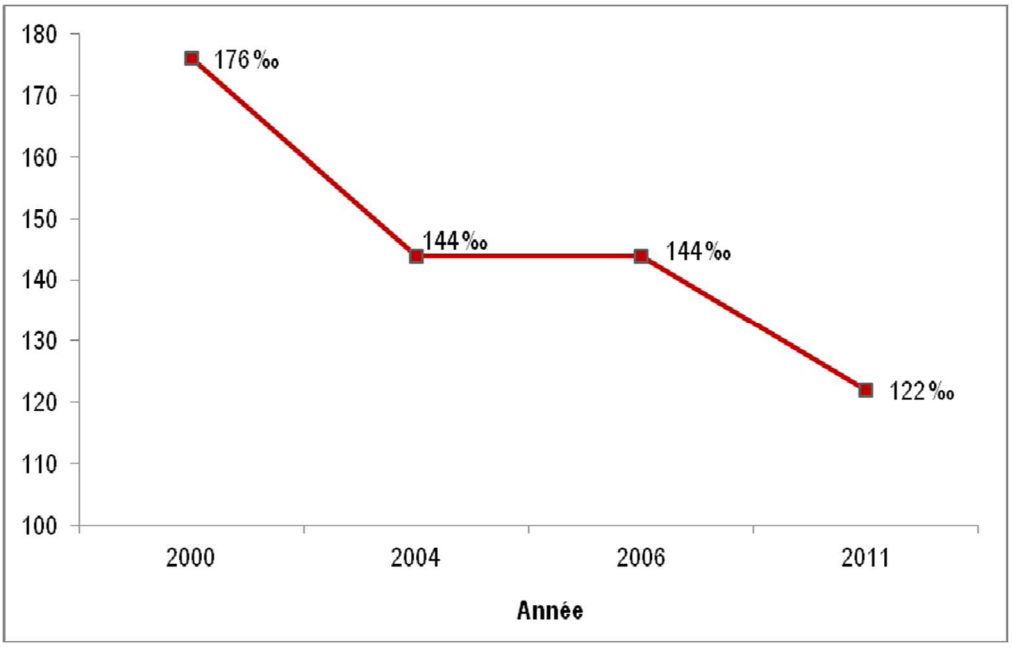

Figure 5: Malaria mortality rate from 2000 to 2011 in children under five in Cameroon. Source: World Health Organization. Consultation on developing a multisectoral approach to malaria: Malaria in Cameroon. (2013). Adapted from World Health Organization by Rollback malaria. Retrieved from http://www.rollbackmalaria.org/files/files/about/MultisectoralApproach/Country-brief-Cameroon.pdf Copyright 2013 by World Health Organization. Reprinted with permission.

However, many children under five do not sleep under ITNs and die as a result of not being able to access recommended treatment in a timely manner. In 2013 only about 36% of children in Africa slept under an ITNs (UNICEF, 2013, WHO, 2014). Some studies have advance the idea that non-use of ITNs is attributed to the lack of access to a net (Hetzel, Gideon, Lote, Makita, Siba, et al. 2012; Ndo et al, 2011) and having enough nets for all within a household is the strongest determinant of net use (Bowen, 2013; Eisele et al 2009). Despite the nationwide malaria intervention targeting pregnant women and children under five years, care has not yielded the desired impact, especially in rural communities. This indicates that it is necessary to combat malaria in rural communities

by involving communities in all intervention efforts. However, involvement of rural communities in malaria control raises several complex questions about the perceptions of malaria, its causes, prevention, and control. The answers to these complex questions reside in the community members who are the end users and are central in the effort to prevent and control malaria through the proper use of the recommended preventive tools such as the use consistent use of ITN and appropriate use of anti-malaria medication to reduce exposure to malaria.

Malaria Preventive Strategies

Strategies currently used to combat malaria in Cameroon include diagnosis and treatment of clinical malaria and the promotion of ITN use in vulnerable populations (Ndo et al 2011). According to Whegang, Tahar, Foumane, Soula, Gwet, et al (2010), between 2002 and 2004, as a result of the ineffectiveness of the medicine, the Cameroon government recommended Amodiaquine and sulphadoxine-pyrimethamine for the first- and second-line treatment of *P. falciparum* infections respectively. Furthermore, since 2011 the Cameroon government has made strides with the help of Global funding and support from partners like the WHO, RBM, and other health partners to acquire and distribute over 8million free long-lasting insecticide treated nets (LLINs) to pregnant women and children under five (Bowen, 2013).Although Cameroon is malaria endemic throughout all parts, various regions experience malaria differently due to the seasons and eco-epidemiological zones (Songue, Tagne, Mbouyap, Essomba, & Somo, 2013).

Malaria is most prevalent in rural, low-income, and hard to reach communities of the world inflicting great burden mostly on children under five and pregnant women

(Lim, Fullman, Stokes, Ravishankar, Masiye, et al 2011; UNICEF 2013). According to Halliday, Okello, Turner, Njagi, Mcharo,Kengo et al (2014) and Lim et al (2011), malaria is preventable by controlling mosquitoes that spread the parasite and by people owning and sleeping under ITN every night to avoid bites from mosquito. Studies show that proper use of ITN in children under five reduced malaria by 13% and deaths by about 18% (Halliday et al 2014; Lim et al 2011). However, studies (Minakawa, et al., 2008; WHO, 2012b) have shown that children in SSA continue to die from malaria because they do not sleep under ITN every night. Evidence show that sleeping under ITN can reduce children malaria mortality by 20% and that is consistent and proper use of ITN can save about 6 out of 1000 children lives every year (UNICEF, 2013). In order to design practical malaria prevention and control strategies in rural Cameroon, it is important to understand some of the malaria risk factors that hamper consistency in available malaria preventive tools such as ITN and antimalarial drugs. Furthermore, this study will focus on identified risk factors based on the variables identified in the research questions, including socioeconomic status, education, proper use of ITN, and healthcare preference.

Malaria Risk Factors

Some research studies (Ndo et al 2011, Tonga et al 2013) have shown that malaria risk factors within rural communities are often described in studies; however, most people (both those at risk and practitioners) do not understand the implementation and practice of malaria prevention and control interventions. In this study, there are four major risk factors which correlate with malaria prevalence in children under five years of

age, pregnant women, and the general population. These include proper use of ITN (Adebayo, Akinyemi & Cadmus, 2015; Apinjoh, et al., 2015), education (Amoran, 2013; Ataka, Inaoka & Ohtsuka; Lowe, Chirombe & Tompkins, 2013), healthcare preference (Akenji et al., 2005; Halle-Ekane et al., 2014; Oyekale, 2015b) and socioeconomic status (Kimbi et al., 2014b; Lowe et al., 2013; Pemunta 2013).

The literature reviewed for this study indicates that proper use of ITN, educational level, healthcare preference, and socioeconomic status were some of the variables influencing malaria prevalence and effective and efficient intervention among the vulnerable and general population in SSA especially in Cameroon (Apinjoh, et al., 2015, Shah, 2010). Furthermore, Shah (2010) points out that in most African countries there are no "built-in" political constituencies for malaria intervention. Moreover, many African countries are poor and as such their government leaders do not allocate political capital to fight malaria despite the high death toll (Shah, 2010). Furthermore, Unger, Van, Sen, and De Paepe (2009) point to the fact that many low resource countries do not cover the basic health needs of the population and that the quality of care is extremely poor especially in the rural areas. In Cameroon for example, the local district is responsible for managing all health activities in rural communities and most often there is only one hospital to serve many rural population (Keugoung, Macq, Buve, Meli, & Criel, 2013). Therefore, it is essential that effective and long-term malaria prevention promotion programs utilize evidence-based and integrated intervention approaches to reduce the inequalities in access to malaria preventions in rural communities (Gilmore & McAuliffe, 2013).

Malaria has been termed “the disease of the poor”, affecting rural marginalized populations especially the vulnerable like children under five, pregnant women, and rural poor in general (UNICEF, 2013; Ricci, 2012). Accordingly, many people in rural communities are often too poor to afford basic life necessities and seeking malaria prevention is often harder considering their socioeconomic status which plays a vital role in accessing treatment options (Ricci, 2012). In a study by Chuma, Okungu, and Molyneux (2010), lack of money was identified among study participants as a major barrier for seeking malaria treatment. In the study 61.5% of respondents who had not sought treatment for malaria mentioned money shortage as a major barrier. Hence, poverty is a major risk factor for malaria, and as Ricci (2012) mentioned, poverty in a broader sense consist of “lack of access to services, resources and skills, vulnerability, insecurity, voicelessness and powerlessness” (p.3), which are factors that cannot be quantified; however, when understood and integrated into malaria prevention programs, they can enable communities to use their meager resources wisely to prevent malaria.

Furthermore, (Chuma, et al, 2010) found that both those who engaged in self-treatment by obtaining drugs from shops and those who went to medical clinic to obtain treatment also mentioned money as an issue in regards to buying drugs or paying for treatment at a clinic. Socioeconomic status refers to educational attainment, wealth, place of residence, proper use of mosquito nets, access to malaria information, access to medical facility and gender roles (Adedokun & Adeyemi, 2013). These are some of the socioeconomic indicators that may hamper malaria prevention practices for most rural community members. Understanding these socioeconomic indices can enable policy

makers and public health officials to better strategize their efforts to ensure that preventive activities are targeted correctly to meet the needs of the rural population.

Lack of education about malaria infection and prevention using antimalarial drugs is another risk factor for malaria prevalence in rural Cameroon. Studies have shown that many people in rural communities engaged in home based disease management (Amaron, 2013; Nsagha, et al., 2011b; Singh, et al., 2014). In Africa and especially Cameroon, many people engage in self-medication, buying antimalarial drugs from street shops and seeking care first from traditional healers (Nsagha et al 2011b). Studies have shown that many rural communities in most African countries engage in self-medication and seeking care from traditional healers instead of going to a modern clinic to get better diagnosis and treatment (Adedokun and Adeyemi, 2013; Nsagha, et al., 2011b; Chuma, et al., 2010; Singh, et al., 2014). In some studies, on rural knowledge of malaria, most people identified malaria as caused by the bites of Anopheles mosquitos and some people associated the cause of malaria to witchcraft, drinking palm wine, and exposure to sun (Pemunta, 2013 and Nsagha, 2011b).

There is a relationship between education and the proper use of antimalarial drugs in Africa (Arrow, Panosian, & Gelband, 2004). Education and knowledge about antimalarial drug resistance, types and dosage amount for malaria prevention and treatment is very poor in rural communities (Nsagha, 2011a). Arrow et al (2004) point out that in resource poor areas like rural communities, other factors besides cost of treatment thwart access and proper use of antimalarial drugs; these includes traditional beliefs, lack of trust in health professionals, illiteracy, and a laissez faire attitude among

members of an endemic community. Education about malaria intervention can improve knowledge of rural community members about the various malaria prevention strategies to reduce malaria morbidity and mortality for all.

According to Nsagha et al 2010; Worall, Bas and Hanson 2003, the variables which influence malaria prevalence and management are less understood among lower socio-economic groups especially in the rural communities. Engaging community members in meaningful use of available preventive tools and empowering them through community health campaigns to improve malaria prevention and control (Nsagha, et al., 2010) is crucial in malaria prevention and control in rural communities.

In one study (Amaron, 2013), health education using various teaching strategies posters, signs, and story books on malaria in various community groups improved mother's knowledge about various anti-malaria strategies. This study will use the integrated approach to engage people in rural Cameroon to utilize various resources and tools for malaria prevention available to them in their communities to improve malaria outcomes in their communities. For example, in some studies (Ajayi, Browne, Garshong, Bateganya, Yusuf, et al., 2008; Yeung, Van Damme, Socheat, White, & Mills, 2008), community-based interventions including the distribution of antimalarial drugs by community health workers were successful in reducing improper use antimalarial drugs. In a new study by Mbonye, Magnussen, Lal, Hansen, et al., (2015), the introduction and use of Rapid Diagnostic Tests (RDT) to registered drug shop owners in Uganda, improved adherence to proper use of antimalarial drugs.

The independent variables in this study include proper use of ITNs, education, health care preference, and socioeconomic status. The dependent variables that have been identified includes; malaria prevalence, use of antimalarial drugs, malaria outcome during pregnancy, and health seeking behaviors, traditional healer or community/private health clinics. Engaging community members in meaningful use of available preventive tools and empowering them through community health campaigns to improve malaria prevention and control is crucial (Nsagha, et al., 2010). It is hoped that improvement will come through the use of available resources, including community health workers in aiding communities on proper use of ITNs; distributing proper dose for antimalarial drugs; training drug shop owners on how to use RDT to ensure that a person receives proper dosage information, and malaria information distribution through local radio, television, local community groups and incorporating malaria day celebration as a cultural or traditional celebration.

This study uses the socio-ecological model to provide a useful framework for understanding individual differences in health behavior, and for designing interventions to change behavior. Through education about malaria, it is hoped that it will increase positive attitude towards ITN usage and improve understanding of the importance of going to a health clinic instead of going to a traditional doctor for malaria treatment. The assumptions of the study are that the information will enable rural residents to engage in informed decision making about malaria prevention and control and hence save time and money and ultimately improve the quality of health in rural Cameroon. The next section of the proposal discusses the variables in the study.

Proper Use of ITN and Malaria Prevalence in Children Under Five

In Cameroon like in many other African countries afflicted by malaria, the governments through the NMCP have designed and adopted several strategies to combat malaria within their communities. According to Tchinda, Socpa, Keundo, Zeuken, Seumen, et al., (2012) malaria prevention and control strategies are based on prompt treatment of confirmed cases with ACT, promotion and distribution of ITNs, using intermittent preventive treatment with sulphadoxine-pyrimethamine for pregnant women, and environmental hygiene. There is a relationship between proper use of ITN and malaria prevalence among children. The proper use of ITN has been shown in other studies (Zimmerman & Voorham, 2003) as a great tool to reduce malaria morbidity and mortality especially among children. However, coverage and proper use remains at a moderate rate in many African countries affected by malaria. This is because as postulated by Ewa et al 2012; Leke et al 2010), there are low coverage health centers in rural communities, cultural preferences, low income, lack of awareness about the benefits of ITNs, lack of trained health personnel, poor infrastructure and high poverty rate in rural areas. In study by Mugisha and Arinaitwe (2003) mothers who were aware of malaria and had engaged in using ITNs were likely to ensure that their children sleep under ITNs every night.

In Cameroon where more than a million cases of clinical malaria are reported annually (Ndong, et al., 2014), there is eminent need to ensure that those who possess ITNs are using them properly to make any type of change especially among children under five, pregnant women, and those living in rural areas. Recent data from the DHS-

MISC 2011 report show that only 21% of children under five slept under ITNs (NIS, 2012). In rural Cameroon 24% of children under five slept under mosquito nets and 19% slept under ITNs the night before the survey was given. According to ITNs Social Marketing in Cameroon (2003), Cameroon lacks resources in its public sector to meet the need for demand of the creation and supply of ITNs for malaria prevention and the existing subsidized malaria treatment hardly benefits those in rural community due to a myriad of reasons.

According to the DHS-MISC 2011 report, about 52% of household in Cameroon own at least one mosquito net of any type 36% own more than one mosquito net, and 42% own at least one ITN (NIS, 2012). In rural Cameroon, 54% of people own one mosquito net and 38% own at least one ITN (NIS, 2012). Cameroon and its health partners distributed over 8million free long-lasting insecticide treated nets (LLINs) in 2011 in an effort to promote use of LLINs and reduce morbidity and mortality (Bowen, 2013). In Cameroon, the use of ITNs has been ongoing and consistent use has been impacted by mass campaigns and advertisement through audiovisual networks and newspapers (Bowen, 2013). In a study by Tchinda et al (2012), many parents who engaged in proper use of ITN were those with secondary education and they were also ready to integrate the messages about the benefits of ITNs and adhere to using it for prevention.

The Ministry of Public Health (Ministère de la Santé Publique, 2010) has distributed over 2million ITNs to children under five and pregnant women throughout Cameroon. Despite this increase in ownership of ITNs, a decrease in malaria morbidity is

yet to be observed, especially in rural Cameroon (Ministère de la Santé Publique, 2010). This suggests that ownership of ITN does not imply proper utilization and could be linked to reasons presented in several studies (Apinjoh, et al., 2015; Atieli et al., 2011; Eisele, et al., 2010; Ibor, Aigbe, Iwara, Okongor, & Okino, 2012; Toe, et al., 2009) from other African countries including; gender, age, social behavior of communities, size and type of housing, level of education, ethnicity, seasons, and frequency of retreatment. Considering these reasons, as part of its free net distribution, the government of Cameroon could target only those hard to reach in the rural areas to increase net coverage and also conduct and enhance health education and community mobilization efforts to increase the possession and proper use of ITN (Apinjoh et al, 2015, Shah, 2010). This leads to the next section on education and the proper use of antimalarial drug.

Education and Proper use of Antimalarial Drugs

According to the WHO (2010) recommendation, all suspected uncomplicated malaria cases have to be confirmed through a diagnostic test prior to prescribing treatment and use of ACTs as the first line of treatment. Regardless of the widespread problem of malaria drugs resistance, the use of antimalarial drugs still remains the most effective option for malaria treatment. For example, if a person with malaria takes chloroquine as a first line drug for treatment, they will still be sick; however, if they take the new drug artemisinin-based combination ACT, they will feel better. Recommendations for new drugs are based on evidence of the efficacy of the drug when tested in the country. For example, Okenu (1999) points out that Pyronaridine was 100%

effective when used in children with uncomplicated malaria in an area of high chloroquine resistance like Cameroon.

In Cameroon, a large majority of rural population who are mostly less educated depend on traditional remedies to treat malaria and use mostly plant medicine for their daily health care needs (Titanji, Zofou, & Ngemenya, 2008). For example, the Baka Pygmies or forest people in South Eastern Cameroon prefer traditional medicine than modern medicine for treatment of common illnesses (Titanji, et al., 2008). Given the general paucity of health care facilities in rural areas and lack of trained health professionals, traditional medicine is sold in local markets and administered by traditional healers who live in close proximity to local residents, making traditional medicine the most preferred cost-efficient treatment for rural people (Titanji, et al., 2008).

Knowledge about drug, dosage and duration of use are very important to ensure proper use of antimalarial drugs. There is a relationship between education and proper use of antimalarial drugs. In a study by Ajibade and Alao (2013) mothers with formal education were likely to consult a health professional for proper diagnoses and treatment of their children and less likely to use herbs while those with no formal education were likely to consult a chemist for antimalarial drug as a first line of treatment. According to Amoran, 2013; Diala et al, 2013; Andrew et al, 2014), educating endemic communities about proper use of antimalarial drugs is crucial to ensure understanding of how to properly use antimalarial and clear out misconceptions concerning the use of these drugs. These measures include using posters, video clips, radio, community-based groups, church, mosque and peer education (Amoran, 2013; Diala et al, 2013).

Prompt access to diagnoses and effective malarial treatment is one of the major strategies for reducing malaria morbidity and mortality. In a study in a rural village in Cameroon, proper health education reduced misuse of antimalarial drugs by mothers (Nsagha et al 2011a). In another study by Takem, Achidi, & Ndumbe (2009), it was revealed that women with higher education were likely to use the full dose of IPT as compared to those with lower education. According to Andrew et al, (2014) the use of proper antimalarial drugs builds patient trust in malaria programs and strengthens confidence in the healthcare system by individuals, families and communities. Most importantly, effective treatment can cure infection and reduce further morbidity and progress to severe malaria. This is why other strategies need to be applied to ensure that antimalarial are properly used, for example using labels on the medication package indicating how many doses per day to take depending on the patients age. There are other barriers that impede proper use of antimalarial drugs, including lack of access to healthcare facilities which offer correct antimalarial and provide dosage information, financial difficulties, poor prescribing practices and shortage of drugs at public healthcare centers (Chuma et al 2010). The next section discusses healthcare preference and malaria outcome in pregnancy.

Healthcare Preference and Malaria Outcome in Pregnancy

The majority of people in developing countries prefer to access care through traditional medicine (Nsagha et al 2011b). This preference of healthcare treatment constitutes one of the issues influencing the effective use and coordination of prevention and treatment method of malaria in Africa and other endemic countries (Suswardany et

al., 2015). In Cameroon, most people use traditional or informal medicine as the first point of treatment of illness. According to a study by Labhardt, Aboa, Manga, Bensing and Langewitz (2010) most people in Cameroon preferred traditional healers to treat their illnesses because the healers seen as more patient-centered than health professionals in public health care facilities. Some people have a personal preference as well as economic reasons to access care from traditional healers, as it is more affordable than conventional medicine (Hillenbrand, 2006). Healthcare preference during pregnancy is critical for the wellbeing of the mother and the unborn baby.

However, the choice to go to a particular healthcare center depends on a number of factors, including, transportation, quality of service, cost of service, perception about healthcare personnel and the location of health center (Bonono & Ongolo-Zogo, 2012). During pregnancy, attending antenatal care is important as to reduce sufferings posed by childbirth; this is an important factor to remember when choosing to go to a health clinic (Bonono & Ongolo-Zogo, 2012). The 2011 DHS-MISC report shows that 85% of women gave birth at a health clinic and received antenatal care from a trained health professional (NIS, 2012). The report also shows that 90% more urban women were likely to receive antenatal care during pregnancy than rural women. Factors such as education and access to health facility influenced some women's preference for care (NIS, 2012). In Cameroon like other African countries, the woman's educational level is associated with optimal utilization of antenatal services (Ministry of Health, 2011).

Another problem that may interfere with the choice of treatment during pregnancy is financial constraints. In studies by Dairo and Owoyokun, 2010; Halle-Ekane,

Obinchmti, Nzang, Mokube, Njie, et al., 2014), it was reported that rural women were less likely to attend antenatal appointments due to financial difficulties. Bonono and Ongolo-Zogo (2012) point out that in Cameroon like many poor African countries, some barriers especially in rural areas are poverty with a poverty rate at 55%, lack of quality health service, and socioeconomic factors that obstruct a woman's will power to decide whether or not to go to a health center during pregnancy. Understanding healthcare preference and health seeking behavior and the factors surrounding decisions making about healthcare preference are important policy implications in health systems development.

Socioeconomic Status and Health Seeking Behavior.

In Africa, the majority of malaria treatment is sought outside of the home and public sector (Kizito, Kayendeke, Nabirye, Staedke, & Chandler 2012). In Cameroon, many people seek healthcare from traditional healers and most people depend on traditional medicine for their healthcare needs with about 7% of their household expenses spent on traditional medicine irrespective of their incomes (Agbor & Naidoo, 2011). According to Lawal et al (2014) and Andrew et al (2014), health seeking behavior is influenced by some factors like quality of care, proximity of healthcare facility, accessibility, cost, social networks, and socioeconomic status of the patient. This study focused on the association between socioeconomic status and health seeking behavior to understand the socioeconomic barriers that deters people in rural Cameroon from seeking immediate and effective care. Socioeconomic status is the parameter used to measure and compare household wealth and it is associated with healthcare seeking behavior.

In Cameroon, due to poverty most people are reluctant to seek care when sick, especially in the rural communities, and if they do, traditional medicine is always preferred over conventional medicine since it is more affordable and easy to access (Hillenbrand, 2006; Titanji, et al., 2008). In a study by Sawalha (2007), most people who sought traditional medicine were women with low incomes and lived in areas where there were no modern health facilities. Studies by Sarmiento, Zuluaga, & Andersson, (2016); Diala et al, (2013); Fraser & Druce (2006); Danso-Appiah, et al. (2010), have shown that traditional medicine was sought as the first line of treatment by the poor, less educated, and those who lived in rural areas. In a study in Kom a rural village in Cameroon, Ryan (1995) found that 83% of illnesses were treated outside of the home.

According to Fraser & Druce (2006) most people in rural communities often seek malaria treatment from retail drug dealers, general stores and street vendors. In a study in the rural village of Ngali II in Cameroon, Leke et al (2010) found that there was only one government health center and a small pharmacy which was always out of stock of antimalarial drugs. This suggested that as a result of the inefficiencies in drug supply and poor strategy in providing health facilities that can carter to the needs of rural residents, most of the malaria sufferers decide to seek care elsewhere. According to Ndo et al (2011), about 81.4% of people in Cameroon engaged in self-medication for malaria treatment. They buy drugs from pharmacist, street vendors and use various kinds of plants concoction to treat illnesses (Agbor & Naidoo, 2011; Ndo, et al., 2011). However, there are potential dangers of self-medication such as over dosing and problems of resistance that have been noted in several studies (Deressa, Ali, & Enqusellassie, 2003;

Gomes, Wayling, & Pang 1998; McCombie, 2002; Pierre, Toua, Tchobsala, Fernand-N, Alexandre-Michael, & Jean, 2011).

According to WHO (2015b), in 2013, only 15million pregnant women living in endemic areas received a single dose of the recommended malaria preventive drug. In most rural communities, women have to obtain permission from their husbands in order to access treatment for themselves and their children despite the fact that they carry the burden of caring for sick members of the family (Fraser & Druce, 2006). A paradigm shift from demand creation to the identification of needs is required based on resources that are available (malaria tools and human resources) to improve on malaria prevention and control. For example, ensuring that free distribution of ITN reach the rural residents and that these communities always have adequate supply of antimalarial drugs. Furthermore, providing adequately equipped health centers within reach for community members and professional staff to manage and care for rural people, taking into account environmental and sociodemographic of communities. In order to achieve the Abuja targets, the new paradigm shift should consider an integrated approach based on lessons learned from the Roll Back Malaria initiatives, NMCP, and other organizations working in the fight to reduce and eliminate malaria.

Summary

Chapter 2 presented a literature review of the extent of the malaria problem in the resource constrained rural communities in Cameroon. In Cameroon, the malaria age adjusted death rate is 72.99 per 100,000 putting Cameroon at number 13 on the world chart for malaria related deaths (WHO, 2011). As earlier mentioned, strategies adopted

by the NMCP to prevent and control malaria include: prompt diagnosis and management of confirmed malaria with ACT, intermittent preventive treatment with sulphadoxine-pyrimethamine for pregnant women, promotion and distribution of ITNs, and environmental hygiene (Tchinda et al 2012). In 2011 Cameroon engaged in a massive free distribution of over 8million free, long-lasting insecticide treated nets to meet the requirement by the WHO for universal coverage (Bowen, 2013; Tchinda, 2012). However, as Apinjoh et al (2015) have pointed out, net use and possession remain low in Cameroon as only 36% of the population owns ITNs and about 21% of children under five are reported to sleep under an ITN every night.

The literature review showed sufficient evidence that available malaria preventive tools such as insecticide treated net/ITN and antimalarial drugs if properly used can reduce malaria prevalence and improve outcomes for children under five and also the general rural population. However,, Kruger, and Greeff (2012) advanced the idea that early recognition and diagnosis of malaria at a health facility by a health professional can facilitate treatment process and hence reduce morbidity and mortality among the population. Many studies have examined the effect of ITNs and antimalarial drugs as important malaria control tools, however no comprehensive studies have been undertaken to examine the proper use of these tools in rural Cameroon to reduce malaria prevalence and improve outcomes using an integrated approach; this study examined this integrated approach.

The variables which hindered effective and proper use of available malaria preventive tools and preventive behaviors were discussed to help in the understanding of

how these tools in conjunction with malaria education could decrease the burden of malaria in rural Cameroon. These include: the proper use of ITN, education, healthcare preference, and socioeconomic status. Finally, based on the review of similar studies, this study will be using secondary data from the 2011 Cameroon Malaria Indicator Survey to examine the association between the independent and dependent variables – proper use of ITN and malaria prevalence among children under five, education and proper use of antimalarial drugs, healthcare preference and malaria outcome among pregnant women, and socioeconomic status and health seeking behavior. These will be further discussed in Chapter 3, describing the design and methodology that will be utilized in the present study.

Chapter 3: Research Methods

Introduction

The fight to reduce malaria in endemic areas has made some progress in reducing malaria prevalence (WHO, 2015a). However, despite the increase in malaria intervention coverage in endemic areas, it was estimated in 2013 that 278 million of the 840 million people at risk of malaria in SSA lived in households without a single ITN. Furthermore, in 2013, 56 to 69 million children with malaria did not receive any treatment (WHO, 2014). Socioeconomic status and education are significant determinants of the lack of access to these essential services. Therefore, continuous effort in malaria prevention is required to ensure that all those at risk engage in the proper use of prevention measures. The purpose of this quantitative study was to increase knowledge of the proper usage of ITNs as part of a larger effort to increase education about malaria prevention. The dissemination of the results of this study would increase education about the need for and proper use of ITNs, encourage community engagement in the prevention of malaria, and help policymakers to provide for properly equipped and accessible health centers.

In the first section of this chapter, I describe the research design and rationale. The research questions and hypothesis are restated followed by the description of variables used. This will be followed by the methodology used in this study including discussion about target population, procedure for collection of secondary data, subject recruitment strategy, sampling, and the data collection instrument used in the original study. Later in the chapter, I discuss the threat to validity and how to mitigate it. The chapter concludes with a discussion of the ethical concerns with the study.

Research Design and Rationale

The purpose of this study was to examine the association between proper use of ITN, level of education, healthcare preference, socioeconomic status, and malaria prevalence. A quantitative research approach was an appropriate methodology for this study as it is based on measuring and analyzing associations between variables using statistical data (Creswell, 2009). Quantitative data can be used to accurately represent health conditions, healthcare needs, and disparities affecting a specific population in the community (Shea, Santos, & Byrnes, 2012). This cross-sectional quantitative study used secondary data from the 2011 Cameroon Demographic and Health Survey (CDHS) and Malaria Indicator Cluster Survey (MICS). The cross-sectional design was chosen as an appropriate design for this study because it measures the relationships between identified variables without manipulating the study environment.

The study subjects were not followed up in a cross-sectional study because data were analyzed at a specific point in time (Suresh, Suresh, & Thomas, 2012). For example, variables representing proper ITN usage, education, and socioeconomic status can be compared or measured against malaria prevalence among children under 5 years old and pregnant women. Experimental design was not appropriate for this study because I did not manipulate subjects to influence outcome of the study. Cross sectional design is the most popular design used by social scientists (Frankfort-Nachmias & Nachmias, 2008). In cross-sectional design, independent and dependent variables are compared.

Furthermore, cross-sectional design is not aimed at establishing cause and effect relationships: rather, it determines correlation between variables, and because the study

was aimed at examining relationships between variables, the cross-section provided an appropriate design. In this study, the cross-sectional survey data was used because the rural communities in Cameroon were examined at a single point in time, thereby addressing the research questions and providing numeric information on malaria knowledge and use of ITN. Analytical statistics are appropriate to prove the hypotheses and a descriptive design was used to provide simple descriptive information on the socioeconomic characteristics as well as other independent variables in regards to malaria knowledge and proper use of ITN in rural communities in Cameroon. This study therefore, will serve as valuable information for future studies and measures that could be taken by policy makers and various rural jurisdictions and traditional stakeholders in Cameroon to improve malaria control.

Research Questions and Hypothesis

This study is based on four main research questions (RQs), each of which generate related hypothesis for more understanding of variables involved.

RQ1: Is there an association between the proper use of ITNs and the prevalence of malaria among children under 5 years old?

The independent variable is the proper use of ITNs, and the dependent variable is the prevalence of malaria among children under 5 years old. The outcome variable is malaria prevalence.

$H_0$1: There is no association between the proper use of ITNs and prevalence of malaria among children under 5 years old.

H_a1: There is an association between use of ITNs and prevalence of malaria among children under 5 years old.

RQ2: Is there an association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon?

The independent variable is education and the proper use of antimalarial drugs is the dependent variable. The outcome variable is the use of antimalarial drugs.

H_02: There is no significant statistical association between education and the proper use of antimalarial drugs for malaria prevention in rural Cameroon.

H_a2: There is a significant statistical association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon.

RQ3. Is there an association between healthcare preference (traditional vs. modern) and malaria outcome in children under 5years and pregnant women?

The independent variable is healthcare preference (traditional vs. modern), and the dependent variable is malaria outcome. The outcome variable is treatment outcome.

H_03: There is no statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

H_a3: There is a statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

RQ4: Is there an association between the socioeconomic status of rural community members and their health-seeking behavior?

The independent variable is socioeconomic status, and the dependent variable is the health-seeking behavior of rural community members. Socioeconomic status is assessed based on educational level, employment, occupation, income, gender, type of housing, and financial assets. Health-seeking behaviors include healthcare preference (traditional/informal vs. modern/formal) and the ability to own and use an ITN as well as to identify malaria signs and symptoms and report them to a health facility for immediate treatment.

$H_0$4: There is no association between the socioeconomic status of rural community members and their health-seeking behavior.

H_a4: There is an association between the socioeconomic status of rural community members and their health-seeking behavior.

Variable Description and Measurement

The variables to be examined in this study include the number of individuals and children under 5 in the household, the sex of the head of the household (male or female), use of ITN, healthcare preference (traditional or modern), wealth index and geographic location of household (urban or rural), age, educational level, marital status, pregnancy status of the mother, and educational level of the respondent. These variables have also been explored in similar studies by Mugisha and Arinaitwe (2003) in Uganda and Noor, Omumbo, Amin, Zurovac, & Snow (2006) in Kenya. Furthermore, some of the variables are compared in studies by Onwujekwe et al. (2005) in Nigeria, Maxwell et al. (2006) in Tanzania, and De La Cruz et al. (2006) in Ghana. In their studies, Mugisha and Arinaitwe (2003), Onwujekwe et al. (2008), Biadgilign, Reda, and Kedir (2012), Larson, Mathanga,

Campbell, and Wilson (2012), and Sena, Deressa, & Ali (2013) concluded that wealth, geography, and marital status play a role in possession and use of mosquito nets. Onwujekwe et al. (2005), Maxwell et al. (2006), and Siri (2014) all found in their studies that wealth was an important factor for net possession and use of net. Moreover, Noor et al. (2006) found in their study that the sex of the head of the household and the marital and pregnancy status of the mother was correlated with net use among young children. In this study, the variables used were classified into independent and dependent variables: level of education classified under categorical variable, including no education, primary education, secondary education, and higher education; and place of residence in two categories; urban and rural.

The variables in this study were constructed based on the four research questions as follows: The dependent variable in this study was malaria prevalence among children under 5 years old, which measured malaria prevalence from the results of the rapid detection test conducted during the survey. Other dependent variables considered for the study included proper use of antimalarial drugs, result of malaria test, and health seeking behavior. The independent variables were proper use of ITN, education, healthcare preference, and socioeconomic status. Other variables that contributed and provided descriptive statistics for the study were age of the child, sex of the child, and type of place of residence.

The measurement scales of the variables used in this study were nominal (categorical and dichotomous) and scale (continuous). The continuous variables in this study were the child's age in months, number of household members, age of household

member, age of head of household, woman's age in years, and man's age in years. Variables that defined sex of household head, place of residence, pregnancy status, use of antimalarial and other medicine for fever, possession of an ITN, and sleep under ITN/LLIN were measured on a dichotomous scale. The variables that defined children under 5 who slept under mosquito bed net, level of education, result of malaria test, where treatment or advice took place, wealth index, and where they got medicine were measured on a categorical scale, and the variables that defined age (in months) and number of children under 5 were measured on a continuous scale. Malaria prevalence was measured on a dichotomous scale. Table 2 lists the study variables and measurement scales.

Table 2

Important Variables Analyzed in this Study

Name	Label	Level of Measurement	Variable Role	Research Question
HV228	Children under 5 slept under mosquito bed net last night	Categorical	Independent	RQ1
SH418	CS Result of malaria rapid test	Categorical	Dependent	RQ1
V106	Highest level of education	Categorical	Independent	RQ2
ML13H	Other antimalarial taken for fever/cough	Dichotomous	Dependent	RQ2
M49E	During pregnancy took: coartem for malaria	Categorical	Dependent	RQ3
S229BC	Number of pregnancies ended with stillbirth	Categorical	Independent	RQ3
ML13D	Quinine taken for fever/cough	Dichotomous	Dependent	RQ3
HW57	Anemia level	Categorical	Independent	RQ3
HV106	Highest education level attained	Categorical	Independent	RQ4
HV219	Sex of head of household	Dichotomous	Independent	RQ4
HV270	Wealth index	Categorical	Independent	RQ4
SH707	Where get medicine for self-medication	Categorical	Dependent	RQ4
SH710	Seek advices or treatment to cure sickness/wound	Dichotomous	Dependent	RQ4
HML10	Insecticide-Treated Net (ITN)	Dichotomous	Dependent	RQ4
HML19	Person slept under an ever-treated net	Dichotomous	Dependent	RQ4
HML20	Person slept under LLIN net	Dichotomous	Dependent	RQ4
HV014	Number of children 5 and under (de jure)	Categorical	Descriptive statistics	
HC1	Child's age in months	Continuous	Descriptive statistics	
HML1	Number of mosquito bed nets	Categorical	Descriptive statistics	
HV024	Region	Categorical	Descriptive statistics	
HV104	Sex of household member	Dichotomous	Descriptive statistics	
HV009	Number of household members	Continuous	Descriptive statistics	
HV105	Age of household member	Continuous	Descriptive statistics	
HV220	Age of head of household	Continuous	Descriptive statistics	
HA1	Woman's age in years	Continuous	Descriptive statistics	
HB1	Man's age in years	Continuous	Descriptive statistics	

Note. CS – Country specific

Methodology

Study Area

Cameroon is located at the end of the Gulf of Guinea and forms a bridge between West and Central Africa. Cameroon is bordered by the Bight of Biafra, between Equatorial Guinea and Nigeria with a total area of 475, 440Km^2 and is administratively divided into 10 regions: Adamawa, Yaounde, East, Far North, Douala, North, North West, West, South, and South West. According to a report from the Central Intelligence Agency [CIA] World Fact Book, 2015, Cameroon has an estimated population of 23,739,218 (July, 2015 estimated) (CIA, 2015). There are four very distinct vegetation and topographical landforms in Cameroon: the southern region has low coastal plain with equatorial rainforests and swamp lands; the Center consists of savannah plateau and also referred to as the Adamawa Plateau; the mountainous west, and the southwestern region with forest cover extending to Mount Cameroon as well as the sub-arid savannah in the north region. Cameroon's climate is tropical, varying from the humid equatorial region in the south to the dry Sahel savanna in the north. The households in the Sahel savannah have rainy season from April to September with an annual average rainfall of 1000-1750mm, while in the southern equatorial region there are two wet and two dry seasons. The coastal regions have an average rainfall of about 4060mm (Oyekale 2015). Previous studies in rural villages in Cameroon show that malaria transmission was higher during the rainy season than in the dry season (Nkuo-Akenji et al 2015; Songue et al 2013).

Figure 6: Map of Cameroon.
Source: Central Intelligence Agency (CIA, 2016). Africa: Cameroon. Retrieved The world factbook: Africa: Cameroon," by Central Intelligence Agency, 2016 https://www.cia.gov/library/publications/resources/the-world-factbook/goes/cm.html Copyright 2016 by Central Intelligence Agency. Reprinted with permission.

Data and Sampling Methods

In quantitative studies, the researcher's goal is to measure variables and generalize findings obtained from a representative sample of the total population. Frankfort-Nachmias and Nachmias (2008) define sampling strategy as a process or procedure for selecting a portion of a population that is used to make inferences about that population. The 2011 DHS data for Cameroon covered a national representation of households after questionnaires were satisfactorily pre-tested. The 2011 DHS/MICS report provides detail information on data collection (NIS, 2012). The samples collected for DHS 2011 survey were obtained through 2-stage stratified sampling and households were selected proportionally to the size with an adequate coverage of all 10 regions in

Cameroon including the two major cities; Yaounde and Douala. It is worth noting that the results for the Centre and Littoral Regions were excluded from the samples from Douala and Yaounde. The first stage of the sampling involved selection of primary Enumeration Areas (EAs) based on the list for the 2005 census on population and housing.

In total, 580 EAs were selected comprising 289 from the rural areas and 291 from the urban areas. The definition of a rural area was based on an area having a population density of less than 20,000 per 1000.00sq km. In most of these areas there was lack of electricity, good road networks, and portable water. The households in each of the EAs formed the sampling unit for the second stage where systematic sampling with equal selection probability was used. Initially, the target population was made up of 15,050 households, however 14,354 were identified and 14,214 households were successfully interviewed, with subsamples of 15,426 women (aged 15 to 49) and 7,191 men (aged 15 to 59) (Oyekale, 2015). Three questionnaires were used during the survey: a household questionnaire, and individual women's questionnaire, and an individual men's questionnaire. House to house fieldwork for the survey was conducted from January 2011 - August 2011.

Power Analysis

Power analysis offers the researcher an opportunity of determining the sample size required in their study to detect the kind of effect they are hoping to get. In addition, power analysis is used to calculate the minimum effect size that is likely to be detected in a study using a specific sample. Sample size calculation is determined using power analysis, and it takes into consideration the effect size, alpha level, and power level

(Fugard & Potts, 2015). The purpose of the sample size is to achieve certain estimation from the population under study and in the case of this study the prevalence of malaria among children under 5years old (Nayak, 2010). Whether it is finding the difference between treatment groups in a clinical trial or proving an association between groups, a right sample size enables a researcher to draw a precise and accurate conclusion (Gogtay, 2010, Nayak, 2010). The effect size measures the strength between variables under study and provides a scale free measure that reflect practical meaningfulness of the relationship among variables (Maher, Markey, & Ebert-May, 2013). The alpha value is the level of significance.

For this study, a medium effect size of (0.3) with a default power of 80% and a default alpha value of (0.05) were used. In order to obtain the appropriate sample size for this study, the PASS software, that provides sample size tools for over 680 statistical tests and confidence intervals scenarios, was used to compute the sample size. Using the PASS software, a sample size of n = 108 achieves 80% power to detect a moderate effect size (W) of 0.3000 using a 2 degrees of freedom Chi-Square Test with a significance level (alpha) of 0.050. The 108-sample size (minimum sample) for this study was obtained prior to the study through power analysis to estimate the appropriate number of sample size required for the study and provides a better opportunity to obtain statistically significant results that are valid, reliable, and accurate.

The minimum sample size calculated prior to this study was 108 in order to realize the minimum effect between the variables under study. However, the power analysis was calculated by considering only one question. Taking into consideration all

the research questions, this study used a larger power to account for all issues related to all questions (Sullivan, 2017). For example, in a study by Liou, Liou, & Chang (2010), to find the association between various risk factors and obesity among adolescents and calculated the minimum sample size was 1842 using a 99% confidence interval and 3% expected error, but in order to increase statistical significance and generalization, they used a sample size of 8,640. In another study, Xu et al, (2011), used a large sample size of n-5226 to understand self-rated health and its associated factors in Chinese adolescents. According to Frankfort-Nachmias and Nachmias (2008), in order for the researcher make inferences the sample has to be large enough so that generalization can be made. The larger sample sizes used in this study were ideal to provide greater precision rather than ignore it by using smaller sample sizes which may not yield valid and precise results. The larger sample sizes used in this study were to provide valid estimates of the study population characteristics and as such the larger the sample size, the more confidence we can have in the sample's representativeness of the population (Schutt, 2015).

Study Population

In this study, the samples that will be used will consist of the households with children under five who were surveyed in Cameroon in 2011. The sample population that will be utilized to estimate the probability of children sleeping under a mosquito net will consist of all households and as a subgroup, only households with ITN and in which children under five live will be included in order to explore the relationship between proper use and malaria prevalence. Furthermore, the sample population that will be used

to estimate the probability of using an ITN net includes those households owning an ITN net at the time of the survey and, subsequently, those households owning a net in which there are children under five.

The main outcome of the data available based on number of children under five who slept under a net the previous night obtained by the interviewer was based on the questionnaire given to the representative of the household that was selected. The bed nets in the survey were defined as all long-lasting insecticide-treated and other insecticide treated nets (ITN). All insecticide treated nets, whether long-lasting insecticide treated net or re-treated nets are referred to in this study as nets or bed nets. Moreover, the data collected included information on the sex of the household head, type of place of residence (rural or urban), whether the household has any type of net (yes or no), and the household's wealth index, constructed using information on household ownership of consumer items, ranging from a television to a bicycle as described in the Cameroon Demographic and Health Survey, 2011 (NIS, 2012).

Data Source and Data Collection

According to Bartholomew, Parcel, Kok, Gottleib, and Fernandez (2011), quantitative data collected from surveys and registries enable community health planners to estimate the incidence and prevalence of health problems and related behaviors in the at-risk-population (p.211). This study will use the Cameroon 2011 Demographic and Health Survey (DHS) data. The DHS survey was originally designed to allow reliability estimation of key demographic and health indicators, such as fertility, contraceptive prevalence, nutritional status, infant and child mortality and anemia prevalence. The DHS

is funded by the United States Agency for International Development and implemented by the National Institute of Statistics (NIS) in collaboration with the Centre Pasteur du Cameroon (CPC) with technical support from ICF Macro through the MEASURE DHS program (NIS, 2012).

This study is based on a nationally representative survey that sampled about 15,060 households using a weighted approach. However, from this sample, 14,354 households were identified and 14,214 were interviewed successfully. Similarly, within the selected 14,214 households that were interviewed, 15,852 eligible women (ages 15-49) were identified and 15,426 were interviewed successfully. Localities were made up of enumerated areas (EAs); households in each of the EAs formed the sampling unit for the second stage, where systematic sampling with equal selection probability was used and of the selected EAs, a total of 578 were sampled. During the survey, the selected women and children were subject to hemoglobin testing in order to determine the prevalence of anemia. Furthermore, all children 6-59months old (5710 in number) were eligible and subject to rapid malaria testing (NIS, 2012). The total number of household members included all people who live together, whether or not they are related and the survey respondents were the ones who answered the household questions regarding exposure to malaria prevention messages as well as the number of children (under five years) who slept under the net the previous night.

Data Storage

The DHS-MISC data is publicly available and can be obtained through permission from the DHS website where the data is stored. In order to access and use the

demographic and health survey data, an online registration is required in order to obtain and download the dataset (DHS, n.d). For my study data, I had to provide personal information including, my name, address, name of institution and phone number. This was followed by the title of the study/project, purpose and brief description of study for data requested. I submitted the request to obtain data for this on November 8, 2015 and received authorization to use data on November 9, 2015. The authorization letter is included in Appendix A.

Data Analysis Plan

Statistical Program for the Social Sciences (SPSS) version 21, a common statistical application developed by IBM, was used to analyze the study data. SPSS was selected for two reasons: a) it has the capability to conduct both descriptive and inferential statistical analyses using all of the statistical tests appropriate to addressing the research questions in this study; and b) the researcher has the proficiency required to use SPSS.

The data for the study are gathered from the 2011 Cameroon Demographic and Heath Survey Program (NIS, 2012). Given that the 2011 DHS dataset was not originally collected for this study, it may require data cleaning that involves identifying and appropriately coding variable measurement scales and mitigating other data quality issues such as missing data. The sample size for this study varied with each research question but did not go below n=108. These included CMPR60FL.SAV and CMKR60FL.SAV. In the cases of RQ1 and RQ3, the original data files were filtered to form new sub-data files named CMPR60FL_Child.sav (where HC1 is between 6 and 59),

CMKR60FL_Children.sav (where HW1 is between 6 and 59) and CMKR60FL_Pregnant.sav (where V213 is "Yes") for ease of analysis.

Data Analysis Plan for Individual Research Questions

Data analysis plans for each research question along with the hypotheses are described below:

RQ1: Is there an association between the proper use of ITNs and the prevalence of malaria among children under 5 years old?

The independent variable is the proper use of ITNs, and the dependent variable is the prevalence of malaria among children under 5 years old. The outcome variable is malaria incidence

$H_0$1: There is no association between the proper use of ITNs and the incidence of malaria among children under 5 years old.

H_a1: There is an association between use of ITNs and the incidence of malaria among children under 5 years old.

Data analysis plan for RQ1. The Chi-Square test will be used to find the association between the proper use of ITNs/LLN and malaria prevalence among children under 5 years old. Chi-Square was chosen because of its widely-used application in finding the association between a categorical or dichotomous independent variable and a categorical dependent variable in the event that logistic regression rules are violated. Clustered bar graphs were used to give a visual illustration of the existence and strength of the computed relationships.

RQ2: Is there an association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon?

The independent variable is education and the proper use of antimalarial drugs is the dependent variable. The outcome variable is the use of antimalarial drugs.

$H_0$2: There is no significant statistical association between education and the proper use of antimalarial drugs for malaria prevention in rural Cameroon.

H_a2: There is a significant statistical association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon.

Data analysis plan for RQ2. The binary logistic regression will be used to measure the relationship between the independent (education) and dependent (proper use of antimalarial drugs). The dependent variable is a yes/no statement and the independent variable is categorical as well.

RQ3. Is there an association between healthcare preference (traditional vs. modern) and malaria outcome in children under 5years and pregnant women?

The independent variable is healthcare preference (traditional vs. modern), and the dependent variable is malaria outcome. The outcome variable is treatment outcome.

$H_0$3: There is no statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

H_a3: There is a statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

Data analysis plan for RQ3. The Chi-Square test will be used to test the statistical association between the independent (healthcare preference) and dependent (malaria treatment outcome in children and pregnant women) variables.

RQ4: Is there an association between the socioeconomic status of rural community members and their health-seeking behavior?

The independent variable is socioeconomic status, and the dependent variable is the health-seeking behavior of rural community members. Socioeconomic status is assessed based on educational level, employment, occupation, income, gender, type of housing, and financial assets. Health-seeking behaviors include healthcare preference (traditional vs. modern) and the ability to own and use an ITN as well as to identify malaria signs and symptoms and report them to a health facility for immediate treatment.

$H_0$4: There is no association between the socioeconomic status of rural community members and their health-seeking behavior.

H_a4: There is an association between the socioeconomic status of rural community members and their health-seeking behavior.

Data analysis plan for RQ4. The multinomial logistic regression will be used to test the significance of selected socioeconomic status variables (education, income, and knowledge) on health-seeking behavior among rural community members.

Threats to Validity

Internal and external validity are two important concepts in research that are helpful in evaluating research findings. Internal validity is concerned with establishing that there is a causal relationship between the independent variable and the dependent

variable, while external validity is concerned with the ability to generalize the findings of a study beyond the study sample (Frankfort-Nachmias and Nachmias, 2008). This study relies on secondary data and does not seek to make causal inferences; therefore, threats to internal validity are limited.

The overall threats to validity in this study are associated with the limitations inherent with using secondary data. Secondary data have some disadvantages when it comes to using them in a new research study since the new study does not influence the purpose and collection method of the original data and as such the researcher has no control over what is already in the data set that may not be applicable to the new study. Another problem is that the variables may not be categorized as the researcher would have chosen for the new study; this may mean manipulating the existing data which can lead to error that can hinder the validity of the study results. Boslaugh, (2007) points that it is important that researchers read between the lines and consider what problems might have been encountered in the data collection process.

Ethical Procedures

This study will use the secondary data of the 2011 Cameroon Demographic and Health Survey. At the time survey was conducted, ethical issues at the collection and collation stages were taken care of and therefore there is no risk of breaking interviewee confidentiality. Hence this study relies on the ethical consideration of the ICF macro for the 2011 Cameroon DHS. According to Siri (2014), interviewers for the DHS data collection are trained extensively and interact with local authorities identifying selected households and administering questionnaires. Confidentiality of information is a major

concern; DHS surveys are anonymous and strict efforts are made to prevent the disclosure of respondent identity (Siri, 2014). The protocols for conducting the anemia and malaria tests during the survey were approved by the National Informed Consent Form Ethics of Cameroon and the Ethics Committee (Institutional Review Board), and Committee International Enumerators were adequately trained to perform hemoglobin and malaria test after obtaining consent from the parents. The Hemocue system was used to perform the hemoglobin test, while the malaria rapid diagnostic test (RDT) was used to ascertain the presence of malaria parasites in blood samples collected by pricking the thumb (Oyekale, 2015b).

Thus, this study poses no ethical threat to the respondents as informed consent was already obtained at the time of the survey in January 2011; additionally, the privacy of the respondents was considered. In order to use existing data for this study, I submitted the request to obtain dataset from the DHS website on November 8, 2015 and received authorization to use data on November 9, 2015. The authorization letter is included in Appendix A. The Walden University Institutional Review Board (IRB) granted approval to use the DHS data for this study on August 8, 2016; IRB approval # (08-08-16-0066421) was provided to go ahead with my study. The data for this study will not be shared with another party and approval from DHS is required before disseminating results of the study.

Summary

This chapter provided an explanation of the research study including the research design and rationale of the study methodology. The components of the study

methodology such as target population, study participants, data source and the sampling procedure used were also explained. This is a quantitative, cross-sectional study design that relies on secondary data from the Cameroon 2011 DHS data. The sample design selected a total of 15,050 households for the 2011 Cameroon DHS data with 15,852 females aged of 15-49 years and 5710 children (6-59months old), under the age of 5 years (NIS, 2012). This study was based on a minimum sample size of n=108. This study did not assess internal validity because the study does not seek cause and effect outcome. However, external validity (generalizability) is supported since the sample size has sufficient power. Ethical concerns related to data source and human participants and Institutional Review Board (IRB) authorization were also discussed. Chapter 4 will discuss the data analysis and results of the study.

Chapter 4: Results

Introduction

The purpose of this study was to examine the association and relationships between proper use of ITN, level of education, healthcare preference, and socioeconomic status based on the socioecological framework in rural Cameroon and malaria prevalence. This cross-sectional study design used secondary data from the 2011 CDHS/MICS conducted jointly by the National Institute of Statistics in collaboration with Centre Pasteur du Cameroon. The 2011 CDHS/MICS survey was sponsored by the Ministry of Public Health, Ministry of Economics, Planning and Regional Development United States Agency for International Development, UNICEF, United Nations Population Fund, and World Bank. The initial target population of the survey was made up of 15,050 households: however, 14,354 were identified and 14,214 households were successfully interviewed, with subsamples of 15,426 women aged 15 to 49 and 7,191 men aged 15 to 59 (Oyekale, 2015b). Three questionnaires were used during the survey: a household questionnaire, an individual women's questionnaire, and an individual men's questionnaire. The SPSS version 21 was used to analyze the following research questions and hypotheses using Chi-Square for association, binary logistic regress, and multinomial logistic regression.

RQ1: Is there an association between the proper use of ITNs and the prevalence of malaria among children under 5 years old?

$H_0$1: There is no association between the proper use of ITNs and the incidence of malaria among children under 5 years old.

H_a1: There is an association between use of ITNs and the incidence of malaria among children under 5 years old.

RQ2: Is there an association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon?

H_02: There is no significant statistical association between education and the proper use of antimalarial drugs for malaria prevention in rural Cameroon.

H_a2: There is a significant statistical association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon.

RQ3. Is there an association between healthcare preference (traditional vs. modern) and malaria outcome in children under 5years and pregnant women?

H_03: There is no statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

H_a3: There is a statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

RQ4: Is there an association between the socioeconomic status of rural community members and their health-seeking behavior?

H_04: There is no association between the socioeconomic status of rural community members and their health-seeking behavior.

H_a4: There is an association between the socioeconomic status of rural community members and their health-seeking behavior.

In this chapter, I discuss data collection and preparation processes explain the representativeness of the sample to the population. I also discuss the use of various statistical tests performed and the reason for their use in this study. I report the results from the analytical tests performed in line with the research questions.

Data Collection

The data used in this study is based on the 2011 Cameroon DHS. The CDHS data contains datasets on various health measures in Cameroon including malaria prevalence and ownership and use of mosquito bed nets among young children and women (NIS, 2012). The 2011 CDHS/MICS data is publicly available and can be obtained through permission from the DHS website. For this study, I had to send a of letter permission via e-mail providing personal information, title of the study, brief description, and purpose of the study in relation to the data requested. I was granted permission to use the requested data within a day after the permission e-mail was sent; approval letter in Appendix A.

The original DHS data samples were collected using two-stage stratified sampling and households were selected comparably to the size of 10 administrative regions including the two major cities of Yaounde and Douala (Oyekale, 2015b; NIS, 2012). During the first stage of sampling, primary Enumeration Areas (EAs) were selected based on the list of the 2005 population housing census (Oyekale, 2015b). There were 580 EAs selected, with about 289 from the rural areas and 291 from the urban areas. The rural area was defined based on an area having a population density of less than 20 000 people. Generally, these places lacked basic social services including a road network, portable water, and electricity. The second stage of sampling involved forming each household in

the selected EAs into a sampling unit using systematic sampling with equal selection probability (Oyekale, 2015b). There were 578 samples from the selected EAs; however, based on the target sample of 15,050 households, 14,354 were identified and 14,214 were interviewed (Oyekale, 2015b). Based on the 14,214 households interviewed, 15,852 eligible women ages 15-49 were identified and 15,426 were interviewed. There were 5,710 children ages 6 to 59 months old who were eligible and were subject to malaria testing (NIS, 2012). Consents for the test were obtained through the National Informed Consent Form Ethics of Cameroon and the Ethics Committee (Institutional Review Board) Committee International (Oyekale, 2015b). Interviewers were adequately trained to perform malaria testing after obtaining consent from parents of young children under 5 who were the only ones getting tested for malaria. The malaria RDT was used to detect the presence of malaria parasites in the blood samples that were collected through thumb pricking. In this study, the DHS data is helpful in finding association and relationships between use of ITN and malaria prevalence in children under 5, proper use of antimalaria, health seeking behavior, and socioeconomic status of people, especially those in rural Cameroon and how they affect malaria prevention and control in the community.

Rationale for Using Demographic Health Survey data.

The reason for using the DHS dataset was due to its comprehensive data collection method and that the data presented makes it flexible for researchers using the dataset to dig deeper in analysis beyond the number of malaria prevalent cases (Corsi, Neuman, Finlay, & Subramanian, 2012). In this study, for example, data were used to

find relationships and associations between independent and dependent variables in regards to malaria prevention and control. Moreover, further studies can be generated using the same data to examine other malaria related health issues. Through the use of the dataset, some loopholes can be identified to improve on data collection. For example, there was some missing data on pregnant women and malaria treatment in the dataset, and this could be an area of future research using a qualitative approach to obtain the data from a local clinic.

Data Exclusion

In this study, each research question had exclusion criteria in order to limit the analysis to valid datasets. The resulting secondary datasets still had adequate records for analysis (more than the minimum sample size of $n = 108$). In order to obtain maximum validity of the analysis results, a sample size of $n = 216$ was randomly selected from the records in each secondary/sub dataset and analyzed.

In analyzing data for RQ1, the ages of the children in months and the RDT obtained for the children were the only two exclusion criteria used to filter the secondary datasets. Excluded from the malaria testing were older adults and those who did not take the RDT during the survey. Consequently, this study used 5,460 out of the 5,710 records for children 6 to 59 months old who had received the RDT for analysis. In RQ3, I used the age of child in months and pregnancy status to make two datasets – one for children aged 6 to 59 months and the other for pregnant women (pregnancy status – Yes). There were 4,693 children aged 6 to 59 months and 1,476 pregnant women. RQ4 used the type of place of residence as the criteria to create the secondary dataset of only those

respondents dwelling in rural areas. There were 40,339 (55%) respondents from rural areas and 32,283 (45%) from urban areas. This number represents multiple responses from each household in the original CMPR60FL.sav data file.

Sample Representation of Population

The sampling frame of the dataset was based on secondary data of the 2011 Cameroon Demographic and Health Survey. According to a report from the Central Intelligence Agency World Fact Book, 2015, Cameroon had an estimated population of 23,739,218 as of July, 2015 (Central Intelligence Agency, 2015). This study was based on a nationally representative survey that sampled about 15,060 households using a weighted approach. However, from this sample, 14,354 households were identified and 14,214 were interviewed successfully. Similarly, within the selected 14,214 households that were interviewed, 15,852 eligible women (ages 15-49) were identified and 15,426 were interviewed successfully. Localities were made up of EAs; households in each of the EAs formed the sampling unit for the second stage, where systematic sampling with equal selection probability was used, and of the selected EAs, a total of 578 were sampled. During the survey, the selected women and children were subject to hemoglobin testing in order to determine the prevalence of anemia. Furthermore, all children 6 to 59 months old (6,623 in number) were eligible and subject to rapid malaria testing (NIS, 2012). The total number of household members included all people who lived together, whether or not they were related, and the survey respondents were the ones who answered the household questions regarding exposure to malaria prevention messages as well as the number of children (under 5 years old) who slept under the net the previous

night. The makeup of the sample in this study was 55% rural and 45% urban. The distribution of the sample in this study by sex was 48.4% male and 51.6% female. All of these characteristics presented the sample as representative of the target population.

Reliability of Statistical Tests and Variables

In regards to the plan presented in chapter 3, three statistical tests; Chi-Square, binary regression, and multinomial logistic regression were used to analyze the samples for this study. In the original analysis, key variables were analyzed using a qualitative approach, hence the challenges confronted with using linear regression, binary regression and multinomial logistic regression in SPSS and some insignificant results. The independent variables (4 of them) were individually regressed on the dependent variable with significance p set at critical value 0.05. The significance of a statistical regression has to be less than the critical level ($p<0.05$) in order for that regression model to be considered significant. The smaller the value of p in the results, the more significant that model is in predicting the dependent/outcome variable. Binary logistic regression is used to predict the probability of an observation being in one of the 2 categories of the dichotomous dependent variable based on one independent variables. The multinomial logistic regression was used to find the association between healthcare preference and malaria treatment outcome because the data support the assumptions of the model (categorical dependent variable, independence of observations, large sample size, no multicollinearity, and no outliers). Chi-Square was used in cases where the logistic regressions produced invalid results i.e. in RQ1 and RQ3.

Validity of Statistical Tests and Selection of Variables

In accordance with the data analysis plan presented in Chapter 3, Chi-square and Logistic Regression were the two statistical tests used to analyze the data. The measurement scales of the variables used in this study were nominal (categorical and dichotomous) and scale (continuous). There were 18 variables in total that were analyzed to answer the four research questions. All these variables were nominal (categorical/dichotomous). The research questions further required to determine association between groups of independent variables and one or more dependent variables. This requirement coupled with the measurement scale of the data (nominal) presented logistic regression as the most suitable statistical test. Where the test had no validity due to the distribution of the data (as in RQ1), Chi-square test (in crosstabulation) was used as this was the next best statistical test for the research questions and data. These tests also had the advantage of measuring the strength of the relationships and provide deductions on the independent variable(s) that had the highest prediction of the dependent variable(s). Although all the variables that were analyzed had large samples, the effective sample size used in each analysis was the smallest sample size in that pair or group of variables being jointly analyzed. Table 3 shows the variables, their data values, effective sample sizes and research questions that they addressed.

Table 3

Variables, Values and Effective Sample Sizes in this Study

Name	Label	Data Values	Research Question
HV228	Children under 5 slept under mosquito bed net last night	0 = No, 1 = All children, 2 = Some children, 3 = No net in household	RQ1
SH418	CS Result of malaria rapid test	1 = Positive with Falciparium, 2 = Positive with others, 3 = Positive with mixte 4 = Negative, 6 = Other	RQ1
V106	Highest level of education	0 = No Education, 1 = Primary, 2 = Secondary, 3 = Higher	RQ2
ML13H	Other antimalarial taken for fever/cough	0 = No, 1= Yes	RQ2
M49E	During pregnancy took: coartem for malaria	0 = No, 1= Yes	RQ3
S229BC	Number of pregnancies ended with stillbirth	Continuous	RQ3
ML13D	Quinine taken for fever/cough	0 = No, 1= Yes	RQ3
HW57	Anemia level	1 = Severe, 2 = Moderate, 3 = Mild, 4 = Not anemic	RQ3
HV106	Highest education level attained	0 = No Education, Preschool, 1 = Primary, 2 = Secondary, 3 = Higher, 8 = Don't know	RQ4
HV219	Sex of head of household	1 = Male, 2 = Female	RQ4
HV270	Wealth index	1 = Poorest, 2 = Poorer, 3 = Middle, 4 = Richest, 5 = Richest	RQ4
SH707	Where get medicine for self-medication	1 = Pharmacy, 2 = Seller of medicines, 3 = Picking plants, 4 = Medicine already available at home, 6 = Other, 8 = DK	RQ4
SH710	Seek advices or treatment to cure sickness/wound	0 = No, 1= Yes	RQ4
HML10	Insecticide-Treated Net (ITN)	0 = No, 1= Yes	RQ4
HML19	Person slept under an ever-treated net	0 = No, 1= Yes	RQ4
HML20	Person slept under LLIN net	0 = No, 1= Yes	RQ4

Note: variables used in the study to answer the research questions.

For all the variables in the study, missing data was excluded case-wise, that is, all records without data for the variables under study were eliminated from the analysis.

Descriptive Statistics

The sample size analyzed in this study varied according to the research questions as earlier shown in Table 3. Males accounted for 48.4% of the total participants, and females accounted for 51.6% as shown in Table 4. The mean age of the adults in the study was 47.71 years while that of children was 28.63 months (2 years) as shown in Table 7. The geographic location of participants was mainly rural, accounting for 55.5% of the sample, while 44.5% of participants were in urban areas as shown on table 5. Table 6 shows the number and proportion of the sex of the heads of the households of the study participants with majority of the households led by men (78.5%) and 21.5% by women.

The mean age of children under 5 was 28.63 months while that of household heads was 22.73 years as shown in Table 7. The average number of people per household was 7.52. The average age of women was 28.06 years while that of men was 30.85 years.

Table 4

Sex of household members

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	35174	48.4	48.4	48.4
Female	37448	51.6	51.6	100.0
Total	72622	100.0	100.0	

Note: number of participants in male headed household was 48.4% and female 51.6%

Table 5

Type of place of residence

	Frequency	Percent	Valid Percent	Cumulative Percent
Urban	32283	44.5	44.5	44.5
Rural	40339	55.5	55.5	100.0
Total	72622	100.0	100.0	

Note geographic location of participant was mainly rural accounting for 55.5% and 44.5% for urban sample participants

Table 6

Sex of heads of household

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	56999	78.5	78.5	78.5
Female	15623	21.5	21.5	100.0
Total	72622	100.0	100.0	

Note: there were 78.5% of male headed household and 21.5% of female headed household

Table 7

Other Demographic Statistics

	Minimum	Maximum	Mean
Number of children 5 and under (de jure)	0	19	1.54
Woman's age in years	15	49	28.06
Child's age in months	0	59	28.63
Man's age in years	15	59	30.85
Number of household members	1	43	7.52
Age of head of household	12	98	47.71
Number of mosquito bed nets	0	7	0.59
Age of household members	0	98	22.73

Note: other demographic included in the study was based on the mean and average age of participants

Data Analysis Results

In order to answer the four research questions, three statistical tests were used namely Chi-Square, binary logistic regression and multinomial logistic regression. These tests had the combined result of determining if there were associations between the independent and dependent variables and measuring the predictability of the dependent variables by the independent variables.

RQ1: Is there an association between the proper use of ITNs and the prevalence of malaria among children under 5 years old?

$H_0$1: There is no association between the proper use of ITNs and the incidence of malaria among children under 5 years old.

H_a1: There is an association between use of ITNs and the incidence of malaria among children under 5 years old.

Using the DHS data file CMPR60FL.sav in SPSS, one independent variable (Children under 5 slept under mosquito bed net last night) and one independent variable (CS result of malaria rapid test) were selected and used for the analysis. There were 5710 records for children aged 6 to 59 months. However, only the 5,460 records that had malaria rapid test results were considered the final random sample (n = 216) for analysis. Chi-square was performed for the independent variable HV228 (Children under 5 slept under mosquito bed net last night) against the dependent variable (CS Results for malaria rapid test) with critical level of significance (p) set at 0.05. As shown in Table 8 there was a statistically significant association between proper use of ITN and the prevalence

of malaria among children under 5; χ^2 (4) = 10.220 at p = 0.017. Cramer's V 0.068 in Table 9 shows that this association was significantly strong at p = 0.017.

Table 8

Chi-square test Results for RQ1 – Children under 5 Slept under Mosquito Bed Net Last Night

Chi-Square Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.220[a]	3	0.017
Likelihood Ratio	8.603	3	0.035
Linear-by-Linear Association	4.918	1	0.027

Note: the chi-square test result showed statistical significant association between proper use of ITN and malaria prevalence among children under 5years; (χ^2 (4) = 10.220 at p = 0.017)

Table 9

Cramer's V for RQ1

Symmetric Measures	Value	Approx. Sig.
Phi	0.220	0.017
Cramer's V	0.220	0.017

Note: Cramer's v test was done to measure strength of association between variables with Cramer's v = 0.068 at p = 0.017

The above results were supported by the clustered graph on *Figure 7* below. Households in which all children under 5years (117 of all children) slept under an ITN had negative malaria when tested.

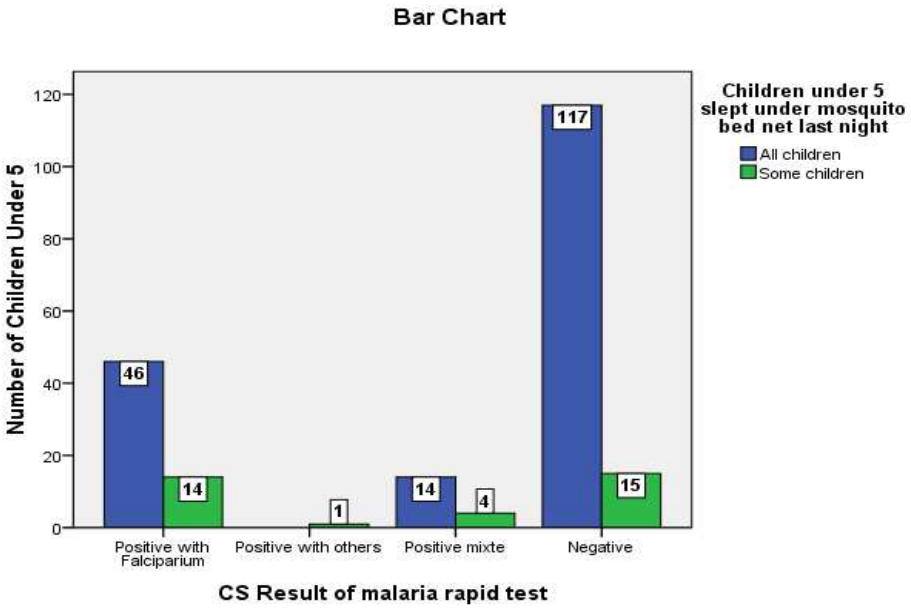

Figure 7: Relationship between children under 5years sleeping under mosquito bed net and malaria prevalence

The researcher therefore, reject the null hypothesis and conclude that there was a statistically significant association between the proper use of ITNs and the prevalence of malaria among children under 5 years old. Children that slept under ITNs were less likely to be infected with malaria.

RQ2: Is there an association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon?

$H_0$2: There is no significant statistical association between education and the proper use of antimalarial drugs for malaria prevention in rural Cameroon.

H_a2: There is a significant statistical association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon.

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Using the DHS data file CMKR60FL.sav in SPSS, one independent variable (V106 -highest level of education) and one dependent variables (ML13H - other antimalarial taken for fever/cough) were selected for the analysis. The sample size was *n* = 216. The binomial logistic regression statistics were run to determine if there was a statistically significant association between the highest level of education and use of antimalarial at critical level of significance (*p*) 0.05. This statistical test was also used to determine extent to which the highest level of education predicted the dependent variable. There was a statistically significant association between the highest level of education and the proper use of antimalarial drugs, χ^2 (3) = 23.978 at *p* = 0.000 as shown in Table 10. The highest level of education predicted 14.8% of taking other antimalarial for fever/cough.

Table 10

Binomial Logistic Regression for RQ2

Chi-Square χ^2	df	Significance	Nagelkerke R^2	Overall Predictive Accuracy
23.978	3	0.000	0.148 (14.8%)	68.5%

Note: the binomial logistic regressions (χ^2 (3) = 23.978 at *p* = 0.000) show that there is a statistically significant association between highest level of education and the proper use of antimalarial drugs.

The Wald statistics in Table 11 showed that people with secondary and higher education significantly used other antimalarial drugs, b = 1.916 Wald χ^2 (3) = 16.465 at p = 0.000 (those with secondary education) and b = 2.100 Wald χ^2 (3) = 9.328 at p = 0.002 (those with higher education).

Table 11

Wald Statistics for Highest Level of Education against Baseline Category 0=No Education for Other Antimalarial Taken for Fever/Cough

Highest Level of Education	***B***	***S.E.***	***Wald***	***df***	***Sig.***	***Exp (B)***	***95.0% C.I for EXP(B)***	
							Lower	***Upper***
V106 - No Education			21.069	3	0.000			
V106(1) - Primary	0.913	0.477	3.658	1	0.056	2.492	0.978	6.350
V106(2) - Secondary	1.916	0.472	16.465	1	0.000	6.794	2.693	17.143
V106(3) - Higher	2.100	0.688	9.328	1	0.002	8.167	2.122	31.429

Note: Wald test showing the statistical signification of association between highest level of education and no education.

The clustered bar graph below gives the graphical illustration of the relationship on Table 11. A, People with secondary education were 49% more likely to take other antimalarial for fever/cough compared to only 10% with no education who also took other antimalarial drugs for fever/cough. In addition, 31% of those with primary education were more likely to take other antimalarial drugs for fever/cough compared to those to only 10% with no education who took other antimalarial drugs for fever/cough. Those with higher education were 4% less likely not to take other antimalarial drugs for fever/cough as compared to 23% of those with no education.

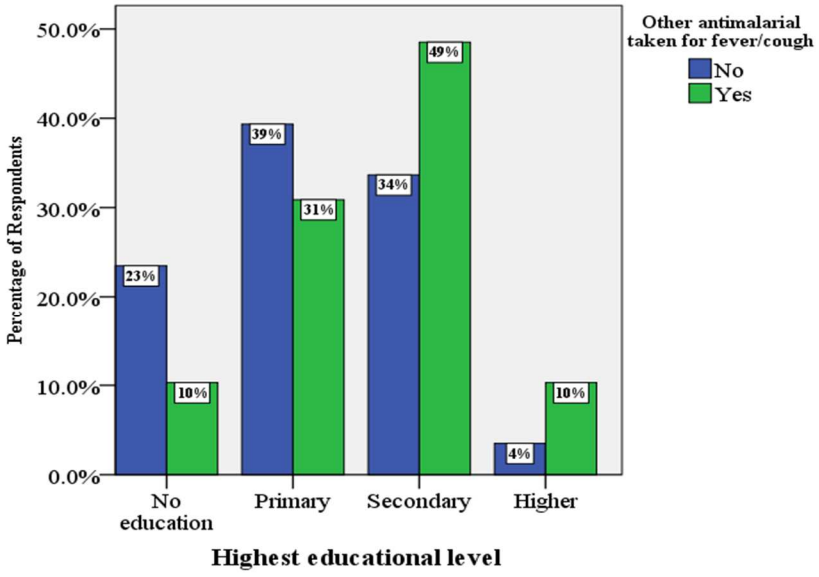

Figure 8: Relationship between highest level of education and taking other antimalarial drugs for fever/cough

The researcher therefore, rejects the null hypothesis and concludes that there was a significant association between education and the proper use of antimalarial drugs. In addition, people with secondary education and higher education used antimalarial drugs to treat fever/cough more than those with primary or no education.

RQ3. Is there an association between healthcare preference (traditional vs. modern) and malaria outcome in children under 5years and pregnant women?

$H_0$3: There is no statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

H_a3: There is a statistical association between healthcare preference (traditional vs. modern) and malaria treatment outcome in children under five and pregnant women.

Using the DHS data file CMKR60FL.sav, two sub-data files were created for children (where Child's age in months (HW1) was between 6 and 59 months) and pregnant women (where Currently pregnant (V213) was "Yes"). The resulting sub-data files were CMKR60FL_Child.sav and CMKR60FL_Pregnant.sav.

In order to analyze the association between healthcare preference (traditional vs. modern) and malaria treatment outcome among children under 5, two variables were chosen. The independent variable selected to represent healthcare preference (ML13D) - Quinine taken for fever/cough) with initial responses 0 = No and 1 = Yes was re-coded as No = traditional and Yes = Modern. The dependent variable for malaria treatment

outcome among children was Anemia level (HW57). The Chi-Square test for association was used with critical significance level $p = 0.05$ and a sample size of $n = 216$. There was a statistically significant association between Quinine for fever/cough and the Anemia level, $\chi^2 (3) = 8.134$ at $p = 0.043$ as in Table 12 below. Cramer's V = 0.195 in Table 13 shows that this association was significantly strong at $p = 0.043$.

Table 12

Chi-Square Results for RQ3 – Children

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.134[a]	3	0.043
Likelihood Ratio	8.250	3	0.041
Linear-by-Linear Association	6.932	1	0.008

Note: This shows the statistical significant association between taking Quinine for fever/cough and Anemia level, $\chi^2 (3) = 8.134$ at $p = 0.043$

Table 13

Cramer's V for RQ3 – Children

Symmetric Measures	Value	Approx. Sig.
Phi	0.195	0.043
Cramer's V	0.195	0.043

Note: Cramer's V = 0.195 at a p = 0.043

The clustered bar graph on *Figure 9* below further illustrates the above association. More children (48) reported taking Quinine for fever/cough compared to 25 who did not. This shows that Quinine use was more commonly used for fever/cough among children under 5years which can increase the level of Anemia.

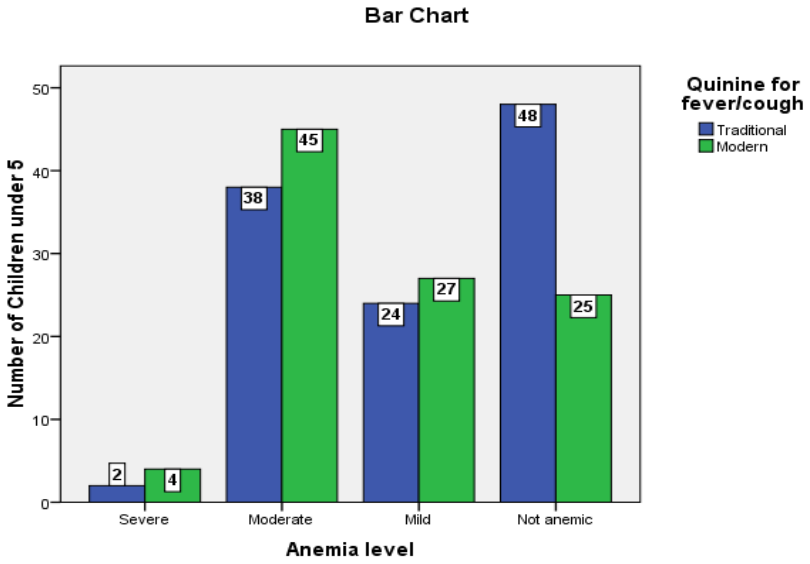

Figure 9: Relationship between Quinine for fever/cough and Anemia level for children under 5years

The independent variable selected to represent healthcare preference (M49E - During pregnancy took: Coartem for malaria) with initial responses 0 = No and 1 = Yes was re-coded as No = traditional and Yes = Modern. The dependent variable for malaria treatment outcome among pregnant women (S229BC - Number of pregnancies ended in stillbirth) was also re-coded as 0 = None and values 1 to 4 = At least 1. This was done to create a dichotomous variable with normally distributed values. The Chi-Square test for association was used with critical significance level $p = 0.05$ and a sample size of $n = 216$. There was a statistically significant association between taking Coartem for malaria during pregnancy and the number of pregnancies ended in stillbirth, $\chi^2 (1) = 9.671$ at $p = 0.002$ as in Table 14 below. Cramer's V = 0.212 in Table 15 shows that this association was significantly strong at $p = 0.002$.

Table 14

Chi-Square Results for RQ3 – Pregnant Women

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.671[a]	1	0.002
Likelihood Ratio	7.346	1	0.007
Linear-by-Linear Association	9.626	1	0.002

Note: The chi-square χ^2 (1) = 9.671 at p = 0.002 results show statistical association between taking Coartem and malaria outcome during pregnancy

Table 15

Cramer's V for RQ3 – Pregnant Women

Symmetric Measures	Value	Approx. Sig.
Phi	0.212	0.002
Cramer's V	0.212	0.002

Note: Cramer's V = 0.212 at a p = 0.002 show the strength of association

The researcher rejects the null hypothesis and concluded that there was a statistically significant association between healthcare preference and the malaria treatment outcome among children under 5 and pregnant women.

RQ4: Is there an association between the socioeconomic status of rural community members and their health-seeking behavior?

$H_0$4: There is no association between the socioeconomic status of rural community members and their health-seeking behavior.

H_a4: There is an association between the socioeconomic status of rural community members and their health-seeking behavior.

Using data file CMPR60FL.sav, records where type of place of residence was rural were filtered out for the analysis. In chapter 3 on table 2, three independent variables (HV106 - Highest education level attained, HV219 - Sex of head of household,

and HV270 - Wealth index) and five dependent variables (SH707 - Where to get medicine for self-medication, SH710 - Seek advices or treatment to cure sickness/wound, HML10 - Insecticide-Treated Net (ITN), HML19 - Person slept under an ever-treated net, and HML210 - Person slept under an LLIN net) were selected for the analyses. In order to eliminate records with missing data for the analyses, a different sample, each of n = 216, was selected for each analysis. In addition, due to the different data structures of the variables in the CMPR60FL.sav dataset, binomial logistic regression was used where the dependent variable was dichotomous (Seek advice or treatment to cure sickness/wound, Insecticide-Treated Net (ITN), Person slept under an ever-treated net, and Person slept under an LLIN net) while multinomial logistic regression was used where the dependent had more than 2 values (Where to get medicine for self-medication) at critical level of significance (p) 0.05.

Multinomial Logistic Regression

The socioeconomic status (sex of the head of the household) was significantly associated with health-seeking behavior (where to get medicine for self-medication) – χ^2 (4) = 12.031 at p = 0.017 and the sex of the head of the household predicted 5.9% of where to get medicine for self-medication as shown in Table 16 below.

Table 16

Multinomial Regression Results for RQ4

Chi-Square χ^2	***df***	***Significance***	***Nagelkerke R^2***	***Overall Predictive Accuracy***
12.031	4	0.017	0.059 (5.9%)	50.7%

Note: multinomial regression shows 50.7% of overall predictive accuracy of where people get medicine

The clustered bar chart on Figure 10 below supports this relationship and further shows that more people (89) in male headed households in rural Cameroon buy medicine for self-medication from medicine sellers.

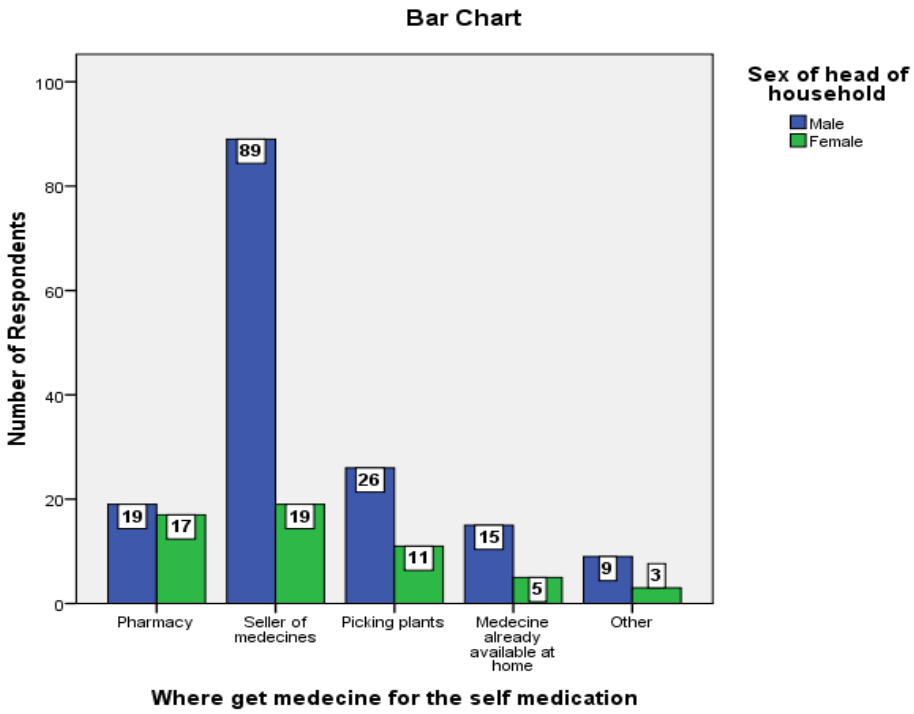

Figure 10: Relationship between Sex of Head of Household and the source of medicine for self-medication

Binary Logistic Regressions

The socioeconomic status (highest education level, sex of head of household, and wealth index) of rural people was statistically significantly association with their health seeking behavior (seek advice or treatment to cure wound) – χ^2 (8) = 20.512 at p=0.009 and the sex of the head of the household predicted 14.8% (Nagelkerke R^2) of seeking advice or treatment to cure sickness/wound and 81.3% overall prediction as shown on Table 17 below.

Table 17

Binomial Logistic Regression Results for RQ4

Independent Variable (Socioeconomic status)	Dependent Variable (Health-seeking behavior)	Chi-Square χ^2	Nagelkerke R^2	Overall Predictive Accuracy	Interpretation
HV106 (Highest education level attained), HV219 (Sex of head of household), HV270 (Wealth index)	SH710 (Seek advices or treatment to cure sickness /wound)	20.512 (8 df) at p=0.009	0.148 (14.8%)	81.3%	The model was statistically significant, $\chi^2(8) = 20.512$ at p=0.009, it explained 14.8% (Nagelkerke R^2) of the variance in SH710 and correctly classified 81.3% cases. Only HV219 significantly predicted SH710.
HV106 (Highest education level attained), HV219 (Sex of head of household), HV270 (Wealth index)	HML10 (Insecticide-Treated Net (ITN)	18.600 (9 df) at p=0.029	0.117 (11.7%)	71.6%	The model was statistically significant ($\chi^2(9) = 18.600$ at p=0.029), it explained 11.7% (Nagelkerke R^2) of the variance in HML10 and correctly classified 71.6% cases. Only HV106 and HV270 significantly predicted HML10.
HV106 (Highest education level attained), HV219 (Sex of head of household), HV270 (Wealth index)	HML19 (Person slept under an ever-treated net)	20.009 (9 df) p=0.018	0.170 (17%)	89.3%	The model was statistically significant ($\chi^2(9) = 20.009$ at p=0.018), it explained 17% (Nagelkerke R^2) of the variance in HML19 and correctly classified 89.3% cases. Only HV219 and HV270 significantly predicted HML19.
HV106 (Highest education level attained), HV219 (Sex of head of household), HV270 (Wealth index)	HML20 (Person slept under an LLIN net)	20.594 (9 df) at p=0.015	0.125 (12.5%)	60%	The model was statistically significant ($\chi^2(9) = 20.594$ at p=0.015), it explained 12.5% (Nagelkerke R^2) of the variance in HML20 and correctly classified 60% cases. Only HV270 significantly predicted HML20.

Note: Binomial logistic regression results and interpretation to show statistical significance association between variables in RQ4

The binary logistic regressions showed that there was a statistically significant relationship between socioeconomic status of people in rural Cameroon and their health-seeking behavior. The most significant association was that between socioeconomic status variables (Highest education level attained, Sex of head of household, and Wealth index) and health-seeking behavior variable (Seek advices or treatment to cure sickness

/wound), χ^2 (8) = 20.512 at p = 0.009, where the socioeconomic status explained 14.8% (Nagelkerke R^2) of the variance in health-seeking behavior.

The clustered bar graphs below were used to give a visual illustration of the above relationships. As shown in *Figure 11*, both men (137) and women (38) were more likely to seek advice or treatment for sickness/wound than not.

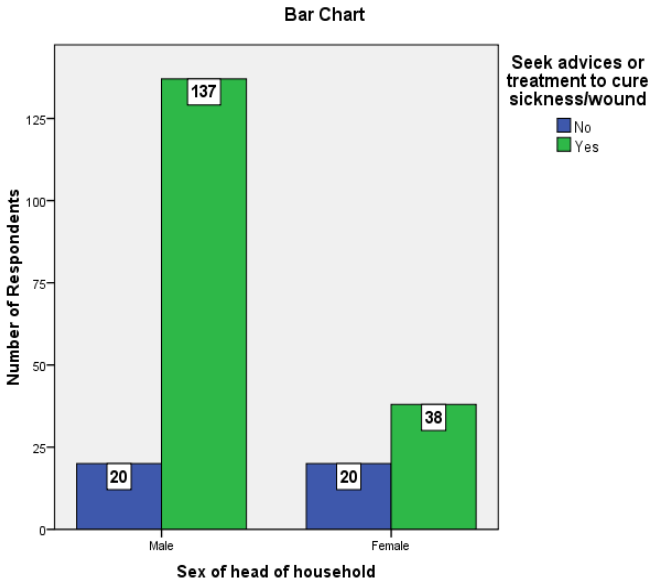

Figure 11: Relationship between Sex of the Head of Household and Seeking Advice or Treatement for sickness

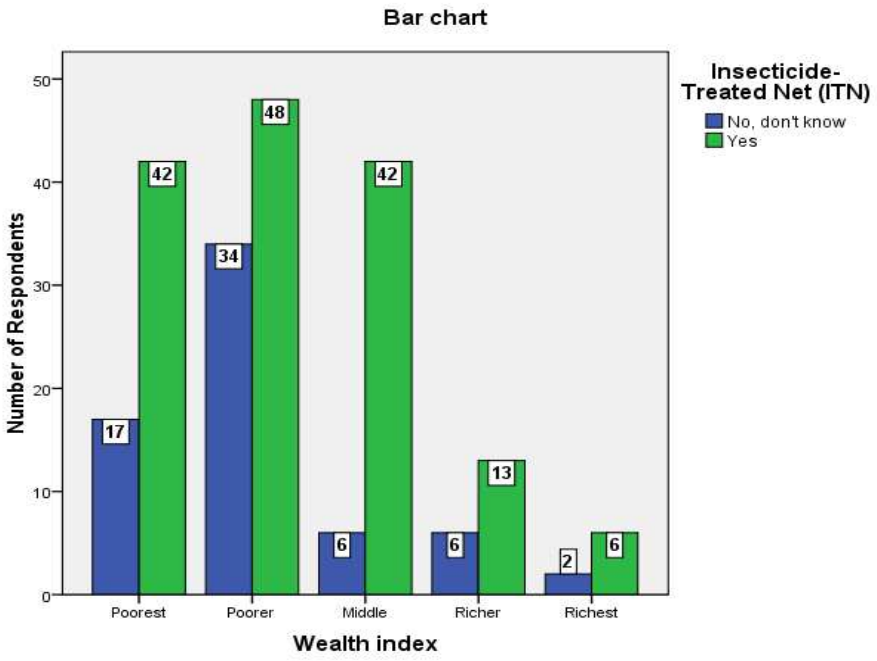

Figure 12: Relationship between Wealth Index and ITN Ownership

More rural community members owned ITNs than did not irrespective of their wealth status as shown on *Figure 12* above.

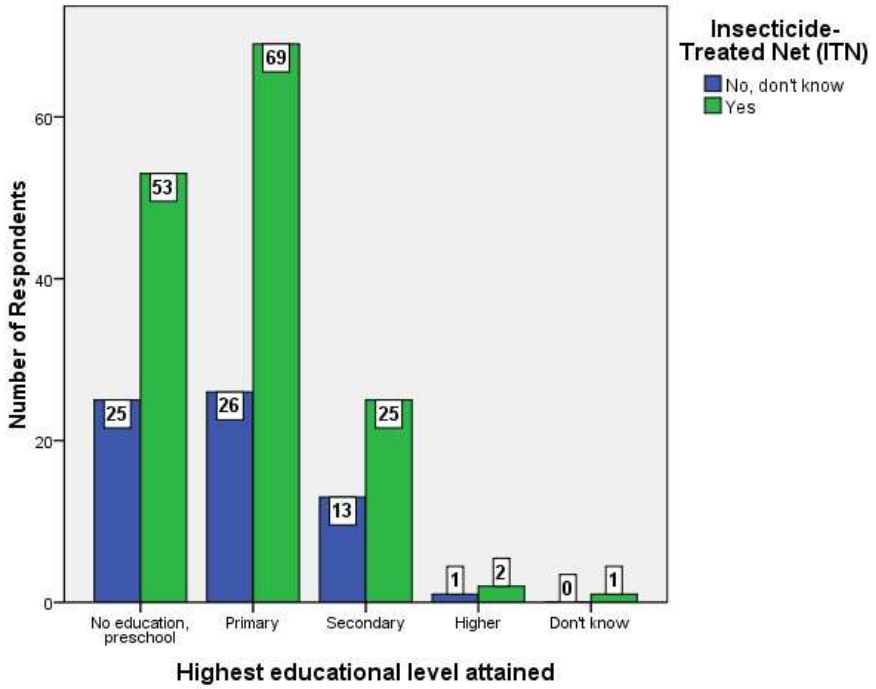

Figure 13: Relationship between Highest education level and ITN ownership

More rural community members owned ITNs than not irrespective of their level of education. In total 150 people, regardless of their educational level owned ITN compared to 65 people who did not own ITN.

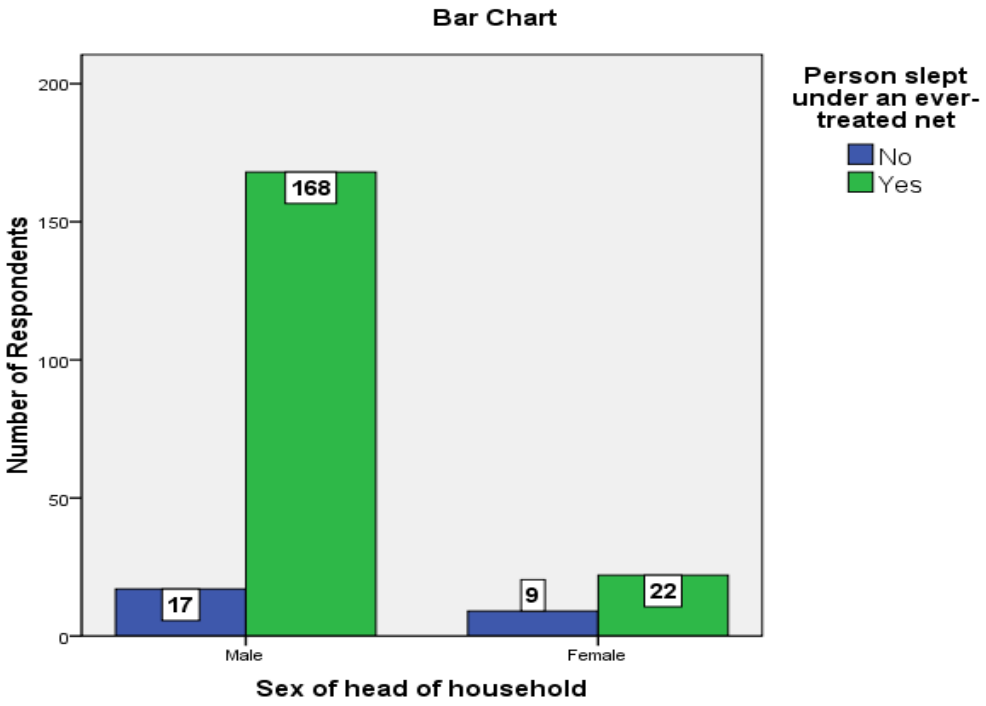

Figure 14: Relationship between the Sex of the Head of Household and Sleeping under and ever-Treated Net

More people in the rural community households slept under an ever-treated mosquito net than not, especially in households led by men. The graph on Figure 14 shows that 168 people in male headed households and 22 people in female headed household slept under and ever treated net.

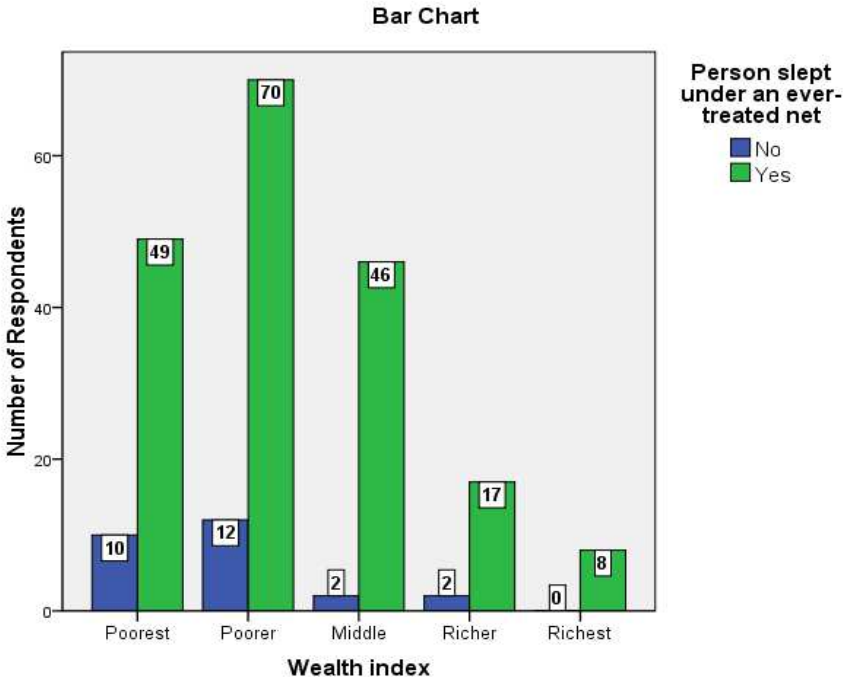

Figure 15: Relationship between Wealth Index and Sleeping under an ever-Treated Net

More people (190) in the rural community households slept under an ever-treated mosquito net than not irrespective of their wealth status as shown on *Figure 15* above.

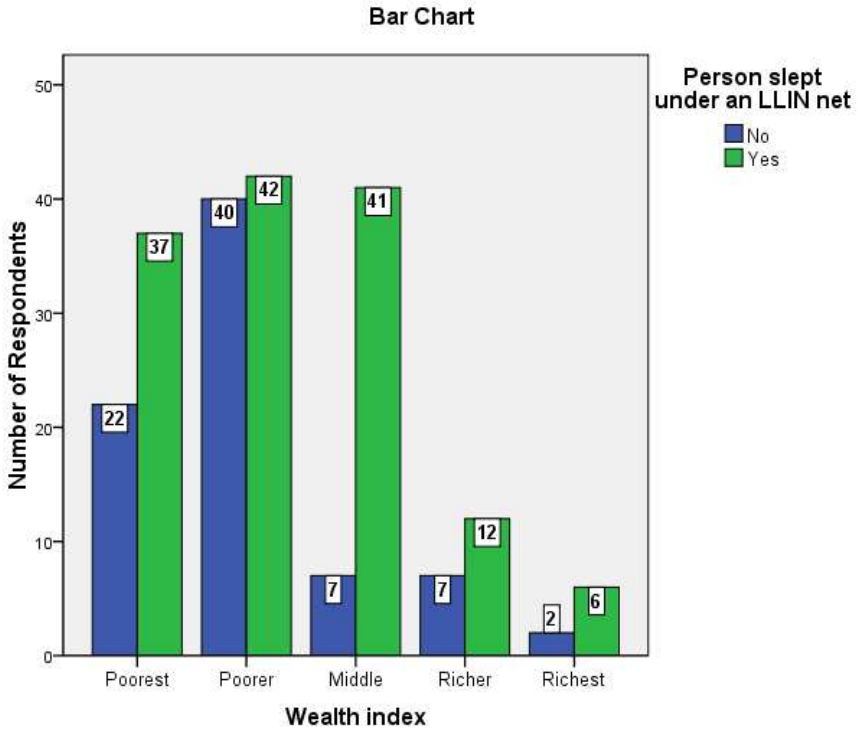

Figure 16: Relationship between Wealth Index and Sleeping under LLIN Net

More people (138) in the rural community households slept under an LLIN nets than not irrespective of their wealth status as shown on *Figure 16* above.

The researcher therefore rejects the null hypothesis and concludes that there is a statistically significant association between the socioeconomic status of the rural community members and their health-seeking behavior.

Summary

In this chapter, results from the analysis of the 2011 Cameroon Demographic and Health Survey (DHS) were presented. Using a sample size n = 216 and critical level of significance (p) 0.05, Chi-Qquare and logistic regression were the two statistical tests used to derive the following results: a) in RQ1, there was a statistically significant

association between the proper use of ITNs and the prevalence of malaria among children under 5 years old and children who slept under ITNs had less malaria infections than not, b) in RQ2, there was a statistically significant association between education and the proper use of antimalarial drugs and people with secondary education and higher education used antimalarial drugs more than those with primary or no education, c) in RQ3, there was a statistically significant association between healthcare preference and malaria treatment outcome among pregnant women and children under 5 and children who took Quinine for fever experienced higher levels of anemia, and d) in RQ4, there was a statistically significant association between the socioeconomic status of the rural community and their health-seeking behavior.

In the next and final chapter, the interpretation of the results will be discussed. The limitations of this study, recommendations for future study, and implications in terms of positive social change will also be discussed.

Chapter 5: Discussion, Conclusion, and Recommendation

Introduction

Malaria continues to be a major public health problem in Africa with children under 5 years old and pregnant women at highest risk (WHO, 2013a). Cameroon is one of the malaria endemic countries in Africa with about 90% of its citizens at risk of malaria infection and about 41% of its people still experiencing an incidence of malaria each year (Antonio-Nkondjo, et al., 2008, Minsante, 2008). Regardless of the continuous efforts by various malaria prevention and control programs to cut down malaria prevalence in endemic areas, only a small handful of successes have been experienced globally. However, as Frech and Chen (2011) points out, malaria is still the primary human infectious disease in Africa. This quantitative study was used to analyze the proper use of available malaria preventive tools to prevent and control malaria in rural Cameroon. The cross-sectional design was chosen using secondary data from the 2011 Cameroon DHS dataset.

In Cameroon, malaria is endemic in all its ten regions with a prevalence rate of 29% (Sumo, Mbah, & Nana-Djeunga, 2015). Malaria is one of the leading cause of illness in Cameroon and the primary cause of morbidity and mortality. Recent data from the DHS and WHO on malaria show that malarial infection is responsible for 40%-45% of medical consultations, 48% of hospitalizations, 30% of morbidity, and 67% of childhood mortality each year (Antonio-Nkonjio, et al., 2013; Sumo, et al, 2015; WHO,2011). Reducing the burden of malaria has been a priority for the government of Cameroon. In an effort to reduce the prevalence of malaria the Cameroon, the

government in 2011 engaged in a mass distribution of insecticide treated nets to all people in the ten regions of Cameroon (Bowen, 2013). The use of a pilot program to utilize the RDTs in healthcare clinics by community health workers and subsidize first line of treatment using ACT (Bowen, 2013). Efforts to reduce the burden of malaria through prevention and control have been recommended by the WHO (2015a). These recommendations include using evidence-based interventions for preventing and treating malaria such as using LLINs, IPT with SP in endemic areas and using RDTs for prompt diagnosis and effective malaria treatment (WHO, 2015a). These recommendations are yet to be appreciated in the efforts to prevent and control malaria in Cameroon, particularly rural Cameroon. There is still a high level of malaria in rural communities in Cameroon (Tientche, Anong, Asaah, Fru-cho, & Nkuo-Akenji, 2016).

The data from 2011 Cameroon DHS survey was used to analyze the relationship and association between variables. The original dataset for this study was filtered to include only children under 5 years old and children who received the RDT during the original data collection. The SPSS version 21 was used to answer the following research questions and hypotheses using Chi-square, binary logistic regression, and multinomial logistic regression.

RQ1: Is there an association between the proper use of ITNs and the prevalence of malaria among children under 5 years old?

RQ2. Is there an association between education and the proper use of antimalarial drugs in malaria prevention in rural Cameroon?

RQ3. Is there an association between healthcare preference (traditional vs. modern) and malaria treatment outcome during pregnancy?

RQ4. Is there an association between the socioeconomic status of rural community members and their health-seeking behavior?

The summaries for findings from the data analysis performed for each question were as follows:

- There was a significant association between the proper use of ITNs and the prevalence of malaria among children under 5 years old. Children who slept under ITNs and other mosquito nets were less likely to be infected with malaria.
- There was a significant association between education and proper use of antimalarial drugs.
- There was a significant association between healthcare preference and malaria treatment outcome among children under 5 years old and pregnant women.
- There was a significant association between the socioeconomic status of the rural community and their health-seeking behavior based on their level of education, sex of head of household and wealth index.

Interpretation of Findings

The findings in the first question on malaria prevalence among children under 5 years old in rural Cameroon related to RQ1. The result of the analysis showed that children who slept under ITNs and other mosquito nets were less likely to be infected with malaria than those who did not. This finding is similar to other studies reported in

Kenya by Okiro et al. (2007), who found that there was a decline in malaria infection among children under 5 years old because they slept under ITN. For Tanzania, Mmbando et al. (2010) found in their study that a decline in malaria infection was attributed to the use of ITNs. Apinjo et al. (2015) also noted that children who slept under ITNs were less likely to experience malaria fever. In their study in the rural area of Tombel Cameroon, Fokam, Dzi, Ngimuh, & Enyong (2016) found that study participants who slept under LLINs experienced less exposure to mosquitos and therefore saw a decline in malaria episodes. One factor that would have contributed to the finding of this study may be the free distribution of ITN/LLIN during the time of the study (Apinjo et al., 2015). Fokam et al. (2016) noted that free distribution of the net made it easy for children to sleep under the net. Apinjo et al. (2015) further pointed out that bed nets as a tool for controlling malaria could be challenging especially in regards to coverage, proper use, and replacement the old or torn net, and emphasized that education was critical to increase knowledge about the link between mosquitos and malaria, proper use of nets in relation to malaria outcomes, and how to maintain nets for continuous protection and prevention. Fokam et al. (2016), stressed the need for continuous education on the importance of using LLIN to prevent malaria prevalence.

The importance of using ITN has been confirmed in a study from three randomly selected areas in Kenya by Atieli et al. (2011), who found ITN ownership was more than 71% and compliance was 56.3%. Notably, malaria prevalence was lower among ITN users during the malaria high peak season than in non-ITN users. More education on the proper use of ITNs for those who own them is crucial to ensure that malaria is prevented

and controlled. This study found that most people in the rural area owned and used ITNs and LLINs for malaria prevention regardless of their socioeconomic status. This was confirmed in a study by Bennett, et al; (2012) where in rural Sierra-Leon many households were significantly more likely to own and use ITN. Making ITN equitably accessible to all in need, especially in rural areas, should be a priority, and free distribution should be maintained and sustained in order to experience reduction in malaria.

In addition to using ITN as a preventive measure, education and the proper use of antimalarial drugs was examined based on RQ2. The result revealed that 33% of those with secondary education and 7% of those with higher levels of education were likely to CS antimalarial drugs for fever/cough than those with primary or no education. The finding was in agreement with several other studies by Akoria and Arhuidese (2014), Anyanwu, Fulton, Paget, and Evans (2016), Cohen et al. (2012), Exavery et al. (2014), and Onyango et al. (2012). In these studies, educational level played a vital role in antimalarial adherence. People with higher education were more likely to adhere to antimalarial treatment guidelines than those with no education. Moreover, those with higher education were able to read the labels on the medication to ensure that it was not expired. In a similar study, Takem et al. (2009) found that women with higher education were likely to use the full dose of IPT as compared to women with lower education.

Some studies (Khan et al., 2012; Nsagha et al., 2011a), suggest that being educated or having a higher level of education alone does not lead to the proper use or adherence to antimalarial treatment. This is because most people in malaria endemic

countries engaged in self-medication, and the health professionals who are considered the experts act contrary to their profession by prescribing antimalarial without any proper diagnosis of the fever (Khan et al., 2012; Nsagha et al., 2011b). Nkuo-Akenji et al, (2005) found that education of Cameroonian villagers about malaria and the health facility was an important step to improving proper use of malaria prevention tools and reducing malaria morbidity and mortality.

To further understand the importance of healthcare preference and malaria outcome during pregnancy, RQ3 was examined There was a statistically significant association between healthcare preference and the malaria treatment outcome among children under 5 and pregnant women. The use of IPT for malaria treatment during pregnancy is a crucial strategy to control for outcomes such as stillbirth (Onyebuchi, Lawani, Iyoke, Onoh, & Okeke, 2014). Healthcare preference, especially in low resource areas with disease such as malaria, is very important during pregnancy. This is because healthcare preference is often associated with treatment outcome. In a study in rural Ghana, Cofie, Barrington, Singh, Sodzi-Tettey, & Akaligaung (2015) pointed out that rural women who preferred homebirth were unlikely to seek timely care for malaria, and when they did, the treatment outcome for malaria during pregnancy was often stillbirth and maternal mortality as a result of delays in seeking timely care. Cofie, et al. (2015) stressed the importance of pregnant women seeking early antenatal care at healthcare institutions with professional experts instead of engaging in self-care or utilizing home-based care.

Furthermore, based on place of residence, rural dwellers reported more positive malaria infection because they preferred traditional healthcare more than the urban dwellers who preferred modern healthcare. This finding has been reported in studies by Fokunang et al. (2011), Oyekale (2015a), and Towns et al. (2014),. The studies reported that place of residence played a key role in healthcare preference. Those who lived in urban area were likely to take their children either to a public or private clinic for treatment, while those who resided in the rural areas were less likely to visit modern hospitals. They preferred traditional medicine. Nsagha et al. 2011b found that in their study in Ndu, a rural village in Cameroon, villagers were likely to go to a traditional healer before going to get medication from a store or pharmacy. This practice most often led to delayed treatment of a fever and other health consequences. There was a relationship between the use of quinine and anemia levels in children under 5. Studies by Aguwa, Ukue and Adibe (2010) and Monebenimp, Bisong, Chiabi, Chelo, and Moyo-Somo (2010), pointed out that quinine was the first line of treatment for severe malaria for children under 5 years old. Both studies found that some of their patients died as a result of the quinine that was used for treatment and suggested that healthcare professionals needed to be sensitive to promptly identifying anemia levels in children under 5years old in order to reduce the rate of mortality. Parents needed to be educated about the importance of seeking immediate care before fever became severe.

The findings related to RQ4 revealed that several factors including place of residence, sex of head of household, level of education, and wealth index influenced health seeking behavior. The finding for this study revealed that most rural community

members preferred self-medication from medicine sellers on the streets. In their studies, Nsagha et al. (2011b), Khan et al. (2012), and Town et al. (2014) found that most rural people were engaged in self-medication as their first point of treatment for care. Furthermore, the finding from this study revealed that both men and women were likely to seek advice and treatment based their educational level and social status. In agreement with this finding, Anyanwa et al. (2016), Fokunang et al. (2011), Oyekale (2015b), and Towns et al. (2014) confirmed in their various studies that those with higher education were likely higher income earners who could afford to seek care at a private clinic or use public clinic, particularly those who lived in rural areas. Women were less likely to seek care, especially antenatal care, until late in the pregnancy (Hurley et al., 2016). This could be attributed to the fact that male dominance is still eminent in many rural areas when it comes to decisions about where to seek care (Musoke et al., 2014).

Study Results in Relation to the Socioecological Model

The socio-ecological model used in this study provides readers an understanding of how using a theoretical framework guide in health promotion activities at various level of society. The socio-ecological model (SEM) describes the relationships between individuals and their environment. The SEM examines the intricate and interdependencies between socioeconomic, cultural, political, environmental, and organizational determinants of health behavior (Chimphamba, et al, 2012). The SEM is a great evaluative tool proficient in supporting a constant holistic approach during the designing, implementation, and evaluation of health improvement interventions like malaria (Moore, et al, 2011). Evidently, malaria is inextricably linked to many factors

and therefore using this theoretical approach can be a new step to design a sustainable malaria prevention and control strategy in rural Cameroon. In regards to the findings from this study, each of the five levels of the SEM was explained in regards to how level could help improve malaria outcome in rural Cameroon.

At the individual level, a person is responsible for ensuring that they utilize available malaria preventive tool to reduce their risk of malaria infection. This means, that if they own an ITN, they should use it as recommended to reduce their risk of being exposed to mosquito bites. However, Apinjo, et al, 2015 posit that owning an ITN can be great but sometimes it torn or not retreated making it less effective to prevent mosquito bites. This means that if individual has no knowledge about retreating the net or getting a new one, reducing malaria prevalence will tend to be challenging. Moreover, when people belief that malaria is cause by witchcraft, (Nsagha, et al, 2011b) it makes it difficult for them to follow the recommended prevention and control approach. This may explain why the finding showed a small significant between ITN and malaria prevalence. Therefore, continuous education through various available communication means to rural community is important to keep them consistent with utilizing the available tools to prevent malaria.

The second level is interpersonal which identify roles of each one within the household, family and community. Mothers for example, responsible for bearing and raising the children and more often when the children are sick, they seek treatment for their children. Many studies confirm that women were likely to seek and use antimalarial treatment Nkuo-Akenji et al, 2005; Nsagha, et al, 2011b; Fokam, et al, 2016 for their

children. Men are most often the decision maker and depending on their socioeconomic status, education and knowledge about malaria, they help their family members seek timely treatment. Diala et al,2013; Andrew, et al, 2014 found in their studies, that pregnant women who had emotional support from their husband, family and friends were likely to attend antenatal care. Mothers who received health education about malaria saw an improvement in malaria prevalence (Fokam, et al, 2016).

At the community level, many factors could infringe on the uptake of the recommended malaria preventive practices to reduce prevalence. Some of these factors include drug use practice which is based on socioeconomic factors like income, educational level, and knowledge about the disease (Anyanwu, et al, 2016). These factors are important for treatment seeking behavior and drug use among individuals, household and communities. Lack of knowledge about malaria treatment guidelines and the use of self-medication have led to continuous increase in malaria incidence (Nsagha, et al, 2011a). It is important to streamline prevention and control strategies to rural communities. There are other determinant factors for proper use of ITN, use of antimalarial, where to seek care and the socioeconomic status of most rural people makes it extremely difficult for them to establish a consistent malaria prevention and control practice.

The organizational level provides and avenue where community organizations and groups can challenge themselves to set community norms on combating malaria. From a personal experience growing up in a rural village, there was one day in a week that was meant for community members to clean their yards and homes with a price

given to the cleanest home. This approach made people to be conscious about the up keep of their immediate environment. Nsagha, et al, (2011a) points out that effective malaria prevention and control require community involvement. This will help them to identify malaria as a health problem in their community and design strategies which take into account cultural belief and norms that will hopefully lead to local member become active in malaria prevention and control.

The policy level provides an opportunity for policy makers to improve strategies on prevention efforts to target vulnerable communities and groups. Lack of malaria knowledge, well equipped health clinics, poor road network, lack of well-trained health professionals are some of the reasons listed in studies by, Nsagha, et al, 2011a; Diala et al, 2013; Andrew, et al, 2014; Apinjo,et al, 2015. Findings from these studies should serve as a road map for policy makers to develop new achievable malaria prevention goals. The distribution of free ITN, and making malaria treatment for children under 5years are great efforts in making easy for especially poor rural people but these efforts will be futile if other conditions like good public clinic, good roads, well trained health professionals, and constant supply of recommended antimalarial drugs are not in place. It is important that health officials set up mechanisms using latest technology to enable most vulnerable population have access to care when they need medical attention. The use of the SEM in this study provided possible potentials for rural community members to engage in proper utilization of the available malaria prevention tools to reduce morbidity and mortality within communities.

Limitations of the Study

The use of secondary data in analyzing malaria problems in rural Cameroon does not cure the malaria problem. The limitations that comes with using a secondary data was unavoidable in this study. Inherent with secondary data, the DHS data was not designed to answer specific research question or hypothesis and therefore some variables had to be re-categorized to address the questions in this study. This might have resulted to some errors and hindered the result of the study (Cheng &Phillips, 2014). Furthermore, the DHS data is secondary data which made it difficult to ensure quality of the data that I used for my analysis. The DHS reported some missing variables for example, there were no data for malaria treatment for pregnant women.. As a result, this may have affected the validity of the result of this study. Moreover, the data used for this study may be old and therefore, not a representative of the current malaria problem in Cameroon.

The results of this study were limited to rural communities in Cameroon and therefore cannot be generalized to urban areas or the country as a whole. Moreover, using secondary data in analyzing malaria problem in rural Cameroon does not solve the malaria problem.

Recommendations

This study was based on a quantitative cross-sectional design aimed to examine the association between sleeping under ITN and malaria prevalence in children under 5years old. there was a significant association between the proper use of ITNs and the prevalence of malaria among children under 5 years old. Children who slept under ITNs were less likely to be infected with malaria than those who did not. Considering that the

public health officials in Cameroon provide free ITNs, it is recommended that local health officials and rural stakeholders engage in the equal distribution of these free ITNs as important strategy to reduce inequality in ITNs ownership. When there is equal distribution of ITNs and ownership, more emphasis through education on the proper use of the ITNs using local signs and symbols and engaging community members in malaria awareness activities should be provided. In this way, people will gain more understanding on what malaria is and why it is important that children sleep every night under an ITN.

The study result revealed that there was a significant association between education and the proper use of antimalarial drugs. The people with secondary education and higher education were more likely to use antimalarial drugs than those with no education. It is recommended that public health official should design a program on educating the public on malaria and the proper use of antimalarial. Another recommendation is for local health officials to adopt a strategy that would enhance public health education within the community on malaria management at home and provide training to drug sellers to properly dispense the right antimalarial drug. There was a significant association between the socioeconomic status of the rural community and their health-seeking behavior. Those who were rich were likely to seek treatment than those who were poor. Other factors that influence health-seeking behavior and healthcare preference like distance to the nearest heath center, quality of care provided, availability of medication, and lack of health infrastructure within a locality. Nsagha, et al, (2011a) points out in their study that self-medication was a very popular practice in rural Cameroon and as a result of poor infrastructure. Poor people were likely to seek care

from traditional healers. This means that a greater focus of local health officials should be on evidence based and community-based approach about the effective interventions aimed at reducing inequalities within communities in the malaria prevention and control effort. The inequalities that exist in rural communities prevent members from accessing effective malaria prevention and treatment options. Public health officials in Cameroon should address the problem of inadequate public health infrastructure which serve as the main source of care in rural areas. Regulations should be in place to ensure that the chain of antimalarial drug supply to rural communities is consistent and that public health infrastructures are built and sufficiently staffed to provide quality service.

Future research should focus on community perceptions and treatment seeking behavior for malaria in rural Cameroon: implication for disease control. Descriptive studies and locally specific data collecting on the care seeking process for malaria would inform programmatic efforts to target the most vulnerable communities. Community-based integrated approach has been used to improve malaria intervention programs in malaria stricken communities and have proven to be effective in reducing malaria burden (Salam, et al., 2014). Therefore, using an integrative approach in malaria prevention and control in rural Cameroon may bring some improvement in malaria prevention and control efforts.

Implication for Social Change

The findings from this study suggest that the proper use of ITN may significantly reduce malaria prevalence among children under 5years old, education may influence proper use of antimalarial drugs, healthcare preference depending on type of treatment

may influence pregnancy outcome and reduce level of anemia in children, and the socioeconomic status of a person may influence their health seeking behavior. These results may assist in promoting social change by helping the Cameroon policymakers and public health officials to engage in more robust strategies to ensure that current malaria prevention and control resources are in constant supply in rural communities. Furthermore, in addition to the proper use of current malaria prevention resources, an integrated strategy should be part of a comprehensive approach involving community members to engage in malaria prevention and control. Through the creation of malaria specific programs within each local community, awareness about malaria would be increased. Increase in malaria knowledge and economic capacity building will empower people in malaria communities with the understanding that they can use available resources and engage in promoting malaria prevention practices within their communities to reduce malaria.

Those who are rich are likely to seek care than those who are poor. Poverty per Ricci (2012) is a big hindrance to malaria prevention and control especially in rural areas because poverty is multidimensional. Understanding the multidimension of poverty is important for policy makers and public health to come up with strategies that will address the poverty experienced by the rural people. A robust malaria prevention and control strategy that will promote positive social change in rural communities will require policy makers and public health officials to engage in improving quality of life for rural communities in Cameroon. They would focus on providing good roads, clean water, schools, and hospitals with professional givers and consistent supply of medical

resources. These strategies are crucial to alleviating emotional and financial constraints on rural community members who often are inflicted by malaria and its complications. If these strategies are implement accordingly, it will enable policy makers and public health officials to always prioritize the needs of the rural communities to ensure their needs are always met. Finally, findings from this study can help policy makers to re-engage their efforts in an integrated approach to reduce the burden of malaria in rural Cameroon.

Conclusion

The results of this study underline the importance of health education, particularly malaria education to raise community awareness about the proper uses of available tools for malaria prevention and control. Understanding the need for rural people to be knowledgeable about malaria in regards to proper use of antimalarial drug, use of ITN and where to seek care is an important step for health officials in Cameroon to rethink about preventive efforts. It important for policy makers to create partnership with rural communities to better understand their needs and enable government and international donor agencies to provide needed resources. For example, partnering with the Global Fund which funds the Affordable Medicine Facility for malaria (AMFm) will provide access to inexpensive and effective antimalarial treatment to rural people.

An integrated approach to malaria prevention and control in rural Cameroon is a great strategy to deliver malarial specific interventions including, proper use of ITN, antimalarial drug, improve socioeconomic situation, and malaria education in an effort to reduce the burden of malarial morbidity and mortality in rural communities especially among vulnerable groups like children under 5years old and pregnant women. In their

study, Musoke et al, (2013), found that using multiple methods in an integrated malaria prevention approach was appreciated by the rural community members in Uganda. Besides the proper use of available malaria preventive tools, like ITNs, and antimalarial drugs, rural community members can also engage in other methods like ensuring that windows are screened, closing doors and windows early, destroying mosquito sites in addition malaria education to reduce malaria prevalence. Studies by Hamel, et al, (2011); Fullman, Burstein, Lim, Medlin, & Gakidou, (2013); Musoke, et al, (2013), have shown that using a combination of ITN and Indoor Residual Spraying (IRS) or multiple method as stated above can reduce exposure to mosquito bites and malaria infection. A well planned integrated malaria prevention and control strategy for future efforts must involve using multiple methods with education and continuous emphasis on the proper use of current prevention methods. If implemented correctly and followed through rural communities will witness a reduction in malaria morbidity and mortality. Future studies such as a pilot study is recommended to further explore using an integrated approach in malaria prevention at the household level in rural communities in Cameroon.

References

Abdullahi, A.A., Zyl-Schalekamp, C.V., & Seneke, A. (2013). Perceived Threat of Malaria and the Use of Insecticide Treated Bed Nets in Nigeria. *African Sociological Review, 17*(1), 25-44.

Abdullahi, A. A. (2011). Trends and challenges of traditional medicine in Africa. *African Journal of Traditional, Complementary, and Alternative Medicines*, *8*(5 Suppl), 115–123. http://doi.org/10.4314/ajtcam.v8i5S.5

Abraham, C., Clift, S., Grabowski, P. (1999) Cognitive predictors of adherence to malaria prophylaxis regimens on return from a malarious region: A prospective study. *Social Science & Medicine*; 48:1641–1654. https://doi.org/10.1016/s0277-9536(98)00455-9

Adedokun, O. & Adeyemi, G.E. (2013). Mother's socio-economic status and malaria prevention: implications for infant mortality in Nigeria. *Humanities and Social Sciences Review*, *2*(4):65–82.

Achidi, E. A., Apinjoh, T. O., Anchang-Kimbi, J. K., Mugri, R. N., Ngwai, A. N., & Yafi, C. N. (2012). Severe and uncomplicated falciparum malaria in children from three regions and three ethnic groups in Cameroon: prospective study. *Malaria Journal, 11,* 215. http://doi.org/10.1186/1475-2875-11-215

ACT Consortium, London School of Hygiene & Tropical Medicine (2010). The REACT facilitator and participant manuals on improving malaria diagnosis and treatment and on improving the quality of care. Retrieved from http://www.actconsortium.org/data/files/WMD2016/R2/20_Improving_quality_of

_care_for_management_of_suspected_malaria_training_programme_for_health_workers_Facilitators_Manual.2-52.pdf

Adebayo, A. M., Akinyemi, O. O., & Cadmus, E. O. (2015). Knowledge of malaria prevention among pregnant women and female caregivers of under-five children in rural southwest Nigeria. *PeerJ, 3,* e792. http://doi.org/10.7717/peerj.792

Adepoju E.G, Onajole A.T, Oreagba L.O, Odeyemi K.A, Ogunnowo B.O, & Olayemi S.O. (2005). Health education and caregivers' management of malaria among under-fives in Ede North L.G.A, Osun State of Nigeria. *Nigeria Medical Practice, 48*, 72–78.

Agbor, A. M., & Naidoo, S. (2011). Knowledge and practice of traditional healers in oral health in the Bui Division, Cameroon. *Journal of Ethnobiology and Ethnomedicine, 7,* 6. http://doi.org/10.1186/1746-4269-7-6

Aguwa, C.N., Ukue, C.V., & Adibe, M.O. (2010). A Comparative Study of Quinine and Artemether in the Treatment of Severe Malaria in Nigerian Children. *Tropical Journal of Pharmaceutical Research, 9*(1), 11-17.

Ajayi, I. O., Browne, E. N., Bateganya, F., Yar, D., Happi, C., Falade, C. O., … Pagnoni, F. (2008). Effectiveness of artemisinin-based combination therapy used in the context of home management of malaria: A report from three study sites in sub-Saharan Africa. *Malaria Journal, 7,* 190. http://doi.org/10.1186/1475-2875-7-190

Ajibade, B.L. & Alao, M.T. (2013). Mothers' Action and Preferences of Treatment of Febrile Illnesses among under- five -year- old Children in Osun State. *Journal of Biology, Agriculture, and Healthcare, 3*(7),148-15.

Akoria, O.A & Arhuidese, I.J. (2014). Progress toward elimination of malaria in Nigeria: Uptake of artemisinin-based combination therapies for the treatment of malaria in households in Benin City. *Annals of African Medicine, 13*(3), 104-113. https://doi.org/10.4103/1596-3519.134383

Amoran, O.E. (2013). Impact of health education intervention on malaria prevention practices among nursing mothers in rural communities in Nigeria. *Nigerian Medical Journal, 54*(2), 115–122. https://doi.org/10.4103/0300-1652.110046

Andrew, E. V. W., Pell, C., Angwin, A., Auwun, A., Daniels, J., Mueller I., . . . Pool, R. (2014) Factors affecting attendance at and timing of formal antenatal care: Results from a qualitative study in Madang, Papua New Guinea. *PLoS ONE, 9*(5): e93025. https://doi.org/10.1371/journal.pone.0093025

Anyanwu P. E., Fulton, J., Paget, T., Evans, E. (2016) Socioeconomic determinants of antimalarial drug use behaviours: A systematic review. *Journal of Community Public Health Nursing, 2,* 123. https://doi.org/10.4172/2471-9846.1000123

Antonio- Nkondjio, C., Atangana, J., Ndo, C., Awono-Ambene, P., Fondjo, E, Fontenille, D. & Simard, F., (2008). Malaria transmission and rice cultivation in Lagdo, Northern Cameroon. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 102,* 352-359.

Antonio-Nkondjio, C., Defo-Talom, B., Tagne-Fotso, R., Tene-Fossog, B., Ndo, C., Lehman, L. G., . . . Awono-Ambene, P. (2012). High mosquito burden and malaria transmission in a district of the city of Douala, Cameroon. *BMC Infectious Diseases*, *12*, 275. https://doi.org/10.1186/1471-2334-12-275

Antonio-Nkondjio, C., Demanou, M., Etang, J., & Bouchite, B. (2013). Impact of cyfluthrin (Solfac EW050) impregnated bed nets on malaria transmission in the City of Mbandjock : Lessons for the nationwide distribution of long-lasting insecticidal nets (LLINs) in Cameroon. *Parasites & Vectors*, *6*, 10. http://doi.org/10.1186/1756-3305-6-10

Apinjoh, T. O., Anchang-Kimbi, J. K., Mugri, R. N., Tangoh, D. A., Nyingchu, R. V., Chi, H. F., . . . Achidi, E. A. (2015). The Effect of Insecticide Treated Nets (ITNs) on Plasmodium falciparum Infection in Rural and Semi-Urban Communities in the South West Region of Cameroon. *PLoS ONE*, *10*(2), e0116300. https://doi.org/10.1371/journal.pone.0116300

Arrow, K, J, Panosian, C., & Gelband, H. (Eds). (2004). *Saving lives, buying time: Economics of malaria drugs in an age of resistance.* Institute of Medicine (US) Committee on the Economics of Antimalarial Drugs. Washington, DC: National Academies Press. Available from http://www.ncbi.nlm.nih.gov/books/NBK215620/

Astatkie, A. (2010). Knowledge and Practice of Malaria Prevention Methods Among Residents of Arba Minch Town and Arba Minch Zuria District, Southern Ethiopia. *Ethiopian Journal of Health Sciences*, *20*(3), 185–193.

Ataka, Y., Inaoka, T., & Ohtsuka, R. (2011). Knowledge, Attitudes and Practices Relevant to Malaria Control in Remote Island Populations of Manus, Papua New Guinea. *Tropical Medicine and Health, 39*(4), 109–117. http://doi.org/10.2149/tmh.2011-14

Atieli, F. K., Munga, S. O., Ofulla, A. V., & Vulule, J. M. (2010). The effect of repeated washing of long-lasting insecticide-treated nets (LLINs) on the feeding success and survival rates of *Anopheles gambiae*. *Malaria Journal, 9*(1):304. https://doi.org/10.1186/1475-2875-9-304

Atieli, H. E., Zhou, G., Afrane, Y., Lee, M.-C., Mwanzo, I., Githeko, A. K., & Yan, G. (2011). Insecticide-treated net (ITN) ownership, usage, and malaria transmission in the highlands of western Kenya. *Parasites & Vectors*, *4*, 113. http://doi.org/10.1186/1756-3305-4-113

Bartholomew, L. K., Parcel, G., Kok, G., & Gottlieb, N. H. (2006). Behavior-oriented theories used in health promotion. In J. Allegrante & K. McLeroy (Eds.), *Planning Health Promotion Programs* (pp. 81-135). San Francisco, CA: Jossey-Bass.

Bardají, A., Sigauque, B., Sanz, S., Maixenchs, M., Ordi, J., Aponte, J. J., Menéndez, C. (2011). Impact of malaria at the end of pregnancy on infant mortality and morbidity. *Journal of Infectious Diseases*, *203*(5), 691–699. https://doi.org/10.1093/infdis/jiq049

Basco, L.K. (2004). Molecular Epidemiology of Malaria in Cameroon. Xix. Quality of Antimalarial Drugs Used For Self-Medication. *American Journal of Tropical Medicine and Hygiene*, *70*(3), 245-250. Retrieved from http://www.ajtmh.org/content/70/3/245.full.pdf

Beer, N, Ali, A.S, Eskilsson, H, Jansson, A, Abdul-Kadir, F.M, Rotllant-Estelrich G, et al., (2012). A qualitative study on caretakers' perceived need of bed-nets after

reduced malaria transmission in Zanzibar, Tanzania. *BMC Public Health, 12*(1), 606. https://doi.org/10.1186/1471-2458-12-606

Bennett, A., Smith, S. J., Yambasu, S., Jambai, A., Alemu, W., Kabano, A., & Eisele, T. P. (2012). Household possession and use of insecticide-treated mosquito nets in Sierra Leone 6 months after a national mass-distribution campaign. *PLoS ONE*, *7*(5), e37927. http://doi.org/10.1371/journal.pone.0037927

Bhatt, S., & Gething, P. (2014). Insecticide-treated nets (ITNs) in Africa 2000-2016: coverage, system efficiency and future needs for achieving international targets. Malaria Journal, 13(Suppl 1), O29. http://doi.org/10.1186/1475-2875-13-S1-O29

Biadgilign, S., Reda, A., & Kedir, H. (2012). Determinants of ownership and utilization of insecticide-treated bed nets for malaria control in eastern ethiopia. *Journal of Tropical Medicine, 2012,* 1-7. https://doi.org/10.1155/2012/235015

Bisong, C.E., & Dongmo, C.M. (2013). Utilization of malaria prevention methods by pregnant women in Yaounde. *The Pan African Medical Journal*, 89. Doi:10.11604/pamj.2013.15.89.2324

Breman, J.G. (2001). The ears of the hippopotamus: manifestations, determinants, and estimates of the malaria burden. *American Journal of Tropical Medicine Hygiene*, 64:1–11

Briand, V., Cottrell, G., Massougbodji, A., & Cot, M. (2007). Intermittent preventive treatment for the prevention of malaria during pregnancy in high transmission areas. *Malaria Journal*, *6*, 160. doi:10.1186/1475-2875-6-160

Bonono R.C., Ongolo-Zogo P. (2012). Optimizing the use of antenatal care services in Cameroon. Centre for Development of Best Practices in Health – Central Hospital Yaoundé, Cameroon.

Boslaugh, S. (2007). *Secondary data sources for public health: A practical guide*. United Kingdom: Cambridge University Press.

Boudová, S., Cohee, L. M., Kalilani-Phiri, L., Thesing, P. C., Kamiza, S., Muehlenbachs, A., Laufer, M. K. (2014). Pregnant women are a reservoir of malaria transmission in Blantyre, Malawi. *Malaria Journal*, *13*, 506. https://doi.org/10.1186/1475-2875-13-506

Bousema, T., Drakeley, C., Gesase, S., Hashim, R., Magesa, S., Mosha, F., Msuya, E. (2010). Identification of hot spots of malaria transmission for targeted malaria control. *Journal of Infectious Diseases,* 201(11), 1764-1774.

Bowen, H. (2013). Impact of a mass media campaign on bed net use in Cameroon. *Malaria Journal, 12,* 36. https://doi.org/10.1186/1475-2875-12-36

Cameroon Coalition Against Malaria Program. (2011). Policy brief on scaling up malaria prevention in Cameroon. Retrieved from http://www.who.int/alliance-hpsr/projects/alliancehpsr_policybriefscalingupmalariacameroon.pdf

Cameroon DHS-MICS. (2011). Preliminary report [PR13] (in French). Available online at: http://www.measuredhs.com/pubs/pdf/PR13/PR13.pdf

Cameroon. (2011). In *Encyclopedia Britannica*. Retrieved from: http://www.britannica.com/EBchecked/topic/90925/Cameroon

Centers for Disease Control and Prevention. (2008). Anopheles mosquitoes Division of parasitic diseases. Atlanta: Retrieved from: http://www.cdc.gov/malaria/biology/mosquito/

Centers for Disease Control and Prevention. (2014a). CDC and malaria. Retrieved from http://www.cdc.gov/malaria/

Centers for Disease Control and Prevention. (2014b). Insecticide treated bed nets. Retrieved from http://www.cdc.gov/malaria/malaria_worldwide/reduction/itn.html

Centers for Disease Control and Prevention (2015). The social ecological model: A framework for prevention. Retrieved from http://www.cdc.gov/violenceprevention/overview/social-ecologicalmodel.htm

Central Intelligence Agency. (2016). Cameroon map. In *The world factbook*. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/br.html

Central Intelligence Agency. (2015). Africa: Cameroon. *In The world factbook*. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/br.html

Cheng, H. G., & Phillips, M. R. (2014). Secondary analysis of existing data: opportunities and implementation. *Shanghai Archives of Psychiatry*, *26*(6), 371–375. http://doi.org/10.11919/j.issn.1002-0829.214171

Chimphamba, B.G., Fjeld, H., Chirwa, E., Sundby, J., Malata, A., & Maluwa, A. (2012). A Social Ecological Approach to Exploring Barriers to Accessing Sexual and Reproductive Health Services among Couples Living with HIV in Southern Malawi. *Public Health*, doi:10.5402/2012/825459

Chuma, J., V. Okungu and C. Molyneux, 2010. The economic costs of malaria in four Kenyan districs. Do household costs differ by disease endemicity? *Malaria Journal*., 9: 149-149.

Clouston, S. A. P., Yukich, J., & Anglewicz, P. (2015). Social inequalities in malaria knowledge, prevention and prevalence among children under 5 years old and women aged 15–49 in Madagascar. *Malaria Journal*, *14*, 499. http://doi.org/10.1186/s12936-015-1010-y

Cofie, L. E., Barrington, C., Singh, K., Sodzi-Tettey, S., & Akaligaung, A. (2015). Birth location preferences of mothers and fathers in rural Ghana: Implications for pregnancy, labor and birth outcomes. *BMC Pregnancy and Childbirth*, *15*, 165. http://doi.org/10.1186/s12884-015-0604-2

Cohen, J. L., Yavuz, E., Morris, A., Arkedis, J., & Sabot, O. (2012). Do patients adhere to over-the-counter artemisinin combination therapy for malaria? evidence from an intervention study in Uganda. *Malaria Journal*, *11*, 83. http://doi.org/10.1186/1475-2875-11-83

Conner, M. & Norman, P. (1996). *Predicting Health Behavior. Search and Practice with Social Cognition Models.* Open University Press: Ballmore: Buckingham.

Corsi, D. J., Neuman, M., Finlay, J. E., & Subramanian, S. V. (2012) Demographic and health surveys: a profile. *International Journal of Epidemiology, 41*(6), 1602-1613. https://doi.org/10.1093/ije/dys184

Creswell, J. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd Ed). Thousand Oaks, CA: Sage Publications.

Cropley L. (2004) The effect of health education interventions on child malaria treatment seeking practices among mother in rural refugee village in Belize, Central America. *Health Promotion International,19,* 445–452.

Dairo, M.D. & Owoyokun, K.E. (2010). Factors Affecting the Utilization of Antenatal Care Services in Ibadan, Nigeria. Benin Journal of Postgraduate Medicine. 2010; 12:5–7.

Danso-Appiah, A., Stolk, W. A., Bosompem, K. M., Otchere, J., Looman, C. W. N., Habbema, J. D. F., & de Vlas, S. J. (2010). Health Seeking Behaviour and Utilization of Health Facilities for Schistosomiasis-Related Symptoms in Ghana. PLoS Neglected Tropical Diseases, 4(11), e867. http://doi.org/10.1371/journal.pntd.0000867De La Cruz, N., Crookston, B., Dearden, K., Gray, B., Ivins, N., Alder, S., & Davis, R. (2006). Who sleeps under bednets in Ghana? A doer/non-doer analysis of malaria prevention behaviours. *Malaria Journal*, 5, 61. http://doi.org/10.1186/1475-2875-5-61

Dellicour, S., Tatem, A. J., Guerra, C. A., Snow, R. W., & ter Kuile, F. O. (2010). Quantifying the Number of Pregnancies at Risk of Malaria in 2007: A Demographic Study. *PLoS Medicine*, *7*(1), e1000221. doi: 10.1371/journal.pmed.1000221

Demographic and Health Survey and Multiple Indicator Cluster Survey (2012) DHS-MICS 2011. Preliminary report.

Deressa, W., Ali, A., & Enqusellassie, F. (2003). Self-treatment of malaria in rural communities, Butajira, southern Ethiopia. *Bulletin of the World Health Organization, 81*(4), 261–268.

Desai, M., ter Kuile, F. O , Nosten, F., McGready, R., Asamoa, K., Brabin, B., & Newman, R. D. (2007). Epidemiology and burden of malaria in pregnancy. *Lancet Infectious Disease, 7,* 93-104. http://dx.doi.org/10.1016/S1473-3099(07)70021-X

Diala, C. C., Pennas, T., Marin, C., & Belay, K. A. (2013). Perceptions of intermittent preventive treatment of malaria in pregnancy (IPTp) and barriers to adherence in Nasarawa and cross River State in Nigeria. *Malaria Journal, 12*(1), 342. https://doi.org/10.1186/1475-2875-12-342

DiClemente, R. J., Salazar, L. F., & Crosby, R. A. (2007). A review of STD/HIV preventative interventions for adolescents: Sustaining effects using an ecological approach. *Journal of Pediatric Psychology*, 32 (8), 888–906.

Eisele, T. P., Larsen, D., & Steketee, R. W. (2010). Protective efficacy of interventions for preventing malaria mortality in children in Plasmodium falciparum endemic areas. *International Journal of Epidemiology, 39*(Suppl 1), i88–i101. http://doi.org/10.1093/ije/dyq026

Eisele, T.P, Keating, J., Littrell, M., Larsen, D., & Macintyre, K. (2009). Assessment of insecticide-treated bednet use among children and pregnant women across 15 countries using standardized national surveys. *American Journal of Tropical Medicine and Hygiene, 80*(2):209–14.

Elder, J. P., Lytle, L., Sallis J. F., Young, D. R., Steckler, A., Simons-Morton, D., . . . Ribisl, K., (2007). A description of the social-ecological framework used in the trial of activity for adolescent girls (TAAG). *Health Education Research, 22*(2), 155–165. https://doi.org/10.1093/her/cyl059

Euroclinix. (2015). Malaria transmission cycle. Retrieved from http://www.euroclinix.co.uk/malaria-transmission.html

Ewa, E.E., C.J. Lasisi, S.O. Maduka, A.E. Ita, U.W. Ibor and O.A. Anjorin, (2012). Perceived factors influencing the choice of antenatal care and delivery Centres among childbearing women in ibadan north south-western, Nigeria. Ethiopian J. Environ. Stud. Manage., 5: 373-383.

Exavery, A., Mbaruku, G., Mbuyita, S., Makemba, A., Kinyonge, I. P., & Kweka, H. (2014). Factors affecting uptake of optimal doses of sulphadoxine-pyrimethamine for intermittent preventive treatment of malaria in pregnancy in six districts of Tanzania. *Malaria Journal*, *13*, 22. http://doi.org/10.1186/1475-2875-13-22

Faul, F., Erdfelder, E., Lang, A.G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39,175-191.

Farquharson, L., Noble, L. M., Barker, C. & Behrens, R. H. (2004), Health beliefs and communication in the travel clinic consultation as predictors of adherence to malaria chemoprophylaxis. *British Journal of Health Psychology*, 9: 201–217. doi: 10.1348/135910704773891050

Fokam, E.B., Dzi, K.T.J., Ngemuh, L., & Enyong, P. (2016). The effect of long lasting insecticide bed net use on malaria prevalence in the Tombel Health District, South West Region -Cameroon. *Malaria Research and Treatment*, *2016,* 1-6. https://doi.org/10.1155/2016/3216017

Fokunang, C., Ndikum, V., Tabi, O., Jiofack, R., Ngameni, B., Guedje, N., … Kamsu-Kom. (2011). Traditional Medicine: Past, Present and Future Research and Development Prospects and Integration in the National Health System of Cameroon. *African Journal of Traditional, Complementary, and Alternative Medicines*, *8*(3), 284–295.

Frank, T. & Kallander, K. (2012). Developing intervention strategies: innovations to improve community health worker motivation and performance. Retrieved from http://www.malariaconsortium.org/media-library/media-files/201303130613-inscale-learning-paper---march-2013.pdf

Frankfort-Nachmias, C., & Nachmias, D., (2008). *Research methods in the social sciences*. (7th Ed). New York, NY: Worth Publishing.

Fraser N., & Druce N. (2006). Partnerships for malaria control: Engaging the formal and informal private sectors, a review. Geneva: Special Programme for Research and Training in Tropical Diseases (TDR); 2006

Frech, C., & Chen, N. (2011). Genome Comparison of Human and Non-Human Malaria Parasites Reveals Species Subset-Specific Genes Potentially Linked to Human Disease. *PLoS Computational Biology*, *7*(12), e1002320. http://doi.org/10.1371/journal.pcbi.1002320

Fru-Cho, J., Bumah, V. V., Safeukui, I., Nkuo-Akenji, T., Titanji, V. P. K., & Haldar, K. (2014). Molecular typing reveals substantial plasmodium vivax infection in asymptomatic adults in a rural area of Cameroon. *Malaria Journal, 13,* 170. https://doi.org/10.1186/1475-2875-13-170

Fugard, A.J.B. & Potts, H W.W. (2015). Supporting thinking on sample sizes for thematic analyses: a quantitative tool. *International Journal of Social Research Methodology* 18:6, pages 669-684.

Fullman, N., Burstein, R., Lim, S. S., Medlin, C., & Gakidou, E. (2013). Nets, spray or both? The effectiveness of insecticide-treated nets and indoor residual spraying in reducing malaria morbidity and child mortality in sub-Saharan Africa. *Malaria Journal*, *12*, 62. http://doi.org/10.1186/1475-2875-12-62

Gallup, J. L. & Sachs, J. D. (2001). The economic burden of malaria. In J. G. Breman, A. Egan, & G. T. Keusch (Eds.), *The intolerable burden of malaria: A new look at the numbers* (Suppl. to Vol. 64, No. 1 of the *American Journal of Tropical Medicine and Hygiene*). Northbrook, IL: American Society of Tropical Medicine and Hygiene Available from: http://www.ncbi.nlm.nih.gov/books/NBK2624/

Gething, P. W., Kirui, V. C., Alegana, V. A., Okiro, E. A., Noor, A. M., & Snow, R. W. (2010). Estimating the number of paediatric fevers associated with malaria infection

presenting to Africa's public health sector in 2007. *PLoS Medicine*, 7(7), e1000301.

George, S. & Marasciulo, M. (2012). Developing and implementing training materials for integrated community case management in South Sudan Retrieved from http://www.malariaconsortium.org/media-downloads/182/Developing and implementing training materials for integrated com

Ghahremani, L., Faryabi, R., & Kaveh, M.H. (2014). Effect of health education based on the protection motivation theory on malaria preventive behaviors in rural household of Kerman, Iran. *International Journal of Preventive Medicine, 5*(4), 463-471.

Gilmore, B., & McAuliffe, E. (2013). Effectiveness of community health workers delivering preventive interventions for maternal and child health in low- and middle-income countries: a systematic review. *BMC Public Health*, 13, 847. http://doi.org/10.1186/1471-2458-13-847

Glanz, K., Rimer, B.K. & Lewis, F.M. (2002). *Health Behavior and Health Education. Theory, Research and Practice.* San Fransisco: Wiley & Sons.

Glanz, K., Rimer, B.K., & Viswanath, K. (Eds). (2008). *Health behavior and health education: theory, research, and practice.* (4th Ed). San Francisco, CA. John Wiley & Sons.

Gogtay, N. J. (2010). Principles of sample size calculation. *Indian Journal of Ophthalmology*, *58*(6), 517–518. http://doi.org/10.4103/0301-4738.71692

Gomes, M., Wayling, S., & Pang, L. (1998). Interventions to improve the use of antimalarials in south-east Asia: an overview. Bulletin of the World Health Organization, 76(Suppl 1), 9–19.

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., Strupp, B., & the International Child Development Steering Group. (2007). Developmental potential in the first 5 years for children in developing countries. *Lancet*, *369*(9555), 60–70. https://doi.org/10.1016/s0140-6736(07)60032-4

Graz, B., Kitua, A.Y., & Malebo, H.M. (2011). To what extent can traditional medicine contribute a complementary or alternative solution to malaria control programmes? *Malaria Journal,* 10(Suppl 1): S6. doi:10.1186/1475-2875-10-S1-S6

Griffin, J. T., Hollingsworth, T. D., Okell, L. C., Churcher, T. S., White, M., Hinsley, W., … Ghani, A. C. (2010). Reducing Plasmodium falciparum Malaria Transmission in Africa: A Model-Based Evaluation of Intervention Strategies. PLoS Medicine, 7(8), e1000324. http://doi.org/10.1371/journal.pmed.1000324

Griffiths, S.M., Tang, T.L., & Yeoh, E.K. (Eds). (2014). *Routledge handbook of global public health in Asia*. New York, NY. Routledge.

Guyatt, H. L., & Snow, R. W. (2004). Impact of Malaria during Pregnancy on Low Birth Weight in Sub-Saharan Africa. *Clinical Microbiology Reviews*, *17*(4), 760–769. doi:10.1128/CMR.17.4.760-769.

Halle-Ekane, G.E., Obinchemti, T.E., Nzang, J.-L.N., Mokube, N.M., Njie, M.M., Njamen, T.N. & Nasah, B.T. (2014) Assessment of the Content and Utilization of Antenatal Care Services in a Rural Community in Cameroon: A Cross-Sectional Study. Open *Journal of Obstetrics and Gynecology*, *4,* 846-856. http://dx.doi.org/10.4236/ojog.2014.414119

Halliday, K. E., Okello, G., Turner, E. L., Njagi, K., Mcharo, C., Kengo, J., … Brooker, S. J. (2014). Impact of Intermittent Screening and Treatment for Malaria among School Children in Kenya: A Cluster Randomised Trial. PLoS Medicine, 11(1), e1001594. http://doi.org/10.1371/journal.pmed.1001594

Hamel, M. J., Otieno, P., Bayoh, N., Kariuki, S., Were, V., Marwanga, D., … Gimnig, J. (2011). The Combination of Indoor Residual Spraying and Insecticide-Treated Nets Provides Added Protection against Malaria Compared with Insecticide-Treated Nets Alone. *The American Journal of Tropical Medicine and Hygiene*, *85*(6), 1080–1086. http://doi.org/10.4269/ajtmh.2011.10-0684

Hay, S. I., Guerra, C. A., Gething, P. W., Patil, A. P., Tatem, A. J., Noor, A. M., … Snow, R. W. (2009). A World Malaria Map: Plasmodium falciparum Endemicity in 2007. PLoS Medicine, 6(3), e1000048. http://doi.org/10.1371/journal.pmed.1000048

Hetzel, M. W., Gideon, G., Lote, N., Makita, L., Siba, P. M., & Mueller, I. (2012). Ownership and usage of mosquito nets after four years of large-scale free distribution in Papua New Guinea. *Malaria Journal*, 11, 192. http://doi.org/10.1186/1475-2875-11-192

Hill, J., Hoyt, J., van Eijk, A. M., D'Mello-Guyett, L., ter Kuile, F. O., Steketee, R., . . . Webster, J. (2013). Factors affecting the delivery, access, and use of interventions to prevent malaria in pregnancy in Sub-Saharan Africa: A systematic review and meta-analysis. *PLoS Medicine, 10*(7), e1001488. http://doi.org/10.1371/journal.pmed.1001488

Hillenbrand, E. (2006). 'Improving traditional-conventional medicine collaboration: perspectives from cameroonian traditional practitioners' *Nordic Journal of African Studies, 15*(1), 1–15.

Hurley, E. A., Harvey, S. A., Rao, N., Diarra, N. H., Klein, M. C., Diop, S. I., & Doumbia, S. O. (2016). Underreporting and Missed Opportunities for Uptake of Intermittent Preventative Treatment of Malaria in Pregnancy (IPTp) in Mali. *PLoS ONE*, *11*(8), e0160008. http://doi.org/10.1371/journal.pone.0160008

Ibor, U.W., Aigbe, G.O., Iwara, A.I., Okongor, O.E., & Okino, I.I. (2012). Ownership and Utilization of Insecticide Treated Nets in Cross River State, Nigeria. Journal of Medical Sciences, 12: 198-206. DOI: 10.3923/jms.2012.198.206

Idro, R., Marsh, K., John, C. C., & Newton, C. R. (2010). Cerebral malaria: Mechanisms of brain injury and strategies for improved neuro-cognitive outcome. *Pediatric Research*, *68*(4), 267–274. ttps://doi.org/10.1203/pdr.0b013e3181eee738

Jamison, D. T., Breman, J. G., Measham, A. R., Alleyne, G., Claeson, M., Evans, D. B., . . . Musgrove, P. (Eds). (2006). *Disease control priorities in developing countries* (2nd Ed). Oxford, United Kingdom: Oxford University Press.

Kahn, G., Harris, B., Mermin, J.H., Clasen, T., Lugada, E, et al., (2011). Cost of Community Integrated Prevention Campaign for Malaria, HIV, and Diarrhea in Rural Kenya. *BMC Health Services Research*, 11:346 doi:10.1186/1472-6963-11-346

Kahn, S. (2008). How malaria works. Retrieved 1st April 2015, from How stuff works: http://www,howstuffworks.com/malaria.htm.

Kaushik, J. S., Gomber, S., & Dewan, P. (2012). Clinical and Epidemiological Profiles of Severe Malaria in Children from Delhi, India. *Journal of Health, Population, and Nutrition*, *30*(1), 113–116.

Kayedi, M. H., Lines J. D., Haghdoost, A. A., Vatandoost, M. H., Rassi, Y., & Khamisabady, K. (2008) Evaluation of the effects of repeated hand washing, sunlight, smoke and dirt on the persistence of deltamethrin on insecticide-treated nets. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 102,* 811–816. https://doi.org/10.1016/j.trstmh.2008.05.025

Ketema, T., & Bacha, K. (2013). Plasmodium vivax associated severe malaria complications among children in some malaria endemic areas of Ethiopia. BMC Public Health, 13, 637. http://doi.org/10.1186/1471-2458-13-637

Keugoung, B., Macq, J., Buve, A., Meli, J., Criel, B. (2013). The interface between the national tuberculosis control programme and district hospitals in Cameroon: Missed opportunities for strengthening the local health system - a multiple case study. *BioMed Central Public Health*, 13, 265

Khan, S. Y., Khan, A., Arshad, M., Tahir, H. M., Mukhtar, M. K., Ahmad, K. R., & Arshad, N. (2012). Irrational use of antimalarial drugs in rural areas of eastern Pakistan: a random field study. *BMC Public Health*, *12*, 941. http://doi.org/10.1186/1471-2458-12-941

Kidane G, & Morrow RH. (2000). Teaching mothers to provide home treatment of malaria in Tigray, Ethiopia: A randomized trial. *Lancet*. 356:550–5

Kimbi, H. K., Nkesa, S. B., Ndamukong-nyanga, J. L., Sumbele, I. N., Atashili, J., & Atanga, M. B. S., (2014a). Knowledge and perceptions towards malaria prevention among vulnerable groups in the Buea Health District, Cameroon. *BMC Public Health, 14*(1). https://doi.org/10.1186/1471-2458-14-883

Kimbi, H. K., Nkesa, S. B., Ndamukong-nyanga, J. L., Sumbele, I. N., Atashili, J., & Atanga, M. B. S., (2014b). Socio-demographic factors influencing the ownership and utilization of insecticide-treated bed nets among malaria vulnerable groups in the Buea district, Cameroon. *BMC Research Notes, 7,* 624. https://doi.org/10.1186/1756-0500-7-624

Kimbi, H.K, Nana, Y, Sumbele, I.N, Anchang-Kimbi, J.K, Lum, E, et al. (2013) Environmental Factors and Preventive Methods against Malaria Parasite Prevalence in Rural Bomaka and Urban Molyko, Southwest Cameroon. *Journal of Bacteriol Parasitol* 4:162. doi: 10.4172/2155-9597.1000162

Kirk, S. (2013). Self-Efficacy: Helping Students Believe in Themselves. Retrieved from http://serc.carleton.edu/NAGTWorkshops/affective/efficacy.html

Kizito, J., Kayendeke, M., Nabirye, C., Staedke, S. G., & Chandler, C. I. (2012). Improving access to health care for malaria in Africa: a review of literature on what attracts patients. Malaria Journal, 11, 55. http://doi.org/10.1186/PREACCEPT-2317562776368437

Ketema, T., & Bacha, K. (2013). *Plasmodium vivax* associated severe malaria complications among children in some malaria endemic areas of Ethiopia. *BMC Public Health*, *13*, 637. doi:10.1186/1471-2458-13-637

Labhardt ND, Aboa SM, Manga E, et al. (2010). Bridging the gap: how traditional healers interact with their patients: a comparative study in Cameroon. *Tropical Medicine and International Health,* 15;9:1099–108.

Larson, P. S., Mathanga, D. P., Campbell, C. H., & Wilson, M. L. (2012). Distance to health services influences insecticide-treated net possession and use among six to 59 month-old children in Malawi. *Malaria Journal, 11,* 18. http://doi.org/10.1186/1475-2875-11-18

Lawal, A. M., Balogun, S. K., & Bada, B. V. (2014). Knowledge of transmission, malaria belief and health-seeking behaviour in Oye-Ekiti local government area of Ekiti State, Nigeria. *American Journal of Rural Development*, *2*(1), 8-12.

Lawal, A.M., Shyngle K. B., & Bukola, V.B. (2014). "Knowledge of Transmission, Malaria Belief and Health-Seeking Behaviour in Oye-Ekiti Local Government Area of Ekiti State, Nigeria." *American Journal of Rural Development* 2.1 (2014): 8-12.

Leke, R. F. G., Bioga, J. D., Zhou, J., Fouda, G. G., Leke, R. J. I., Tchinda, V., … Taylor, D. W. (2010). Longitudinal Studies of *Plasmodium falciparum* Malaria in Pregnant Women Living in a Rural Cameroonian Village with High Perennial Transmission. *The American Journal of Tropical Medicine and Hygiene*, *83*(5), 996–1004. doi:10.4269/ajtmh.2010.10-0249

Littrell, M., Gatakaa, H., Evance, I., Poyer, S., Njogu, J., Solomon, T., . . . O'Connell, K. A. (2011). Monitoring fever treatment behaviour and equitable access to effective medicines in the context of initiatives to improve ACT access: Baseline results and

implications for programming in six African countries. Malaria Journal, 10, 327.

Lim, S. S., Fullman, N., Stokes, A., Ravishankar, N., Masiye, F., Murray, C. J. L., & Gakidou, E. (2011). Net Benefits: A Multicountry Analysis of Observational Data Examining Associations between Insecticide-Treated Mosquito Nets and Health Outcomes. *PLoS Medicine*, *8*(9), e1001091. doi: 10.1371/journal.pmed.1001091

Lowe, R., Chirombo, J., & Tompkins, A.M. (2013). Relative importance of climatic, geographic and socio-economic determinants of malaria in Malawi. *Malaria Journal*. 2013; 12:416.

Maher, J. M., Markey, J. C., & Ebert-May, D. (2013). The Other Half of the Story: Effect Size Analysis in Quantitative Research. CBE Life Sciences Education, 12(3), 345–351. http://doi.org/10.1187/cbe.13-04-0082

Maheu-Giroux M. & Castro MC (2013) Impact of Community-Based Larviciding on the Prevalence of Malaria Infection in Dar es Salaam, Tanzania. *PLoS ONE* 8;8: e71638. doi: 10.1371/journal.pone.0071638

Malaney M, Spielman A, & Sachs J. (2004). The Malaria Gap. Am J Trop Med Hyg. 2004; 71:141–146.

Matendo, R. M., Engmann, C. M., Ditekemena, J. D., Gado, J., Tshefu, A., McClure, E. M., … Bose, C. L. (2011). Challenge of Reducing Perinatal Mortality in Rural

Congo: Findings of a Prospective, Population-based Study. Journal of Health, Population, and Nutrition, 29(5), 532–540.

Maxwell, C. A., Chambo, W., Mwaimu, M., Magogo, F., Carneiro, I. A., & Curtis, C. F. (2003). Variation of malaria transmission and morbidity with altitude in Tanzania and with introduction of alphacypermethrin treated nets. *Malaria Journal*, 2, 28. http://doi.org/10.1186/1475-2875-2-28

Mbacham W. F, Evehe, B.M, Netongo, P.M, Ateh, I.A, Mimche1, P.N., et al. (2010). Efficacy of amodiaquine, sulphadoxinepyrimethamine and their combination for the treatment of uncomplicated Plasmodium falciparum malaria in children in Cameroon at the time of policy change to artemisinin-based combination therapy. *Malaria Journal* 9: 34

Mmbando, B. P., Vestergaard, L. S., Kitua, A. Y., Lemnge, M. M., Theander, T. G., & Lusingu, J. P. (2010). A progressive declining in the burden of malaria in north-eastern Tanzania. *Malaria Journal*, *9*, 216. http://doi.org/10.1186/1475-2875-9-216

Mbonye, A. K., Clarke, S. E., Lal, S., Chandler, C. I., Hutchinson, E., Hansen, K. S., & Magnussen, P. (2015). Introducing rapid diagnostic tests for malaria into registered drug shops in Uganda: lessons learned and policy implications. *Malaria Journal*, 14, 448. http://doi.org/10.1186/s12936-015-0979-6

McCombie SC. Self-treatment for malaria: the evidence and methodological issues. Health Policy Plan. 2002; 17:333–44. doi: 10.1093/heapol/17.4.333.

McQueen, P. G., Williamson, K. C., & McKenzie, F. E. (2013). Host immune constraints on malaria transmission: insights from population biology of within-host parasites. Malaria Journal, 12, 206. http://doi.org/10.1186/1475-2875-12-206

Mikhail, B. (1981). The health belief model: A review and critical evaluation of the model, research and practice. Advances in Nursing Science. 1981;4(1):65–81.

Minakawa, N., Dida, G. O., Sonye, G. O., Futami, K., & Kaneko, S. (2008). Unforeseen misuses of bed nets in fishing villages along Lake Victoria. Malaria Journal, 7, 165. http://doi.org/10.1186/1475-2875-7-165

Minsanté (Ministère de la Santé Publiqu) (2008). Cameroun: vers un meilleur accès à la prévention et au traitement duSIDA, de la tuberculose et du paludisme. Retrieved from [http:// www.afriscoopnet/journal/spipphp].

Ministère de la Santé Publique. Plan stratégique national de lutte contre le paludisme 2011–2015. Cameroun: Ministère de la Santé Publique; 2012.

Ministère de la Santé Publique du Cameroun. (2010). Stratégie sectorielle de santé. Unpublished

Ministry of Public Health, Cameroon (2009) Health Sector Strategy 2001–2015. 109p

Ministry of Health: Report on the evolution of malaria cases and access to health centers in the city of Yaounde. Report of the National Programme against malaria in Cameroon]. Cameroon: Ministry of Health; 2010. French

Mishra, S. K., & Newton, C. R. J. C. (2009). Diagnosis and management of the neurological complications of falciparum malaria. *Nature Reviews. Neurology*, *5*(4), 189–198. doi:10.1038/nrneurol.2009.23

Monebenimp, F., Bissong, C.E., Chiabi, A., Chelo, D., & Moyo-Somo, R. (2010). Clinical and biological factors associated with treatment outcome of cerebral malaria in children under five in Yaounde. *Journal of Neuroparasitology, 1,* 1-5. https://doi.org/10.4303/jnp/n100506

Moore, S. N, Murphy, S., & Moore, L. (2011). Health improvement, nutritional behaviour and the role of school meals: The usefulness of a socio-ecological perspective to inform policy design, implementation and evaluation. *Critical Public Health, 21*(4), 441-454. ttps://doi.org/10.1080/09581596.2011.620604

Muganga, G. (2011). Malaria control for rural areas in Uganda: Localizing the interventions. *Malaria World Journal*, *2*, 2.

Mugisa, M., & Muzoora, A. (2012). Behavioral change communication strategy vital in malaria prevention interventions in rural communities: Nakasongola district, Uganda. *Pan African Medical Journal*, *13*(Suppl 1), 2.

Mugisha, F., & Arinaitwe, J. (2003). Sleeping arrangements and mosquito net use among under-fives: results from the Uganda Demographic and Health Survey. Malaria Journal, 2, 40. http://doi.org/10.1186/1475-2875-2-40.

Muller, O., Garenne, M., Kouyaté, B., Becher, H. (2003). The association between protein-energy malnutrition, malaria morbidity and all-cause mortality in West African children. Tropical Medicine and International Health 8(6):507-511

Mutulei, A.C.N. (2013). Factors Influencing the Uptake of Intermittent Preventive Treatment for Malaria in Pregnancy: Evidence from Bungoma East District,

Kenya. *American Journal of Public Health Research,* 1; 5:110-123. DOI:10.12691/ajphr-1-5-2

Murray, C. J. L, Rosenfeld L. C, Lim S. S., Andrews K. G., Foreman K. J., Haring D., . . . Lopez A. D. (2012) Global malaria mortality between 1980 and 2010: A systematic analysis. *Lancet.* 379(9814), 413-431. https://doi.org/10.1016/s0140-6736(12)60034-8

Murthy, P. & Smith, C.L. (2010). *Women's global health and human rights.* Sudbury, MA. Jones and Bartlett Publishers

Musoke, D., Miiro, G., Karani, G., Morris, K., Kasasa, S., Ndejjo, R., Musoke, M. B. (2015). Promising Perceptions, Divergent Practices and Barriers to Integrated Malaria Prevention in Wakiso District, Uganda: A Mixed Methods Study. *PLoS ONE*, *10*(4), e0122699. https://doi.org/10.1371/journal.pone.0122699

Musoke, D., Karani, G., Ssempebwa, J. C., & Musoke, M. B. (2013). Integrated approach to malaria prevention at household level in rural communities in Uganda: experiences from a pilot project. *Malaria Journal*, *12*, 327. https://doi.org/10.1186/1475-2875-12-327

Nahlen, B.L & Low-Beer, D. (2007). Building to collective impact: The global fund support for measuring reduction in the burden of malaria. *American Journal for Tropical Medicine and Hygiene*, *77,* 321–327. Retrieved from http://www.ajtmh.org/content/77/6_Suppl/321.full.pdf+html

Nayak, B. K. (2010). Understanding the relevance of sample size calculation. *Indian Journal of Ophthalmology, 58*(6), 469–470. http://doi.org/10.4103/0301-4738.71673

National Malaria Control Program Report Cameroon. (2008). Situation of Malaria control progress report No. 1. 4, 8-10. Retrieved from http://www.who.int/alliance-hpsr/projects/alliancehpsr_policybriefscalingupmalariacameroon.pdf.

National Institute of Allergy and Infectious Disease. (2009). Malaria. Retrieved from https://www.niaid.nih.gov/topics/malaria/Pages/default.aspx

National Institute of Statistics. (2012). Demographic and health survey and multiple indicators cluster survey DHS-MICS 2011: Preliminary report. Retrieved from www.statistics-cameroon.org/downloads/EDS-MICS11/DHSMICS_2011_preliminary_report.pdf

Ndo, C., Menze-Djantio, B., & Antonio-Nkondjio, C. (2011). Awareness, attitudes and prevention of malaria in the cities of Douala and Yaoundé (Cameroon). *Parasit Vectors, 4,* 181. https://doi.org/10.1186/1756-3305-4-181

Ndong, I.C., Reenen, M.V., Boakye, D.A., Mbachamm, W.T. & Grobler, A.F. (2014). Trends in malaria admissions at the Mbakong Health Centre of the North West Region of Cameroon: a retrospective study. *Malaria Journal*, 13:328 doi:10.1186/1475-2875-13-328

Nkuo-Akenji T, Ntonifor N.N, Ndukum M.B, Kimbi H.K, Abongwa E.L, et al., (2006): Environmental factors affecting malaria parasite prevalence in rural Bolifamba, South West Cameroon. *African Journal of Health Science*, 13:40-46

Nkuo-Akenji T, Ntonifor NN, Ching JK, Kimbi HK, Ndamukong KN, Anong DA, et al. Evaluating a malaria intervention strategy using knowledge, practices and coverage surveys in rural Bolifamba, South West Cameroon. Trans R Soc Trop Med Hyg. 2005;99:325–332. doi: 10.1016/j.trstmh.2003.12.016.

Ng'ang'a, P. N., Shililu, J., Jayasinghe, G., Kimani, V., Kabutha, C., Kabuage, L., . . . Mutero, C. (2008). Malaria vector control practices in an irrigated rice agro-ecosystem in central Kenya and implications for malaria control. *Malaria Journal*, *7*, 146. ttps://doi.org/10.1186/1475-2875-7-146

Ngassa Mbenda, H. G., & Das, A. (2014). Molecular Evidence of Plasmodium vivax Mono and Mixed Malaria Parasite Infections in Duffy-Negative Native Cameroonians. PLoS ONE, 9(8), e103262. http://doi.org/10.1371/journal.pone.0103262

Ngonghala, C. N., Del Valle, S. Y., Zhao, R., & Mohammed-Awel, J. (2014). Quantifying the impact of decay in bed-net efficacy on malaria transmission. *Journal of Theoretical Biology*, *363,* 247–261. http://doi.org/10.1016/j.jtbi.2014.08.018

Nsagha D.S., Nsagha S.M., Shey C.U., Njunda A.L., Kamga H.L., Njamnshi A.K. (2011a). Knowledge and practices relating to malaria in a semi-urban area of Cameroon: choices and sources of antimalarials, self-treatment and resistance. *Pan African Medical Journal*, 9:8. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3215530/

Nsagha, D.S., Njunda, A.L., Kamga, H.L.F., Nsagha, S.M., Assob, J.C.N., Shey, C.W., … Njamnshi, A.L. (2011b). Knowledge and practices relating to malaria in Ndu community of Cameroon: Signs and symptoms, causes and prevention. *Journal of Public Health and Epidemiology*, 3:6, 294-300. Retrieved from http://www.academicjournals.org/article/article1379431086_Shey%20et%20al.pdf

Nsagha, D.S, Njunda, A.L, Kamga, H.L.F, Assob, J.C.N, Wiysonge, C.S, Nsagha, S.M., … Njamnshi, A.K. (2010). Knowledge and practices relating to malaria in Ndu community of Cameroon: Signs and symptoms, causes and prevention. *Journal of Public Health Epidemiology, 3,* 294–300.

Noor, A.M., Moloney, G., Borle, M., Fegan, G.W., Shewchuk, T. & Snow, R. W. (2008). The Use of Mosquito Nets and the Prevalence of Plasmodium Falciparum Infection in Rural South-Central Somalia. Public Library of Science ONE 3(5): e2081. doi: 10.1371/journal.pone.0002081

Noor, A. M., Omumbo, J. A., Amin A. A., Zurovac, D., & Snow, R. W. (2006). Wealth, mother's education and physical access as determinants of retail sector net use in rural Kenya. *Malaria Journal, 5*(5).

Novignon, J., & Nonvignon, J. (2012). Socioeconomic status and the prevalence of fever in children under age five: evidence from four sub-Saharan African countries. *BMC Research Notes*, *5*, 380. https://doi.org/10.1186/1756-0500-5-380

Okeke, T.A. (2010). Improving malaria recognition, treatment and referral practices by training caretakers in rural Nigeria. *Journal of Biosocial Science, 42*(3), 325-339. https://doi.org/10.1017/s0021932009990484

Okenu, D.M.N. (1999). An integrated approach for malaria control in Africa. *Malaria and Infectious Diseases in Africa*, 10:4–13

Okiro, E. A., Hay, S. I., Gikandi, P. W., Sharif, S. K., Noor, A. M., Peshu, N., . . . Snow, R. W. (2007). The decline in paediatric malaria admissions on the coast of Kenya. *Malaria Journal*, *6*, 151. http://doi.org/10.1186/1475-2875-6-151

Ongola-Zogo, P. & Bonono, R. (2010). Policy brief on improving access to artemisinin-based combination therapies for malaria in Cameroon. *International Journal of Technology Assessment in Health Care* 26, 237-241.

Onwujekwe, O., Ojukwu, J., Uzochukwu, B., Dike, N., Ikeme, A., & Shu, E. (2005). Where do people from different socio-economic groups receive diagnosis and treatment for malaria in southeast Nigeria? *Annals of Tropical Medicine & Parasitology, 99*(5), 473–481. https://doi.org/10.1179/136485905x51283

Onwujekwe, O., Uzochukwu, B., Eze, S., Obikeze, E., Okoli, C., & Ochonma, O. (2008). Improving equity in malaria treatment: Relationship of socio-economic status with health seeking as well as with perceptions of ease of using the services of different providers for the treatment of malaria in Nigeria. *Malaria Journal, 7,* 5. http://doi.org/10.1186/1475-2875-7-5

Onyebuchi, A. K., Lawani, L. O., Iyoke, C. A., Onoh, C. R., & Okeke, N. E. (2014). Adherence to intermittent preventive treatment for malaria with sulphadoxine-

pyrimethamine and outcome of pregnancy among parturients in South East Nigeria. *Patient Preference and Adherence*, *8*, 447–452. http://doi.org/10.2147/PPA.S61448

Onyango, E. O., Ayodo, G., Watsierah, C. A., Were, T., Okumu, W., Anyona, S. B., … Ouma, C. (2012). Factors associated with non-adherence to Artemisinin-based combination therapy (ACT) to malaria in a rural population from holoendemic region of western Kenya. *BMC Infectious Diseases*, *12*, 143. http://doi.org/10.1186/1471-2334-12-143

Osonuga, O., Osonuga, A., Osonuga, A., & Osonuga, I. (2012). Resolution pattern of jaundice among children presenting with severe malaria in rural South-West Nigeria. *Asian Pacific Journal of Tropical Biomedicine*, *2*(7), 551–553. doi:10.1016/S2221-1691(12)60095-1

Osungbade, O.K. & Oladunjoye, O.O. (2012). Prevention of congenital transmission of malaria in sub-Saharan countries: challenges and implications for health system strengthening. *Journal of Tropical Medicine*,2012,648456. Doi:10.1155/2012/648456

Owusu Adjah, E. S., & Panayiotou, A. G. (2014). Impact of malaria related messages on insecticide-treated net (ITN) use for malaria prevention in Ghana. Malaria Journal, 13, 123. http://doi.org/10.1186/1475-2875-13-123

Oyekale, A. S. (2015a). Assessment of Malawian mothers' malaria knowledge, healthcare preferences and timeliness of seeking fever treatments for children

under five. *International Journal of Environmental Research and Public Health, 12*(1), 521–540. http://doi.org/10.3390/ijerph120100521

Oyekale, A.S. (2015b). Do ownership of mosquito nets, dwelling characteristics and mothers' socio-economic status influence malaria morbidity among children under the age of 5 in Cameroon? *International Journal of Occupational Medicine and Environmental Health, 28*(3), 479-497. https://doi.org/10.13075/ijomeh.1896.00340

Pamuk, E. R., R. Fuchs, & W. Lutz. (2011). Comparing relative effects of education and economic resources on infant mortality in developing countries. Population and Development Review 37:637–664. http://dx.doi.org/10.1111/j.1728-4457.2011.00451.x

Pagnoni F, Convelbo N, Tiendrebeogo J, Cousens S, & Esposito F. A. (1997) community-based programme to provide prompt and adequate treatment of presumptive malaria in children. Trans R Soc Tropical Medicine and Hygiene, 91:512–517. doi: 10.1016/S0035-9203(97)90006-7

Peace Corps (2013). Stomping out malaria in Africa, 2013 Annual Report. Retrieved from http://stompoutmalaria.org/wp-content/uploads/2014/02/2013-Stomping-Out-Malaria-Annual-Reportsmallpdf.com_.pdf

Pemunta, N.V. (2013). The Social Epidemiology and Burden of Malaria in Bali Nyonga, Northwest Cameroon. *Journal of Health, Culture and Society*, 4:1. DOI 10.5195/hcs.2013.69

Pell, C., Straus, L., Andrew, E. V. W., Meñaca, A., & Pool, R. (2011). Social and Cultural Factors Affecting Uptake of Interventions for Malaria in Pregnancy in Africa: A Systematic Review of the Qualitative Research. *PLoS ONE, 6*(7), e22452. https://doi.org/10.1371/journal.pone.0022452

Pierre S, Toua V, Tchobsala TF, Fernand N, Alexandre-Michel NN, Messi J. Medicinal plants used in traditional treatment of malaria in Cameroon. J Ecol Nat Environ 2011; 3(3):104-117.

Pimenta, P. F., Orfano, A. S., Bahia, A. C., Duarte, A. P., Ríos-Velásquez, C. M., Melo, F. F., . . . Secundino, N. F. (2015). An overview of malaria transmission from the perspective of Amazon Anopheles vectors. Memórias Do Instituto Oswaldo Cruz, 110(1), 23–47. http://doi.org/10.1590/0074-02760140266

Ricci, F. (2012). Social Implications of Malaria and Their Relationships with Poverty. *Mediterranean Journal of Hematology and Infectious Diseases, 4*(1), e2012048. http://doi.org/10.4084/MJHID.2012.048

Rickard, D., Dudovitz, R., Wong, M., Jen, H., Osborn, R., Fernandez, H., & Donkor, C. (2011). Closing the gap between insecticide treated net ownership and use for the prevention of malaria. *Progress in community health partnerships: research, education, and action*, 5:123 -131

Richardson, D.J., Richardson, K.R., Richardson, K.E., Gross, J., Tsekeng, P., Dondji, B., & Foulefack, S. (2011). Malaria, Intestinal Parasitic Infection, Anemia, and Malnourishment in Rural

Cameroonian Villages with an Assessment of Early Interventions. *Journal of the Arkansas Academy of Science*, 65:72-97. Retrieved from http://libinfo.uark.edu/aas/issues/2011v65/v65a12.pdf

Ryan, G.W. (1998) What do sequential behavioural patterns suggest about the medical decision-making process? Modeling home case management of acute illnesses in a rural Cameroonian village. *Social Science & Medicine*, 46:209-225

Ryan, G. W. (1995). Medical decision making among the Kom of Cameroon: modelling how characteristics of illnesses, patients, caretakers and compounds affect treatment choice in a rural community. University of Florida.

Roll Back Malaria (2015). Endemic countries. Retrieved from http://www.rollbackmalaria.org/about/about-malaria/endemic-countries

Rowe, A. K., Steketee, R. W., Arnold, F., Wardlaw T., Basu S., Bakyaita, N., . . . Nahlen, B. L., (2007). Viewpoint: Evaluating the impact of malaria control efforts on mortality in sub-Saharan Africa. *Tropical Medicine for International Health*, *12,* 1524–1539. https://doi.org/10.1111/j.1365-3156.2007.01961.x

Sacarlal, J., Nhacolo, A. Q., Sigaúque, B., Nhalungo, D. A., Abacassamo, F., Sacoor, C. N., Alonso, P. L. (2009). A 10-year study of the cause of death in children under 15 years in Manhiça, Mozambique. *BMC Public Health*, *9*, 67. doi:10.1186/1471-2458-9-67

Sachs, J. & Malaney, P. (2002). The economic and social burden of malaria. Nature. 2002;415:680–685. doi: 10.1038/415680a.

Salam, R.A, Das, J.K, Lassi, S.A., & Bhutta, Z.A. (2014). Impact of community-based interventions for the prevention and control of malaria on intervention coverage and health outcomes for the prevention and control of malaria. *Infectious Diseases of Poverty*, 3:25 doi:10.1186/2049-9957-3-25

Sallis, J. & Owen, N. (2002). Ecological models of health behaviour In K. Glanz, B. Rimer, and F. Lewis (Eds.), *Health behaviour and health education: Theory, research and practice* (3rd ed.; pp. 462–484). Hoboken, NJ: John Wiley & Sons.

Sarmiento, I., Zuluaga, G., & Andersson, N. (2016). Traditional medicine used in childbirth and for childhood diarrhea in Nigeria's Cross River State: interviews with traditional practitioners and a statewide cross-sectional study. *BMJ Open*, *6*(4), e010417. http://doi.org/10.1136/bmjopen-2015-010417

Sawalha, A. F. (2007). Complementary and alternative medicine (CAM) in Palestine: use and safety implications. *Journal of Alternative Complementary Medicine*, 13:263-9.

Schantz-Dunn, J., & Nour, N. M. (2009). Malaria and Pregnancy: A Global Health Perspective.

Reviews in Obstetrics and Gynecology, *2*(3), 186–192.

Schutt, R.K. (2015). *Investigating the social world. The process and practice of research*. (8th Ed). Canada. Sage Publication.

Sena, L. D., Deressa, W. A., & Ali, A. A. (2013). Predictors of long-lasting insecticide-treated bed net ownership and utilization: evidence from community-based cross-

sectional comparative study. *Southwest Ethiopia. Malaria Journal, 12,* 406. http://doi.org/10.1186/1475-2875-12-406

Shah, S. (2010). *The fever: How malaria has ruled humankind for 500,000 years*. (1st ed.). New York, NY. D&M publishers.

Shea, J., Santos, J.J., & Byrnes, P. (2012). Community needs assessment and data supported decision making: Keys to building responsive and effective health centers. Bethesda, MD: National Association of Community Health Centers. Retrieved from http://www.lpca.net/main/uploads/Image/CommunityNeedsAssessmentNACHC2012.pdf

Shumaker S, Ockene J, Riekert K (Eds): (2009). *The Handbook of Health Behavior Change*. (3rd Ed.). New York, NY: Springer Publishing Company.

Sinka, M. E., Rubio-Palis, Y., Manguin, S., Patil, A. P., Temperley, W. H., Gething, P. W., . . . Hay, S. I. (2010). The dominant Anopheles vectors of human malaria in the Americas: occurrence data, distribution maps and bionomic précis. *Parasites & Vectors, 3,* 72. http://doi.org/10.1186/1756-3305-3-72

Singh, R., Musa, J., Singh, S., & Ebere, U.V. (2014). Knowledge, Attitude and Practices on Malaria Among the Rural Communities in Aliero, Northern Nigeria. *Journal of Family Medicine and Primary Care, 3*(1), 39-44. https://doi.org/10.4103/2249-4863.130271

Siri, J. G. (2014). Independent associations of maternal education and household wealth with malaria risk in children. *Ecology and Society, 19*, 33.

Steketee, R. W., Nahlen, B. M., Parise, M. E, & Menendez, C. (2001). The burden of malaria in pregnancy in malaria-endemic areas. *American Journal of Tropical Medicine and Hygiene, 64*(1), 28–35. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK2623/

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion, 10*(4), 282–298.

Sonko, S.T, Jaiteh, M., Jafali, J., Jarju, L.B., D'Alessandro, U., Camara, A., . . . Saho, A. (2014). Does socio-economic status explain the differentials in malaria parasite prevalence? Evidence from The Gambia. *Malaria Journal, 13*(1), 449. https://doi.org/10.1186/1475-2875-13-449

Songue, E, Tagne, C., Mbouyap, P., Essomba, P., & –Somo, R. M. (2013). Epidemiology of Malaria in three Geo-Ecological Zones along the Chad-Cameroon Pipeline. *American Journal of Epidemiology and Infectious Disease*, *1*(4), 27-33.

Sullivan, L.M. (2017). *Essentials of biostatistics in public health.* (3rd Ed). Burlington, MA. Jones & Bartlett.

Sumo, L., Mbah, E. N., & Nana-Djeunga, H. C. (2015). Malaria in pregnancy in the Ndop health district (North West Region, Cameroon): Results from retrospective and prospective surveys. *Journal of Parasitology and Vector Biology*, *7*(9), 177-181.

Suswardany, D. L., Sibbritt, D. W., Supardi, S., Chang, S., & Adams, J. (2015). A critical review of traditional medicine and traditional healer use for malaria and among

people in malaria-endemic areas: contemporary research in low to middle-income Asia-Pacific countries. *Malaria Journal*, *14*, 98. doi:10.1186/s12936-015-0593-7

Suresh, K., Suresh, G., Thomas, S.V. (2012). Design and data analysis 1 study design. *Annals of Indian Academy of Neurology, 15*, 76-80. https://doi.org/10.4103/0972-2327.94987

Takem, E. N., Achidi, E. A., & Ndumbe, P. M. (2009). Use of intermittent preventive treatment for malaria by pregnant women in Beua, Cameroon. *Acta Tropica, 112*(1), 54–58. https://doi.org/10.1016/j.actatropica.2009.06.007

Tchinda VHM, Socpa A, Keundo AA, Zeukeng F, Seumen CT et al. (2012) Factors associated to bed net use in Cameroon: a retrospective study in Mfou health district in the Centre Region. Pan Afr Med J 12:112

Teklehaimanot, A., & Paola, M. (2008), *Malaria and Poverty*. Annals of the New York Academy of Sciences, 1136: 32–37. doi: 10.1196/annals.1425.037

The DHS program. http://dhsprogram.com/data/available-datasets.cfm.

Tientche, B., Anong, D. N., Asaah, S., Fru-Cho, J., & Nkuo-Akenji, T. K. (2016). Asymptomatic malaria parasitaemia in school children of Ekondo Titi Sub-division, Cameroon. *International Research Journal of Public and Environmental Health, 3*(8), 182-190. http://dx.doi.org/10.15739/irjpeh.16.024

Titanji, V. P., Zofou, D., & Ngemenya, M. N. (2008). The Antimalarial Potential of Medicinal Plants Used for the Treatment of Malaria in Cameroonian Folk Medicine. African Journal of Traditional, Complementary, and Alternative Medicines, 5(3), 302–321.

Toe, P. L., Skovmand, O., Dabire, R. K., et al, (2009). Dereased motivation in the use of insecticide treated nets in a malaria endemic area in Burkina Faso. *Malaria Journal*, 8:175.

Tonga C, Kimbi, H.K, Anchang-Kimbi J.K, Nyabeyeu H.N, Bissemou Z.B, & Lehman L.G. (2013) Malaria risk factors in women on intermittent preventive treatment at delivery and their effects on pregnancy outcome in Sanaga-Maritime, Cameroon. *PLoS One*, 8: e65876

Towns, A.M, Mengue, Eyi, S, van Andel, T. (2014) Traditional Medicine and Childcare in Western Africa: Mothers' Knowledge, Folk Illnesses, and Patterns of Healthcare-Seeking Behavior. *PLoS ONE* 9(8): e105972. doi:10.1371/journal.pone.0105972

Unger, J.P, Van Dessel, P., Sen, K., & De Paepe, P. (2009). International health policy and stagnating maternal mortality: is there a causal link? *Reproductive Health Matters*. 2009; 17:91–104. doi: 10.1016/S0968-8080(09)33460-6.

UNICEF (2013). Malaria. Retrieved from http://www.unicef.org/health/index_malaria.html

Uzochukwu, B. S., & Onwujekwe, O. E. (2004). Socio-economic differences and health seeking behaviour for the diagnosis and treatment of malaria: a case study of four local government areas operating the Bamako initiative programme in south-east Nigeria. International Journal for Equity in Health, 3, 6. http://doi.org/10.1186/1475-9276-3-6

Van der Hoeven, M., Kruger, A., & Greeff, M. (2012). Differences in health care seeking behaviour between rural and urban communities in South Africa. International Journal for Equity in Health, 11, 31. http://doi.org/10.1186/1475-9276-11-31

Walker, K, & Lynch, M. (2007). Contributions of Anopheles larval control to malaria suppression in tropical Africa: review of achievements and potential. *Medical and Veterinary Entomology, 21*(1), 2–21. https://doi.org/10.1111/j.1365-2915.2007.00674.x

Whegang, S. Y., Tahar, R., Foumane, V. N., Soula, G., Gwét, H., Thalabard, J.-C., & Basco, L. K. (2010). Efficacy of non-artemisinin- and artemisinin-based combination therapies for uncomplicated falciparum malaria in Cameroon. *Malaria Journal,* 9, 56. http://doi.org/10.1186/1475-2875-9-56

World Bank. (2000). World development report 2000/2001: Attacking poverty. New York, NY: Oxford University Press.

World Health Organization. (2010). *Guidelines for the treatment of malaria*. (2nd Ed). Geneva Switzerland.

World Health Organization. (2011). World malaria report 2011. Geneva, Switzerland: WHO Press.

World Health Organization. (2012a) Global plan for insecticide resistance management in malaria vectors. Geneva, Switzerland: WHO Press.

World Health Organization. (2012b). *World malaria report 2012.* Geneva, Switzerland: WHO Press.

World Health Organization. (2013a). Consultation on developing a multisectoral approach to malaria: Malaria in Cameroon. Retrieved from http://www.rollbackmalaria.org/files/files/about/MultisectoralApproach/Country-brief-Cameroon.pdf

World Health Organization. (2013b). World malaria report 2013. Geneva, Switzerland: WHO Press.

World Health Organization. (2014). World malaria report 2014. Retrieved from http://apps.who.int/iris/bitstream/10665/144852/2/9789241564830_eng.pdf?ua=1

World Health Organization. (2015a). The determinants of health. Retrieved from http://www.who.int/hia/evidence/doh/en/

World Health Organization. (2015b). World malaria day: Call to close gaps in prevention and treatment to defeat malaria. Retrieved from http://www.who.int/mediacentre/news/releases/2015/world-malaria-day-2015/en/

Worrall, E., Basu, S., & Hanson, K. (2005). Is malaria a disease of poverty? A review of the literature. Tropical Medicine and International Health 10: 1047–1059. doi: 10.1111/j.1365-3156.2005.01476. x.

Worrall, E.S, Basu, X.X, & Hanson, K. (2003). The relationship between socio-economic status and malaria: a review of the literature. Background paper prepared for conference on Ensuring that malaria control interventions reach the poor, 5–6 September 2002. London, United Kingdom.

Yeung, S., Van Damme, W., Socheat, D., White, N. J., & Mills, A. (2008). Access to artemisinin combination therapy for malaria in remote areas of Cambodia. Malaria Journal, 7, 96. http://doi.org/10.1186/1475-2875-7-96

Zimmerman, R.H. & Voorham, J. (2003). Use of insecticide impregnated materials for malaria control in the Americas. Rev. Panam Salud Publica., 2: 23-34.

Appendix A: Permission to Use Data

November 9, 2015

Naomi Azunie

WaldenUniversity

Dear Naomi:

You are authorized to use all available Cameroon Demographic and Health Survey (DHS) datasets, for your research project titled: "An Integrated Approach to Malaria Control and Prevention in Rural Cameroon".

To download the DHS datasets. Please login to your user account at:

http://www.dhsprogram.com/data/dataset_admin/login_main.cfm

- The user name is your registered email address: ncnaomi@yahoo.com
- The password is the one you selected during the registration process.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.
The DHS datasets must not be passed on to other researchers without the written consent of DHS. You are requested to submit an electronic or hard copy of any reports/publications resulting from using the DHS data files to our office.

Sincerely,

Bridgette Wellington

Data Archivist

The Demographic and Health Surveys (DHS) Program

11785 Beltsville Drive, Suite 300 • Calverton, MD 20705 • 301.572.0200 •

Appendix B: Permission to Use Diagram

Re: Fw: Permission to use diagram from your website.

People

euroClinix <info@euroclinix.co.uk> Mar 23 at 10:27 AM

To

ncnaomi@yahoo.com

Message body

Hi Naomi

Thank you for your email.

We're glad to hear that our image has been useful to you for your dissertation proposal and are happy for you to reproduce the image in your work, as long as it is cited.

We would also like to request that if this image is used in any online publications that you credit euroClinix.co.uk for the image and provide a link to the original source.

Good luck with your studies.

Kind Regards,

Adam Legister

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Appendix C: NIH Training Certificate

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Naomi Azunie** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 03/24/2013

Certification Number: 1149189

Appendix D: Permission to Use Map

Dear Mrs Azunie,

Thank you for your interest in WHO publications.

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Should you have further questions, please do not hesitate to contact us.

Kind regards,

Tatiana Titova

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