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Insecticide Treated Nets and Malaria Control Strategy in Sierra Leone

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Walden University
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Abstract

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by

Henry Biayemi

MSc, University of Perpignan, 1989

BS, Njala University College, Sierra Leone, 1983

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

Malaria is a deadly disease and endemic in Sierra Leone. It is the leading cause of morbidity and mortality amongst children younger than five years in Sierra Leone. Insecticide treated nets (ITNs) are not used widely despite free distribution, low health risks, and proven ability to reduce malaria. The purpose of this quantitative cross-sectional study was to investigate the association between a set of independent variables (parental education, parents' economic status, household size, and residence) and the use of ITNs among children under five years of age in Sierra Leone. The study used a secondary dataset from the Ministry of Health and Sanitation, Sierra Leone. The health belief model guided this study. Chi-squared analysis showed that those who resided in rural areas [χ^2 (1) = 53.16, (p = 0.001)], and in the lower wealth index [χ^2 (2) = 52.47, (p = 0.001)] use ITNs more compared with their counterparts. The results of the simple logistic regression revealed that higher economic status (OR 0.28, 95% CI: 0.03 – 2.6, p = 0.001), and living in urban residences (OR 0.28, 95% CI: 0.2 – 0.4, p = 0.001) could predict ITN use. Likewise, controlling for all other factors, multiple logistic regression showed that the wealth index (OR 1.45, 95% CI: 1.1 – 1.9, p = 0.008) and residence (OR 0.41, 95% CI: 0.25 – 0.65, p = 0.001) significantly predicted ITN use among children under five years in Sierra Leone. Wealth index and residence were identified as factors that may affect the use of ITNs as a malaria control measure among children under five years in Sierra Leone. Considering these factors for future mass distribution of ITNs could help achieve the desired malaria prevention goals. This will reduce morbidity and mortality of the children thus bringing about positive social change.

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Dedication

This dissertation is dedicated to my deceased parents' loving memory Sumaila Biayemi and Seibatu Biayemi; though farmers, they instilled the value of education in their children and laid the groundwork for my educational development.

I also dedicate this dissertation to my beautiful wife Augusta Sombo Biayemi and my children Henry Rex Biayemi, Lucy Fatmata Biayemi, Albert Sumaila Biayemi, Henrietta Seibatu Mabinty Biayemi; including my nieces Hawa Biayemi, Christiana Seibatu Biayemi, and Kuntumi Biayemi; (and my grandkids) for their prayers, loving support, and understanding through the COVID period of my doctoral study.

This dissertation is equally dedicated to all the young children living in malaria-endemic countries like Sierra Leone, where they experience the most significant malaria disease burden. Conclusively, thanks to all those that are earnestly working to prevent and control malaria in the communities.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Introduction

Malaria is a deadly disease caused by parasites transferred through the bites of infected female *Anopheles* mosquitoes. Though preventable and curable, malaria is of utmost public health concern and a significant global health problem. Globally, it accounted for close to 228 million cases and more than 405,000 deaths in 2018 (World Health Organization [WHO], 2020). WHO also stated that children younger than five years are most susceptible to malaria. In 2018, they accounted for about 67% (272,000) of global malaria deaths.

WHO (2019) reported that every two minutes, a child under five dies of malaria, and most of these deaths happened in sub-Saharan Africa (SSA). In 2018, WHO reported 93% of malaria cases worldwide and 94% of malaria deaths in the SSA. Malaria's direct costs are estimated to be $12 billion per year (WHO, 2019; 2020). WHO (2019) reported that families are trapped in a cycle of illness, suffering, and poverty by malaria and treatment costs in Africa's sub-Sahara countries. Malaria is endemic in Sierra Leone, with a stable and perennial transmission in all parts of the country. According to Table 1, malaria is currently the principal cause of disease and death in children younger than five years in Sierra Leone (WHO, 2020).

Table 1.

Malaria Mortality Estimates Among Children Under Five Years in Sierra Leone

Indicators	DHS 2008	DHS 2013	DHS 2019
Infant mortality rate (per 1,000 live births)	89 /1,000	92/1000	
Under-five mortality rate (per 1,000 live births)	140 /1,000	156 / 1000	122/1000

*DHS – Demographic and Health Survey

Malaria is also appraised as a significant impediment to socioeconomic development, leading to poverty in Sierra Leone (U.S. Global Malaria Coordinator [USGMC], 2019). In 2017, the U.S. President Malaria Initiative (PMI) launched Malaria prevention programs to fight Malaria in Sierra Leone. PMI proposed a $15 million budget for FY 2018 and FY 2019, respectively (Table 2) (USGMC, 2019).

Table 2.

PMI – Annual Malaria Budget for Sierra Leone

	FY 2017	FY 2018	FY2019
Malaria Preventive Activities	$15 millions	$15 millions	$15 millions

Data source: PMI (2017, 2018, 2019)

Several preventive procedures are presently employed to control or eliminate malaria as a public health problem. These strategies include malaria awareness and education, insecticide-treated nets (ITNs, including long-lasting insecticidal nets and insecticidal-treated bed nets), indoor residual spraying, prophylactic drugs, and untreated nets (Wangdi et al., 2018). ITNs have contributed significantly to declines in malaria morbidity and all-cause mortality across sub-Saharan Africa (Shah et al., 2020). The ITNs are known to kill mosquitoes and have proven repellent properties that decrease mosquitoes' numbers entering the house. They are considered twice as effective as untreated nets and provide more than 70% protection equated with no bed nets (Ntonifor & Veyufambom, 2016; Shah et al., 2020). The health-related side effects of using ITNs include heat discomfort and irritations from the insecticides sprayed. Systemic toxicity may develop after intense dermal exposure, inhalation, or ingestion. Systemic toxicity symptoms include headache/dizziness, convulsion, fatigue, vomiting, tingly or burning sensation, cough, pinkeye, skin eruption, and rhinitis (Lu et al., 2015).

With the help of numerous partners and donors, including WHO and Centers for Disease Control and Prevention [CDC], Sierra Leone achieved significant strides that successfully reduced the number of new malaria cases by 40% over time (Ministry of Health and Sanitation [MoHS], 2016). The National Malaria Control Program (NMCP) was created in 2006 to distribute ITN every three years. A report revealed that the overall proportion of children under five years using an ITN in all households has remained low at 44% in Sierra Leone (USGMC, 2019). However, despite the massive progress achieved in ITN distribution, malaria remained a public health concern and an endemic disease (MoHS, 2017a). Malaria accounts for 47% of outpatient morbidity for children under five years of age, 38% of hospital admissions, and has a case fatality rate of 17.6% (MoHS, 2017a). There is a gap in the literature about why ITNs are not used widely despite their low health risks and their proven ability to reduce malaria in children under five, and more specifically in Sierra Leone (CDC, 2019).

This study will investigate the efficacy of ITNs as a useful malaria control strategy among children under five years of age. More specifically, this study will examine the role of parental education, economic status of parents, household size, residence (rural vs. urban) as independent variables, and their associations with the outcome of ITNs use in the control of malaria among children under five years of age in Sierra Leone. This study's social change implication is a responsive and robust malaria control intervention that will reduce malaria morbidity and mortality rates among children under five years of age in Sierra Leone.

Background

Malaria is a preventable and curable disease transmitted through *Anopheles* mosquitos (WHO, 2017). Although there has been a breakthrough in malaria treatment and prevention, Africa accounts for 93% of global malaria cases (WHO, 2017). Likewise, malaria continues to be an enormous public health concern in Sierra Leone. According to the Sierra Leone Malaria Indicatory Survey, approximately 49.4% of children under five living in rural and urban locations tested positive for Malaria (National Malaria Control Program [NMCP], 2016).

To control malaria in Sierra Leone, the NMCP developed a strategic plan to find evidence-based solutions (NMCP, 2016). In 2019, USGMC reported that NMCP distributed 3,264,927 and 3,523,873 ITNs in 2010 and 2014 to households throughout the country. However, despite the massive progress achieved in ITN distribution, malaria remains a public health issue and an endemic disease (MoHS, 2017a).

ITNs prevent malaria spread because it acts as a barrier between humans and mosquitoes (WHO, 2020). According to WHO, malaria vector mosquito species bite between dusk and dawn. Although the weather can affect mosquitos' lifespan and movement, Sierra Leone has tropical climate conditions that allow for malaria transmission all year-round (Malaria Indicator Survey [MIS], 2016). Thus, the use of ITNs during sleep is incredibly important (Ahorlu et al., 2019). ITNs remain the most effective tool available to prevent malaria. Ensuring high access to and using ITNs is therefore crucial to their success (Ahorlu et al., 2019)

Along with public health outbreaks, overall household characteristics are deemed to be a problem with ITN usage. Findings from the 2016 Sierra Leone Malaria Indicator Survey (SLMIS) showed that more than half (60%) of Sierra Leonean households own at least one ITN. The SLMIS concluded that individual families could use one ITN to serve two people. Studies have found that only 16% of households adhere to this (NMCP, 2016). Studies have also indicated that despite the availability of ITNs, their use remains low across the population (Konlan et al., 2017; MoHS, 2016, 2017; Ranasinghe et al., 2015; Vincent, 2020). There is a clear behavioral gap in the use of ITNs by families that must be studied and addressed. Thus, this study analyzed survey data to examine the household factors that affect ITNs usage and provide educational approaches that consider household beliefs and education.

Geography and Climate

Sierra Leone has a population of 7,813,215 (Word Bank, 2019). The country is located on the West Coast of Africa, between latitudes 7 and 10 north and longitudes 10.5 and 13 west (MoHS, 2016, 2020). It is a compact country with a total area of 71,740 km2 (27,699 sq. ml) on the great bulge of West Africa’s 402 km coastline. The Atlantic Ocean serves as the country's boundary on the west, the north, and east by Guinea and southeast by Liberia (MoHS, 2016, 2017, 2020).

The country has varied terrain, ranging from coastline swamps through inland swamps and rain forest to one of the highest mountains in West Africa, the Bintumani at 2200 meters. There are several mangrove swamps on the country's coastal line, which serves as the breeding sites for *Anopheles melas* mosquitoes, a primary vector of malaria besides *Anopheles gambiae* and *Anopheles funestus* (MoHS, 2016, 2017, 2020).

The typical climate in Sierra Leone is tropical, with temperatures ranging from a low of 21^{o}C to a high of 32^{o}C. The mean daily temperature is 25^{o}C. The country has two major seasons, including the wet season (May to October) and the dry season (November to April), with heavy rains in July and August. Sierra Leone has an average rainfall of about 320cm yearly. The relative humidity is high, extending from 60 to 90%. (MoHS, 2016, 2017, 2020)

Epidemiology of Malaria Parasite

Malaria is endemic in Sierra Leone, with all the population at risk, pregnant women and children younger than 5 years of age are the most vulnerable. For malaria transmission to occur, three components of the malaria life cycle must be present, such as *Anopheles* mosquitoes, humans, and malaria parasites. The malaria parasites initially develop and multiply in the liver cells and continue in the blood's red cells of the human host. The successive broods of parasites develop within the red blood cells and destroy them, discharging offspring parasites ("merozoites") that continue the cycle by attacking other red cells (CDC, 2020a).

The blood-stage parasites cause the symptoms of malaria, such as fever, chills, and flu-like disease. During blood-feeding of the female *Anopheles* mosquito, certain types of blood-stage parasites (gametocytes) are consumed and mate in the mosquito's gut, thereby starting a cycle of development and multiplication of the mosquito (CDC, 2020a). After 10-18 days of the infectious mosquito blood meal, a parasite termed sporozoite travels to the mosquito's salivary glands. Once a female *Anopheles* mosquito ingests a blood meal on a human, the saliva and the parasite are injected and then migrates to the liver, thus starting a new cycle (CDC, 2020a).

Impact of Malaria on Children Under Fiver

Malaria is a deadly disease caused by parasites transferred through the bite of the female *Anopheles* mosquito. It poses the most significant health threat to children under five in malaria-prone areas such as sub-Saharan Africa (Afoakwah et al., 2018). Malaria is disproportionately deadly to children. In 2015, over 70% of the 446,000 malaria deaths worldwide were in children under five years of age (Oxner et al., 2020). Unfortunately, the rising investment to control the disease does not lead to a significant fall in infection among young children.

Children younger than five years are one of the most vulnerable groups to malaria. In Africa, according to WHO (2018), around 285,000 children died in 2016 before their fifth birthdays, and they are the most vulnerable people impacted by malaria disease. As is the case of many other countries in sub-Saharan Africa, malaria transmission is high throughout the year, contributing to partial immunity development within the first two years of life (MoHS, 2016). Many people, including children, many with asymptomatic infection, contribute to the spread of malaria transmission and increase the risk of anemia and other associated morbidity among infected individuals

(MoHS, 2016). Malaria is the number one cause of pediatric deaths (38%) in Sierra Leone (Oxner et al., 2020). In 2016, NMCP reported that 40% of children aged 6-59 months were positive for malaria parasites according to microscopy results compared to 53% of children aged 6-59 months who tested positive for malaria antigens using rapid diagnostics tests (RDTs). RDTs and microscopy are used to diagnose malaria. The results are presented as percentage positive of the total number of patients under study. Microscopy is the most reliable and widely used method to diagnose malaria (Azikiwe et al., 2012). The RDT is as reliable as microscopy for malaria diagnosis. Still, only the antigen-based kits method is suitable for most patients in endemic regions, especially in poor power, where there is a shortage of qualified workforce (Azikiwe et al., 2012). RDTs are commercially available in kit forms and do not require extensive training or equipment to perform the results and are read in 12–15 min. The use of malaria RDTs, as reported by Azikiwe et al. (2012), is recommended by WHO when reliable microscopy is not available.

Insecticide Treated Nets Use to Control Malaria

Children younger than five years are most susceptible to malaria. In 2018, they accounted for about 67% (272,000) of global malaria deaths (WHO, 2020). Despite the significant investments to control malaria infection rates over the past years, infection rates among children under five years remain substantial in sub-Saharan Africa (Afoakwah et al., 2018). ITN use is a major vector control method for preventing malaria. It has been shown to reduce malaria incidence by 50% in several countries endemic with malaria (Nkoka et al., 2018). However, controlling malaria is still a public health challenge in Sierra Leone, where the burden of infection is endemic. Malaria accounts for 40.3% of outpatient morbidity for all ages. Malaria accounts for 47% of outpatient morbidity for children younger than 5 years and 37.6% for hospitalization, with a case fatality of 17.6% **(**MoHS, 2016).

According to MoHS (2016), in 1900, Christophers and Stevens visited Freetown to make endorsements on mosquito control, and from 1931-1932, there was a conceivable epidemic upsurge in malaria in Freetown. In 1991, the civil war led to a massive population dislocation and the absence of corresponding malaria control. In 1993, trials of ITNs started in Sierra Leone, and 5% of children slept under an ITN in 2005. Since 1998, Sierra Leone became dedicated to the Roll Back Malaria (RBM) Initiative. The country became a signatory to the Abuja Declaration in 2005 as part of the RBM initiative and plan of action. In 2006, national free mass LLIN distribution for children under one year alongside measles vaccine campaigns distributed over 1.1 million nets. There were another 600,000 ITNs distributed in 2008 through antenatal and other clinics, and 26% of children slept under ITNs. Another free mass distribution of 3.2 million ITNs took place in 2010, and 30% of children slept under an ITN. Also. in 2011and 2013, 72% and 45% of children slept under an ITN.

In 2014, the Ebola virus disease (EVD) outbreak struck Sierra Leone and had a devastating effect on malaria control interventions. Irrespective of the vulnerability and significant outcomes of malaria among under five children, many studies on Malaria in Sierra Leone focused on the sociological and behavioral aspects of the condition at the population level. Although malaria prevalence has witnessed a significant reduction within the past decade, malaria still constitutes the most critical health and economic problem, especially in low-income countries, such as Sierra Leone (Ngonghalaa et al., 2016).

To manage and eliminate Malaria in Sierra Leone, the NMCP engaged in distributing ITNs every three years. Despite the fact ITN use is considered an effective inhibitor against malaria transmission, there remain significant concerns in Sierra Leone that indicate that malaria is still and will be a persistent endemic in the country (MIS, 2016). This study contributed to knowledge by investigating the efficacy of ITNs as the outcome to affect useful malaria control measures among children under five years of age in Sierra Leone.

Problem Statement

Malaria control remains a priority in the national health plan in Sierra Leone. The disease is currently the foremost cause of morbidity and death among children younger than five years. Approximately 95% of the entire population is at risk (MoHS, 2016; WHO, 2019). Malaria is also considered a significant impediment to socioeconomic development, leading to poverty in Sierra Leone (USGMC, 2019).

In efforts to manage and eliminate Malaria in Sierra Leone, the NMCP was created in 2006 to distribute ITN every three years. For example, the MoHS gave out 3,264,927 and 3,523,873 ITNs in 2010 and 2014 to households throughout the country (USGMC, 2019). However, despite the massive progress achieved in ITN distribution, Malaria remains a public health issue and endemic disease. Malaria accounts for 47% of outpatient morbidity for children under five years of age, 38% of hospital admissions, and has a case fatality rate of 17.6% (MoHS, 2017a). Studies have indicated that despite the availability of ITNs, their use remains low across the population (Konlan et al., 2017; MoHS, 2016, 2017; Ranasinghe et al., 2015; Vincent, 2020). A report from USGMC (2019) revealed that the overall proportion of children under five years using an ITN in all households has remained low at 44 % in Sierra Leone.

There is a gap in the literature about why ITNs are not being used widely despite their wide free distribution, low health risks, and proven ability to reduce Malaria in children under five. The CDC has reported that the “lack of understanding of its (ITNs) importance” may be a reason for its low usage among children under five years (CDC, 2019).

Purpose of the Study

This quantitative cross-sectional study investigated the association between a set of independent variables (parental education, parents' economic status, household size, and residential location in Sierra Leone) and the use of ITNs as malaria control measures among children under five years of age in Sierra Leone**.** The study results may guide the development of appropriate education and outreach in Malaria prevention interventions among children under five years of age. I also explored other variables, such as the side effects of ITN use, gender, and age on ITN use.

Research Questions and Hypotheses.

The following are the research questions this study answered:

Research Question 1: Is there an association between parental education and ITN use among children under five years of age in Sierra Leone?

$H_0 1$: There is no association between parental education and ITN use among children under five years of age in Sierra Leone

$H_a 1$: There is an association between parental education and ITN use among children under five years of age in Sierra Leone

Research Question 2: Is there an association between the economic status of parents and ITN use among children under five years of age in Sierra Leone?

$H_0 2$: There is no association between the economic status of parents and ITN use among children under five years of age in Sierra Leone.

$H_a 2$: There is an association between the economic status of parents and ITN use among children under five years of age in Sierra Leone

Research Question 3: Is there an association between household size and ITN use among children under five years of age in Sierra Leone?

$H_0 3$: There is no association between the household size and ITN use among children under five years of age in Sierra Leone.

$H_a 3$: There is an association between the household size and ITN use among children under five years of age in Sierra Leone.

Research Question 4: Is there an association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone?

$H_0 4$: There is no association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone.

$H_a 4$: There is an association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone.

Research Question 5: What is the association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone?

$H_0$5: There is no association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone

H_a2: There is an association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone

Theoretical Framework.

The health belief model (HBM), established in the 1950s by social psychologists Hochbaum, Rosenstock, and Kegels, guided this study. These psychologists posited people's failure to partake in programs to avert and detect disease (Siddiqui et al., 2016). It focuses on the individual's beliefs and perceptions, so it is appropriate to change behaviors that are not heavily influenced by society and social norms. It tells us the importance of highlighting both the negative consequences of the current behavior and the positive consequences of alternative, suggested behavior. ITNs are inherent of any malaria elimination strategy. However, compliance is a challenge, and determinants of use vary by location and context.

The HBM is a device that can be used to discover perceptions and beliefs concerning malaria and ITN use (Watanabe et al., 2014). The HBM helped understand health behavior influences and detect the factors that may determine ITN to prevent malaria in children under five years of age in Sierra Leone. The backgrounds of behavior and social change are affected by cultural norms, traditions, societal and religious beliefs, gender roles, institutional and environmental factors (Diala et al., 2013, Ruyange et al., 2017**).** The HBM is essential when trying to create an appropriate approach to controlling malaria in Sierra Leone.

The HBM is a theory-based framework for understanding the individual choices people make regarding their understanding of their health. Table 3 shows three constructs of HBM relevant to this study. They are perceived susceptibility, perceived barrier, and self-efficacy. The table also shows the modifying variables that will be explored.

Table 3.

HBM Constructs and Study Variables

Study Variables	Measurement scale	Value	HBM Constructs
Parental educational	Ordinal	0 1 2	Modifying Variable: Individual factor
The economic status of parents	Ordinal	Low Middle High	Modifying Variable: Individual factor
Household size.	Nominal	≤5 >5	Perceived Barriers to ITN use (receive the intervention)
Residential location (rural VS urban)	Nominal	1 2	Perceived susceptibility to malaria infection
ITN use to control malaria prevalence.	Nominal/ Dichotomous	Yes No	Self-efficacy

According to Diptyanusa et al. (2020), the HBM is one of the oldest theoretical models for social and behavioral change communication and considers individual perceptions, including perceived susceptibility, severity, benefits, and barriers, self-efficacy, and cues to action in the prevention of a disease. This framework considers the social and behavioral influences and choices individuals make regarding their health and perceptions of health. The HBM is essential when trying to create an appropriate approach to controlling malaria in Sierra Leone.

Nature of the Study

This study utilized a quantitative approach to examine and understand the association between independent and dependent variables. I worked with pre-identified secondary data gathered by the MoHS in Sierra Leone for the study. As the research questions were focused at determining the associations between different independent variables and the dependent variable and the probable impacts of some covariates, by means of a quantitative method has an advantage. Since I examined the different hypotheses on measuring the changing relationships and predictive capabilities among the independent and dependent variables and the strength of such associations. A qualitative method was not appropriate as it is generally based on words, not numbers, on exploration, not associations (Frankfort-Nachmias & Nachmias, 2008).

The quantitative cross-sectional research design was used for this study. The cross-sectional study is like a snapshot of the population requires a one-time evaluation of the study's independent and dependent variables. This cross-sectional study examined factors that influence the use of ITNs to control malaria prevalence, including parental education, income status of parents, household size, and residential location (rural VS urban).

Secondary data were used for this study. Secondary data or archival data are previously collected by another person for a different purpose and now available for use to seek other information. The Statistical Program for the Social Sciences (SPSS) version 25 was used for data analysis.

Possible Types and Sources of Data

This study used a quantitative method employing secondary data gathered by health professionals from Sierra Leone's Ministry of Health and Sanitation concerning malaria prevalence. All the variables including, the independent variables of parental education, economic status of parents, household size, and residential location (rural VS urban) and the dependent variable (ITNs use to control malaria prevalence), were derived from Sierra Leone's Ministry of Health and Sanitation (MoHS) database.

Definition of Terms

In this study, the dependent variable is ITN use to control malaria infection among children under five years of age in Sierra Leone. The independent variables are parental education, parents' economic status, household size, and residential location (rural vs. urban). The following are the definition of some terms used in this study:

Anopheles mosquitoes: They are known as malaria mosquitoes and the chief vector for malaria (WHO, 2016a).

Endemic disease: The constant presence (usual prevalence) of a disease or infectious agent in a population within a geographic area.

Household size: This is essentially the number of persons for whom one is financially responsible. The household, defined as a group of persons who make standard provision of food, shelter, and other essentials for living, is a fundamental socioeconomic unit in human societies. Households are the centers of demographic, social, and economic processes (United Nations, 2017).

Insecticide-treated net (ITN): This is a mosquito bed-net treated with insecticides used as a protective cover against mosquito bites and malaria, including killing mosquitoes that come into contact with it or repels them (Malaria Consortium, 2016).

Malaria disease: It is considered a deadly disease transmitted by a parasite that infects Anopheles mosquitoes that feed by biting humans. People who are infected by malaria becomes very sick, showing symptoms like elevated temperature, shaking chills, and flu-like sickness (CDC, 2020).

Poverty: The state or condition in which a person or community lacks the financial resources and essentials for a minimum standard of living, including access to health care, education, and even transportation (Okalow, 2020)

Residential location: This is an independent variable in this research study in which the country's geographical area is classified as urban and rural.

Socioeconomic status: This is the social standing or class of an individual or group, which is often measured as a combination of education, income, and occupation (American Psychological Association, 2017).

Assumptions

Enhancing the overall efficiency of health research is by analyzing the existing secondary data. The information's availability depends on governments, funding agencies, and researchers making the data collected in primary study and in clinical data registry records accessible to investigators that were not involved in the original research. I assumed that the data source is verified, and the information and data are accurate. Also, I considered that the secondary data were correctly recorded and devoid of error. When a secondary dataset is used that was not the study's primary intent, missing data may have occurred. Furthermore, I assumed secondary databases should provide adequate statistics to measure the data's internal and external validity and permit investigators to determine the likelihood of sufficient cases in the dataset to make meaningful evaluations regarding the subject of interest.

Scope and Delimitation

According to the literature, ITNs have been shown to decrease morbidity and mortality. Still, coverage and appropriate utilization remain moderate in numerous sub-Saharan African (SSA) countries. Despite the free distribution campaign in many SSA countries, ITN ownership and usage, though improved, is still low (Apinjoh et al., 2015). The scope of this study is for children younger than five years in Sierra Leone. The study did not cover the effects of ITN on pregnant women or other age groups that are also unduly affected by malaria.

Limitations, Challenges, and Barriers

The main limitation is that the secondary data from the MoHS in Sierra Leone is dynamic and may not incorporate the total picture of malaria infection and ITN used among the children under five years of age. As previously stated, there is no 100% coverage of ITN use by these children. Therefore, this study's findings reflected only those households who have and used ITN for their children.

Another limitation includes, secondary dataset collected may also not be entirely for the population subgroups of interest, or the geographic province of interest, or address a specific research question to examine a particular hypothesis (Cheng & Phillips, 2014). Although secondary data are readily available, there may be challenges with obtaining approvals for their use. There are travel restrictions that the dataset used represents the study population, children under five regulations due to the COVID-19 pandemic globally that may inhibit the opportunity of traveling to Sierra Leone.

Significance of the Study

Children younger than five years are most susceptible to malaria. In 2018, they accounted for about 67% (272,000) of global malaria deaths (WHO, 2020). Despite the significant investments to control malaria infection rates over the years, infection rates among children under five years remain substantial in sub-Saharan Africa (Afoakwah et al., 2018). Malaria control remains a challenge and public health problem in Sierra Leone, where the burden of infection is endemic. There has been a considerable setback in malaria control in Sierra Leone due to the concomitant outbreak of Ebola virus disease and its impact on the health system.

To manage and eliminate malaria in Sierra Leone, the NMCP engaged in distributing free ITN every three years. Although ITN use is considered an effective inhibitor against the transmission of malaria, in Sierra Leone, there remain concerns indicating malaria will be endemic in the country (MIS, 2016). This study is essential to fill the literature gaps relating to why ITNs are not being used widely despite their low health risks and their proven ability to reduce malaria in children under five (CDC, 2019). This study added to knowledge by identifying some potential risk factors that may be militating against the use of ITNs as a useful malaria control among children under five years in Sierra Leone.

Social Change Implication

The purpose of this study was to investigate the association between a set of independent variables and the use of ITNs as control measures and initiatives that public health officials can utilize when combatting malaria. The evidence generated by the study may guide the development of appropriate policies to be used by stakeholders such as public health workers, healthcare professionals, non-governmental organizations, community leaders, and social policymakers on the impact of ITN interventions. This will support advocacy to increase the use of these free ITNs, thereby reducing morbidity and mortality of children under five years of age in Sierra Leone and other groups affected by this infection. Enhancing the use of ITNs to prevent malaria could increase productivity and attendance at work and school, thereby improving the country's economic growth. This study's social change implication is ultimately a robust malaria control intervention initiative with its attendant benefits.

Summary

Malaria can be prevented and treated. Nevertheless, malaria remains and continues to affect numerous countries in SSA. Malaria is the main cause of morbidity and mortality in Sierra Leone, principally in children younger than five years of age. The disease is a significant threat to socioeconomic development in the country (WHO, 2017).

This chapter presented a detailed background of the disease, control programs initiated by the Sierra Leonean government to combat the infection, including ITNs use among children under five. Despite the massive campaign, the utilization of ITN is still low, and malaria remains a significant public health challenge. This chapter also provided a summary of the study by describing the purpose of the study, problem statement, and knowledge gap. Other areas covered in the chapter are the theoretical framework, research questions, the background of the problem, significance of the study, and the implications for social change. Chapter 2 provided a concise synopsis of the disease's literature review, the search strategy utilized, and the theoretical framework underpinning the study.

Chapter 2: Literature Review

Introduction

There have been numerous attempts to combat malaria in Sierra Leone due to the ineffective use of ITNs among children younger than 5 years. As such, malaria remains uncontrolled, leading to a consistent prevalence of the disease. Malaria is also considered a significant impediment to socioeconomic development, causing poverty in Sierra Leone (USGMC, 2019). In 2017, the PMI launched malaria prevention programs to fight malaria in Sierra Leone. PMI proposed a $15 million budget for FY 17, FY 2018, and FY 2019, respectively (USGMC, 2019).

In efforts to manage and eliminate Malaria in Sierra Leone, the National Malaria Control Program (NMCP) was created in 2006 to distribute ITNs every three years. For example, the MoHS gave out 3,264,927 and 3,523,873 ITNs in 2010 and 2014 to households throughout the country (USGMC, 2019). Notwithstanding the progress achieved with ITN distribution, malaria remains a public health issue and an endemic disease. Malaria accounts for 47% of outpatient morbidity for children under five years, 38% of hospital admissions, and has a case fatality rate of 17.6% (MoHS, 2017a). Studies have indicated that despite the availability of ITNs, their use remains low across the population (Konlan et al., 2017; MoHS, 2016, 2017; Ranasinghe et al., 2015; Vincent, 2020). A report from USGMC (2019) revealed that the overall proportion of children under five years using an ITN in all households has remained low at 44 % in Sierra Leone.

There is a gap in the literature about why ITNs are not being used widely despite their wide free distribution, low health risks, and proven ability to reduce malaria in children under five (CDC, 2019). CDC has reported that the "lack of understanding of its [ITNs] importance" may be a reason for its low usage among children under five years. This quantitative cross-sectional study investigated the association between a set of independent variables and the use of ITNs as the outcome to affect useful malaria control measures among children under five years of age in Sierra Leone**.** I also explored other variables, such as the side effects of ITN use, gender, and age on ITN use.

ITNs significantly reduce child mortality, parasite prevalence, uncomplicated and severe malaria episodes. Thus, they have become a core intervention for malaria control and contributed considerably to the dramatic decline in disease incidence and malaria-related deaths seen since the millennium (Pryce et al., 2018).

This chapter discussed the literature search strategy delineating library databases and the list of essential search terms. The study's theoretical foundation, literature review related to key variables and concepts were also examined in this chapter. These included the geographical location and population of Sierra Leone, epidemiology of malaria in Sierra Leone, the transmission of malaria in Sierra Leone, the life cycle of the malaria parasite, environmental factors, household ownership and use of insecticide-treated mosquito nets, parental educational level, household, and the parents' economic status.

Literature Search Strategy

For this study, admission to research literature was quite productive due to information technology, and many electronic databases are readily available online for public and private use. One of the search engines used was PubMed - a publicly accessible online database. According to Fink (2010), PubMed is an available search engine to get into the MEDLINE database of research and abstracts on life sciences and biomedical subjects (Fink, 2010). This study's search criteria included a) peer-reviewed study articles and b) study reports issued in the latter five years (2015 – 2020). In this study, the following keywords were used to explore the database: *Malaria, Malaria in Sierra Leone, Malaria deaths, Mosquito nets, Insecticide-treated nets, ITN, Sierra Leone malaria control strategy, Insecticide resistance, Mosquito nets misuse, and ITN misuse.* The Cochrane Infectious Diseases Group Specialized Register, the Cochrane Central Register of Controlled Trials (CENTRAL) published in the Cochrane Library, MEDLINE, Embase, LILACS, the World Health Organization (WHO) International Clinical Trials Registry Platform, ClinicalTrials.gov, and the ISRCTN registry for new trials were also searched. Reports of publications from the WHO, the CDC, and Sierra Leone's MoHS were also consulted. Additionally, Google was another search engine used to retrieve articles for review from Lancet Global Health and Malaria Journal journals

Theoretical Foundation

The theoretical foundation proposed for this study is HBM. The HBM, established in the 1950s by social psychologist Hochbaum, Rosenstock, and Kegels, guided this study. These psychologists posit people's failure to partake in programs to avert and detect disease (Siddiqui et al., 2016).

The HBM is a theoretical model that can guide health promotion and disease prevention programs (LaMorte, 2019; Siddiqui et al., 2016). It is one of the most extensively used models for comprehending health behaviors for its predictive and explanatory characteristics of human actions. The key elements of HBM focus on individual beliefs about health conditions. This, in turn, predicts individual health-related behaviors (LaMorte, 2019; Siddiqui et al., 2016). The model explains the following key factors that influence health behaviors: the individual's perceived threat to sickness or disease (perceived susceptibility), the belief of consequence (perceived severity), potential positive benefits of action (perceived usefulness), perceived barriers to action, exposure to factors that prompt action (cues to action), and the confidence in the ability to succeed (self-efficacy).

Jones et al. (2015) used the HBM as an explanatory framework in communication research while exploring parallel, serial, and moderated mediation in their study. Jones et al. posited there will be optimal behavior change if messages successfully target perceived barriers, benefits, self-efficacy, and threats. While HBM seems to be an ideal explanatory framework for communication research, its use in the field had been limited by theoretical limitations. Notably, variable ordering is currently undefined in the HBM. Therefore, it is not clear whether constructs mediate relationships comparably (parallel mediation), in sequence (serial mediation), or tandem with a moderator (moderated mediation).

In an investigation on the aftermath of an 8-month flu vaccine campaign using HBM, Jones et al. (2015) found a positive correlation between behavior to vaccination exposure and the campaign. Statistical analysis showed a model where the indirect effect of exposure on behavior via perceived barriers and threats was influenced by self-efficacy. More so, there was the possibility that perceived barriers and benefits formed a serial mediation chain. The results indicated that variable ordering in the HBM might be complicated, explaining the past's conflicting results and a good focus for future research (Jones et al., 2015).

Table 4.

HBM Constructs and Study Variables

Study Variables	Measurement scale	Value	HBM Constructs
Parental educational	Ordinal	0 1 2	Modifying variable: individual factor
The economic status of parents	Ordinal	Low Middle High	Modifying Variable: Individual factor
Household size.	Nominal	≤5 >5	Perceived barriers to ITN use (receive intervention)
Residential location (rural VS urban)	Nominal	1 2	Perceived susceptibility to malaria infection
Dependent variable: ITN use to control malaria infection.	Nominal/ dichotomous	Yes No	Self-efficacy

Additionally, Raamkumar et al. (2020) used the HBM-based deep learning classifiers for COVID-19 social media content to examine public perceptions of physical distancing. Specifically, Raamkumar et al. focused on content related to the physical distancing interventions put forth by public health authorities to test the model with a real-world case study. They used a data set for this study prepared by analyzing Facebook comments posted by the public in response to the COVID-19–related posts of three public health authorities. Raamkumar et al. noted that public health authorities recommend interventions such as physical distancing and face masks to curtail the spread of coronavirus disease (COVID-19) within the community. Public perceptions toward such interventions should be identified to enable public health authorities to address valid concerns effectively. The HBM has also been used to characterize user-generated content from social media during previous outbreaks to understand the public's health behaviors.

Albashtawy et al. (2016) mentioned that HBM is useful by focusing on individuals' attitudes, beliefs, and practices. The HBM suggests that a person will take a health-related action such as complementary and alternative medicine if they feel that they can avoid a negatively related condition or side-effects. Contrariwise, a person with a positive expectation of taking a recommended action or perceives that the benefits of taking part in a new behavior will reduce the chances of developing a medical condition or illness and its related symptoms. Perception and attitude might determine how people will practice and behave in individual states. The HBM is widely used in health promotion and health education situations. It was found to predict various health behaviors such as taking a prognostic test, choosing to use a type of treatment or medicine or taking a preventive action regarding any illness (Albashtawy et al., 2016).

Using the HBM as the theoretical framework for this study helped me understand the influences of health behavior on the use of ITN to prevent malaria and identify the factors that may determine such utility in children under five years in Sierra Leone. The HBM is a theory-based framework for understanding the individual choices people make regarding their understanding of their health. The backgrounds of behavior and social change are impacted by cultural norms, traditions, societal and religious beliefs, gender roles, institutional and environmental factors (Diala et al., 2013, Ruyange et al., 2017).

Literature Review Related to key Variables and Concepts

The literature review is discussed under the following sub-headings: the geographical location and population of Sierra Leone, the epidemiology of malaria, malaria transmission, the life cycle of the malaria parasite, environmental factors, ITN ownership and efficacy, parental education level, and household and socioeconomic factors**.**

Geographical Location and Population of Sierra Leone

Sierra Leone has a population of 7,813,215 (Word Bank, 2019). The country is located on the West Coast of Africa, between latitudes 7 and 10 north and longitudes 10.5 and 13 west. (MoHS, 2016, 2020). It is a compact country with a total area of 71,740 km^2 (27,699 sq. ml) on the great bulge of West Africa's 402 km coastline.

The Atlantic Ocean serves as the country's boundary in the west, the north and east by Guinea and south-east by Liberia (Figure 1). The country has varied terrain, ranging from coastline swamps through inland swamps and rain forest to one of the highest mountains in West Africa, the Bintumani, at 2200m. The country's coastal line has several mangrove swamps, which provide the breeding sites for A*nopheles melas* mosquitoes, one of the primary vectors of malaria besides *Anopheles gambiae*, and *Anopheles funestus*.

The typical climate of Sierra Leone is tropical, with temperatures ranging from 21^{o}C to 32^{o}C and a mean daily temperature of 25^{o}C. The country has two major seasons, including the wet season (May to October) and the dry season (November to April), with heavy rains in July and August. It has an average rainfall of about 320cm yearly. The relative humidity is high, extending from 60 to 90%. (MoHS, 2016, 2017, 2020).

Figure 1.

The Geographical Location of Sierra Leone.

According to the MoHS (2017b), the country is subdivided into four administrative regions – the North, East, Southern provinces, and the Western Area, where the capital city (Freetown) is located. Roughly 21% of Sierra Leoneans live in the geographically small Western Area; 35% in the North; 23% in the East; and 20% in the South. These regions are further segmented into 14 districts, as shown in Figure 2. Freetown, the capital, is located in the Western Area. The districts are subdivided into 152 chiefdoms.

Figure 2.

The Fourteen Districts of Sierra Leone

The Government of Sierra Leone (GoSL) has been attempting to devolve many functions to the district and chiefdom levels since the Local Government Act was passed in 2004, with mixed results across its various sectors. The country has roughly fifteen different ethnic groups. The official language is English, and most individuals also speak Krio, the most common local language

The Epidemiology of Malaria in Sierra Leone

In Sierra Leone, malaria is endemic, with a steady perennial transmission in all parts of the country. Malaria is presently the chief cause of illness and death among children under five years and a critical public health challenge in the country. Even though pregnant women and children under five years of age are typically affected, approximately 95% of the whole population is at risk of malaria (MoHS, 2016; WHO, 2019). An estimated 2,240,000 outpatient visits annually in Sierra Leone are due to malaria. About one million out of this figure are children under five years of age. Pregnant women and children under five constitute 4.4% and 17.7 % of the total population, respectively, and are the most vulnerable (WHO, 2019). Malaria accounts for 40.3% of outpatient morbidity for all ages. The MIS (2013) reported the malaria prevalence rate of 43% as measured by microscopy, with the prevalence higher in rural areas (48%) than in urban areas (28%). The prevalence rates of *P. falciparum, P. malariae,* and *P. ovale* in 0-7-year-old children, during two surveys directed over 12 months, averaged 61%, 12%, and 1%, respectively. Groups of feverish children had higher prevalence rates than afebrile groups (Barnish, 1993).

Malaria is a deadly disease. It is caused by parasites transferred through the bites of the infected female *Anopheles* mosquitoes known as malaria vectors (WHO, 2020). There are five parasite species (p. *falciparum*, p. *vivax*, p. *malariae*, p. *knowlesi*, and p. *ovale*) that cause malaria in humans. The two species (*P. falciparum* and *P. vivax*) in sub-Saharan Africa are considered the deadliest (WHO, 2020).

In Sierra Leone, *plasmodium falciparum* is the main parasite mostly responsible for all severe cases and over 95% of uncomplicated cases. The chief vector is *Anopheles gambiae sl*. but other species found in Sierra Leone are *Anophele funestus* and *Anopheles melas*. The *Anopheles gambiae sl is* the dominant specie. The ultimate biting period is between 10 p.m. – 2 a.m. (NMCP, 2017).

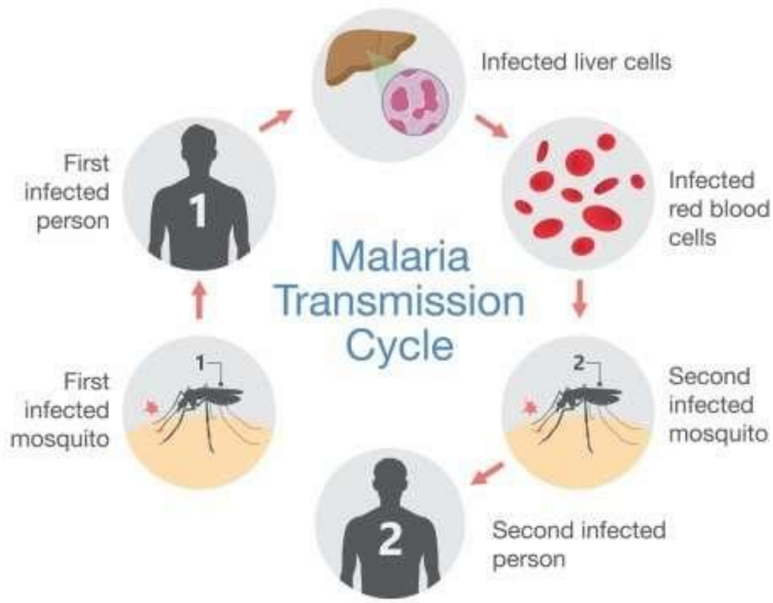
Malaria Transmission

Malaria disease is spread by the bite of an infected female *Anopheles* mosquito. The *Anopheles* mosquito carrying the *P. falciparum* parasite when trying to take a blood meal from a person, injects the parasite into the person. The parasite enters the bloodstream and travels to the liver. The infection develops in the liver before re-entering the bloodstream and invading the red blood cells (Pimenta et al., 2015; WHO, 2020). The mosquito parasites grow, multiply, and develop in the red blood cells. The infected blood cells burst at regular intervals of every 48-72 hours, releasing more parasites into the blood as shown in Figure 3. The mosquito development takes around 15 to 20 days, wherein the infected person shows symptoms of increased perspiration, headache, wariness, and fever (WHO, 2020). Also, there are other acute malaria symptoms such as anemia, jaundice, convulsion, vomiting, bloody stools, and death, predominantly in vulnerable people like children and pregnant women (Pimenta et al., 2015; WHO, 2020).

The transmission's intensity depends on the parasite (agent), the vector, the human host, and the environmental conditions. If a mosquito (vector) bites a person (host) already infected with malaria, it (vector) can also become infected and spread the parasite on to other people (susceptible host). During the transmission mode, the infected mosquito bites a second person, and it is transmitted to the second person. The transmission of malaria is also dependent on climatic conditions that may affect mosquitoes' number and survival, such as rainfall patterns, temperature, and humidity (WHO, 2020). Transfusion of blood from infected persons and the use of contaminated needles and syringes are other potential modes of transmission (Georgia Department of Public Health [GDPH], 2014).

Figure 3.

Malaria Transmission Cycle



This is the triad concept of infection: The *Anopheles* mosquito (vector) ingests blood from an infected person (host). It (vector) picks up the parasite plasmodium. The plasmodium is harmless to the mosquito (vector). However, after being stored in the salivary glands (vector) and then injected into the next person (susceptible host) upon which the mosquito feeds, the plasmodium can cause malaria in the infected person within a favorable environment. Thus, the *Anopheles* mosquito serves as a vector for malaria.

Life Cycle of the Malaria Parasite

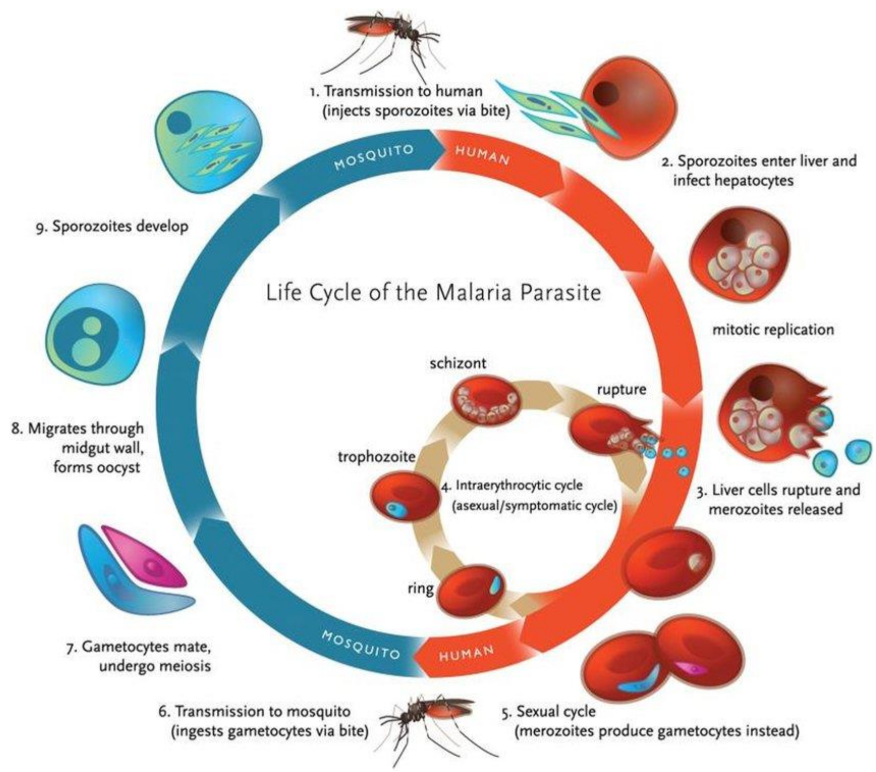
There are nine stages in the life cycle of the malaria parasite, as shown in Figure 4. The process is as follows: Transmission of malaria occurs through a vector, the mosquito, that ingests gametocytes, the sexual form when feeding on an infected human (Center for Disease Dynamics, Economics & Policy [CDDEP], 2013; Wiser, 2020). These gametocytes (both male and female) mate within the mosquito's gut and undergo meiosis. They migrate through the mosquito's midgut wall and form an oocyst, within which thousands of sporozoites develop after 10-18 days. These sporozoites with anticoagulant saliva are injected into a human during the next blood meal. These rapidly make their way to the liver, infect hepatocytes, and begin asexually (mitotically) replicating (CDDEP, 2013; Wiser, 2020). After a period of six to fifteen days, the liver schizonts rupture, releasing thousands of merozoites into the blood where they invade red blood cells. Over the next 48 hours, the parasites begin replicating mitotically, progressing through a set of stages (ring, trophozoite, and schizont) and producing an average of 16 new daughter merozoites per schizont. The schizonts then burst near synchrony with other parasites, creating the characteristic fever cycle that embodies the disease's clinical manifestations. With each replication, some of the merozoites develop into gametocytes, infecting susceptible mosquitoes, thereby beginning a new cycle. See Figure 4.

Environmental Factors

Environmental factors such as altitude, rainfall, humidity, and temperature all play important roles in the malaria transmission cycle. There is a positive correlation between malaria transmission and the warm tropical and subtropical climate (Arab et al., 2014). Humidity and temperature are suitable environments for breeding mosquitoes. Heavy rainfall creates stagnant pools, while ditches act as conducive breeding sites for the mosquitoes, thereby multiplying rapidly (Chua, 2012). Also, parasite growth within the host increases with an increase in temperature to complete the cycle (Jackson et al., 2015).

Figure 4.

The Life Cycle of the Malaria Parasite



In Rwanda, Rudasingwa and Cho (2020) explored the determinants of persistent malaria in children under five years. They found that malaria was more persistent in children living in areas with sea level below 1700 meters, households with a meager income, and who do not use ITNs. Rudasingwa and Cho's findings suggest that those living in low-income families have a higher propensity of contracting malaria infections. However, the disease decreases with increasing altitude. Graves et al. (2009) observed the person, family, and ecological risk factors for malaria contamination in Ethiopia's three provinces. The authors found that possessing an ITN and individual asset index were significant risk factors for malaria infection. They also found that the wealthiest households and households sprayed with insecticides in the last 12 months before the survey had a lower risk of malaria infection. In the three regions studied, maximum rainfall was a strong predictor of malaria (Graves et al., 2009). A similar study by Kaindoa et al. (2018) showed a positive relationship between houses' physical characteristics and surrounding environments on the biting risk of mosquitoes and malaria transmission. These findings indicate why mosquitoes were significantly higher in homes with open eaves, grass roofs, mud walls, and unscreened windows. Kaindoa et al. further revealed that keeping chickens inside the house was also associated with many mosquitoes.

Sierra Leone has varied terrain, ranging from coastline swamps through inland swamps and rain forest to one of the highest mountains in West Africa, the Bintumani, at 2200 meters. There are many mangrove swamps at the country's coastal line which serve as the breeding sites for *Anopheles melas* mosquitoes, one of the primary vectors of malaria besides *Anopheles gambiae Anopheles funestus* (MoHS, 2016, 2017, 2020).

Household and Socioeconomic Factors

Socioeconomic features are useful for understanding the influences affecting well-being services and other health behaviors associated with malaria control (NMCP, 2016). Some of these factors are household and socioeconomic. These could range from personal demographic factors down to materials used in building construction (Bah, 2020). According to literature, household income and educational level are important determinants of malaria. This is because those households with low financial status have limited access to healthcare and thus a high disease burden (Bah, 2020). likewise, education help improves health status as a result of compliance with prevention strategies. Chitunhu and Musenge (2015) reported that either positively or negatively, wealth and academic levels were correlated with deaths due to malaria in children under five years. Moreover, a study completed by Mpimbaza et al. (2017) revealed that households with advanced socioeconomic status and parents with over three children under five years of age are positively correlated with malaria.

Socioeconomic status is a significant variable to consider when measuring the effectiveness of health interventions or programs. More importantly, it is vital to know whether the interventions are accessible by needy community members as much as the comparatively wealthy individuals in society. In their study, Kanmiki et al. (2019) found an upsurge in ownership of ITN with cumulative wealth. In contrast, they noticed that the wealthiest category was 33% less likely to use ITN, equated to the most impoverished class. Nevertheless, despite the relatively high percentage of ownership and use of bed nets, the study has revealed disparities by socioeconomic status such as wealth index, occupation, district of residence, residence location, and religious affiliation (Kanmiki et al., 2019).

Roberts and Mathew (2016) researched malaria risk factors in children under five years in a Ugandan study. They found that household factors such as floor and wall material and the availability of electricity were closely associated with malaria risk factors. Likewise, homes with low income had higher chances of acquiring malaria (Zgambo et al., 2017). A follow-up study by Zgambo et al. revealed that other socioeconomic factors like water and sanitation facilities at the household could exacerbate malaria in children. Also, Ruyange et al. (2016) investigated the factors related to ITN non-use among children under five years. The results suggested that mother, household, and community-level factors were associated with the ITN nonuse among Rwanda's under-fives. They proposed that strategies designed to improve ITN use among under-fives should address individual and community-level elements (poverty, education, birth spacing, and antenatal clinic attendance). Based on this analysis, there is a need to ensure increased ownership and use of ITNs in under-five children by tackling poverty reduction in the community with possible income-generating cooperatives, strengthening women's and girls' opportunities for education.

In Sierra Leone, the problem of malaria affects tourism, creating a significant strain on the economy. WHO (2015) reported that several African countries could not afford the substantial financial cost needed for adequate malaria control as experienced in Sierra Leone. It has been determined that a close relationship exit between malaria, poverty, low economic development in endemic malaria counties, such as Sierra Leone.

The report by WHO (2017) emphasized that malaria is the single largest contributor to death and disability in Sierra Leone, particularly in children under five. Malaria is not only a health challenge –through its impact and the costs that it imposes at the individual, household, and society levels, it is a significant threat to socioeconomic development in Sierra Leone. Because of that, the government of Sierra Leone (GoSL) has identified malaria as substantial health and socioeconomic burden.

Parental Education Level

There has been a marked increase in social promotion and the present free distribution of ITNs in recent epochs. The use of ITNs is mostly affected by the knowledge of people. As the awareness and possession of ITNs increase in families with under-five children, it is expected that there would be a corresponding increase in their utilization for the group most at risk of malaria morbidity and mortality (Iloh et al., 2013). Behavioral patterns of people-utilization of the ITN are dependent on their knowledge of the consequence of non-use (Lonlan et al., 2019).

According to Iloh et al. (2013), the education of primary caregivers in the families, particularly mothers, for whom the priority should be the supply of proper adequate information to counter the commonly held erroneous beliefs and misconceptions on ITNs. The NMCP (2016) reported that 60% of parents in Sierra Leone were entirely conscious that proper use of ITN protects their and community from malaria. Also, NMCP stated that the percentage of parents with complete knowledge of malaria augmented with cumulative education levels, such as 84% of those with no education compared with 91% of those with more than secondary education (NMCP, 2016).

According to Iloh et al. (2013), parental educational status meaningfully influenced the use of ITNs for children under the age of five. According to Esimai and Aluko (2014), the level of knowledge of parents about ITN was the chief determinant of ITN use among those whose children were younger than five years. Degarege et al. (2019) added that public policy measures that can reduce inequity in health coverage and improve economic and educational opportunities for the poor would reduce the malaria burden in SSA. Nkoka et al. (2019) performed a multiple logistic regression analysis to examine a child's associations with maternal and household factors with ITN usage. The study stated that, among others, being aged ≥ 24 months, residing in a female-headed household, without proper or primary education, and with limited access to ITN source was substantially connected with reduced odds of ITN usage. Still, continued efforts to increase awareness of the importance of using ITNs in malaria prevention in Malawi are necessary (Nkoka et al., 2019). The parents should understand the usefulness of ITNs in protecting children against malaria, including free distribution campaigns and ownership of ITNs to control malaria prevalence in a country like Sierra Leone.

Household Ownership and use of Insecticide-Treated Mosquito nets in Sierra Leone

In Sierra Leone, the burden of malaria infection control remains a challenge and public health concern. Malaria accounts for 40.3% of outpatient morbidity for all ages and accounts for 47% of outpatient morbidity for under-five children and 37.6% for hospitalization with a case fatality of 17.6% **(**MoHS, 2016). Malaria transmission is high throughout the year, contributing to partial immunity development within the first two years of life. However, many people, including children, may have malaria parasites in their blood without showing any signs of infection. Such asymptomatic infection contributes to further transmission of malaria and increases the risk of anemia and other associated morbidity among infected individuals.

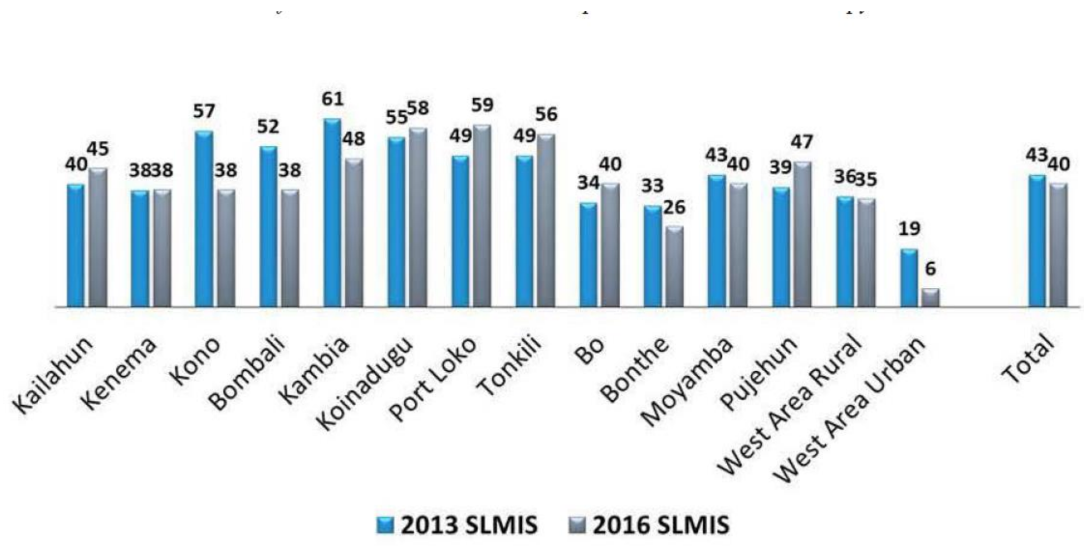
As shown in Figure 5, the Sierra Leonean national malaria prevalence has not changed meaningfully between the 2013 SLMIS and the 2016 SLMIS. However, some district-level changes have occurred. Malaria prevalence declined from 57% to 38% in Kono, from 52% to 38% in Bombali, from 61% to 48% in Kambia, and from 19% to 6% in West Area Urban. During the same period, Malaria prevalence rose from 49% to 59% in Port Loko, from 49% to 56% in Tonkolili, from 39% to 47% in Pujehun, and from 34% to 40% in BO between the 2013 SLMIS and the 2016 SLMIS (NMCP, 2017).

In 1993, trials of ITN started in Sierra Leone, and 5% of children slept under an ITN in 2005. With the help of numerous partners and donors, including WHO and CDC, Sierra Leone achieved significant strides that successfully reduced the number of new malaria cases by 40% over time (MOHS, 2016). The distribution and use of ITNs are cardinal for malaria infection prevention in Sierra Leone.

The NMCP distributed over 1.1 million nets long-lasting insecticide-treated nets (LLIN) to children under one year alongside measles vaccine campaigns. Another 600,000 ITNs were distributed in 2008 through ante-natal and other clinics, and 26% of children slept under an ITN. There was another free distribution of 3.2 million ITNs, and 30% of children slept under an ITN in 2010.

Figure 5.

Malaria Prevalence among Children in Sierra Leone by Region



Also. in 2011and 2013, 72% and 45% of children slept under an ITN. A report from USGMC (2019) revealed that the overall proportion of children under five years using an ITN in all households has remained low at 44 % in Sierra Leone. In November 2010, NMCP distributed over three million LLINs. Bennett et al. (2012) mentioned that among individuals in households possessing more than one ITN, 76.5% slept under an ITN the night preceding the survey. Individuals in homes where the household head had heard malaria messages had correct knowledge of malaria transmission. At least one where one ITN was hanging, there was more probability of having slept under an ITN (Bennett et al., 2012). In conclusion, the mass distribution campaign effectively achieved high coverage levels across the population, notably among rural households where the malaria burden is more elevated.

ITN ownership of at least one ITN from the 2013 baseline of 62% to 100% by 2020 is a priority of the NMCP strategic plan for 2016-2020 (MoHS 2015a). According to the 2016 SLMIS, 60% of households in Sierra Leone own at least one ITN. One of the study findings showed that only 16% of households have at least a net for every two people who stayed in the house the night before the survey. Ownership of ITNs increased from 37% in the 2008 SLDHS to 62% in the 2013 SLMIS and remained at similar levels in 2016 (60%) (See Table 5).

Table 5

Insecticide Treated Net use by Children Under Five Years of Age

Indicator	2008 DHS	2013 DHS	2013 MIS	2016 MIS	2017 MICS
% Households with at least one ITN	37%	64%	62%	60%	71%
% Population with access to an ITN	15%	15%	17%	16%	33%
% Children under five who slept under an ITN the previous night	61%	49%	69%	71%	78%
% Pregnant women who slept under an ITN the previous night	70%	53%	76%	75%	83%
% Population that slept under an ITN the previous night	NA	42%	39%	39%	53%
% of the population using LLINs among those with access	NA	NA	62%	63%	72%

DHS – Demographic Health Survey, MIS – Malaria Indicator Survey, MICS – Multiple Indicator Cluster Survey

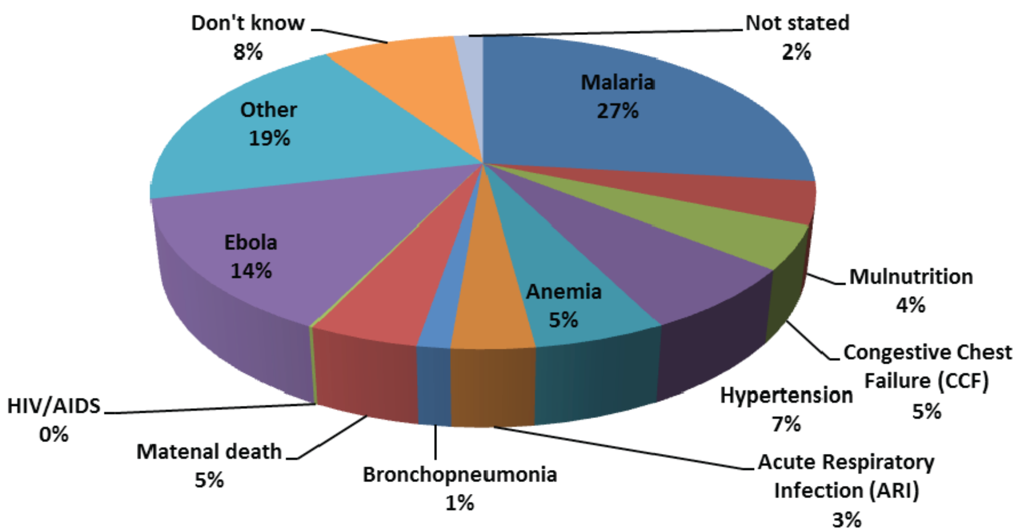
The percentage of households with enough ITNs to cover the entire household population increased from 7% in the 2008 SLDHS to 17% in the 2013 SLMIS and remained at similar levels in 2016 (16%). Also. in 2011and 2013, 72% and 45% of children slept under an ITN. A report from USGMC (2019) revealed that the overall proportion of children under five years using an ITN in all households has remained low at 44 % in Sierra Leone.

However, despite the massive progress achieved in ITN distribution, malaria remains a public health concern and endemic disease. In the 2017 MoHS report, for all age groups, more than 40% of outpatient morbidity is due to malaria, while malaria accounted for 47% of morbidity in under-five children. It also accounts for 37.6% of all hospitalizations, with a case fatality of 14.6%. Routine data on malaria cases and deaths are weak, but available information indicates that they account for 25% of deaths of all ages and 38% among under-five children (MoHS, 2017). Malaria is the primary cause of illness and death amongst children younger than five years in Sierra Leone. From 2008 to 2019, there were 31 fewer malaria deaths among children under five years of age, representing a 19.9% drop (Table 2). Figure 6 shows the morbidity of diseases in the country, with malaria at 27% the highest.

A study by Konlan et al. (2019) found out that ownership of ITN was higher (80.7%) than its utilization (41.7%). They reinforced that to ensure high ITN coverage and utilization; there is a need for a continuous distribution of ITNs to households. Households should be sensitized to use the nets to prevent the persistent spread of malaria. Notwithstanding, Degarege et al. (2019) conducted a systematic review and meta-analysis on the effects of housing structure, education, occupation, income, and wealth on malaria, which can help design socioeconomic interventions for the disease. Results revealed that lack of knowledge, low income, living in poorly constructed houses, and having an occupation in farming might increase the risk of *Plasmodium* infection among SSA people.

Figure 6.

Causes of Death in Sierra Leone



Although malaria prevalence has witnessed a significant reduction within the past decade, Ngonghalaa et al. (2016) emphasized that malaria still constitutes the most critical health and economic problem, especially in low-income countries. ITNs remain one of the primary measures for preventing malignant disease. Unfortunately, the success of ITN campaigns is hampered by improper use and natural decay in ITN-efficacy over time. Since 2000, malaria control progress had resulted mainly from extended access to vector control interventions, particularly in sub-Saharan Africa. Still, these fragile improvements are threatened by emerging resistance to insecticides among *Anopheles* mosquitoes. Without being checked, insecticide resistance could lead to a considerable increase in malaria incidence and mortality. The crucial action is essential to prevent the additional development of resistance and maintain the effectiveness of existing vector control interventions (WHO, 2020).

The ITNS are known to kill mosquitoes and have proven repellent properties that decrease the number of mosquitoes that enter the house. They are considered to be twice as effective as untreated nets and provide more than 70% protection equated with no bed nets (Ntonifor & Veyufambom, 2016; Shah et al., 2020). The health-related side effects of using ITNs include heat discomfort and insecticide irritation. Among the ITN users, infants are considered biologically more vulnerable and likely more susceptible to insecticide side effects aggravated by oral exposure (Lu et al., 2015). It has been observed that infants frequently suck and chew ITNs, which may accumulate insecticide in their bodies.

Moreover, young infants are likely more susceptible to synthetic pyrethroids' neurotoxic effects compared to older children. Systemic toxicity may develop after intense dermal exposure, inhalation, or ingestion. Systemic toxicity symptoms include headache/dizziness, convulsion, fatigue, vomiting, tingly or burning sensation, cough, pinkeye, skin eruption, and rhinitis (Lu et al., 2015).

Associating ITN access and ITN use indicators can help programs detect a behavioral gap in which accessible ITNs are not used. Suppose the change among these indicators is significant. In that case, the program may want to focus on behavior modification and how to detect the critical issues to ITN use to strategy a suitable intervention. This examination supports the ITN program's control, whether they need to attain higher ITN coverage, encourage ITN use, or both (NMCP, 2017a).

Summary and Conclusion

Malaria is a curable and preventable disease that plagues many countries and presents one of SSA's most significant public health concerns. Malaria is the primary cause of illness and death amongst children younger than five years in Sierra Leone. (NMCP, 2016). This disease is considered a significant impediment to socioeconomic development on individuals and communities and leads to poverty in Sierra Leone (USGMC, 2019). In efforts to control and eliminate malaria in Sierra Leone, in 2006, the NMCP was established to distribute free ITNs to children under five years every three years. However, despite the massive progress achieved in ITN distribution, malaria remains a public health issue and an endemic disease. Since 2006, more than 4 million ITNs had been distributed to households with children under five years.

ITNs prevent malaria spread because it acts as a barrier between humans and mosquitoes (WHO, 2020). ITNs remain the most effective tool available to prevent malaria; ensuring high access to and using it is crucial to their success (Ahorlu et al., 2019). Current literature revealed that ITNs reduce the prevalence of malaria, malaria-related illnesses, and deaths among children under five years. However, none of these studies that examined the effectiveness of ITN as a malaria control tool in Sierra Lone analyzed the risk factors associated with the use of ITNs to control malaria infection. This study will explore the reasons for the low use of ITNs among children. HBM theory will guide this quantitative cross-sectional study. The literature review examined the following factors that may affect the use of ITN; side effects of insecticide, discomfort (heat), parental awareness, access / low ITN ownership and coverage, damaged or turned

ITN, Using ITN for fishing. The next chapter outlined the study's research design with a detailed explanation of the research methodology used to investigate the research questions.

Chapter 3. Methodology

Introduction

This quantitative cross-sectional study investigated the association between a set of independent risk factors (parental education, parents' economic status, household size, and residential location in Sierra Leone) and the use of ITNs as malaria control measures among children under five years of age in Sierra Leone**.** The study results may guide the development of appropriate education and outreach in Malaria prevention interventions among children under five years of age. I also explored other variables, such as the side effects of ITN use, gender, and age on ITN use.

This chapter described the justification of the choice and design of the study. I described the study area, the source of data, and how it was accessed. This chapter also composed an account of the variables collected, their measurements scale, sampling procedure, and data analysis plan. Other important areas addressed consist of the study's internal and external validity, ethical concerns, and a summary of the research methods, and the transition to the next chapter.

Research Questions and Hypotheses.

The following are the research questions this study answered:

Research Question 1: Is there an association between parental education and ITN use among children under five years of age in Sierra Leone?

$H_0 1$: There is no association between parental education and ITN use among children under five years of age in Sierra Leone

*H_a*1: There is an association between parental education and ITN use among children under five years of age in Sierra Leone

Research Question 2: Is there an association between the economic status of parents and ITN use among children under five years of age in Sierra Leone?

*H_0*2: There is no association between the economic status of parents and ITN use among children under five years of age in Sierra Leone.

*H_a*2: There is an association between the economic status of parents and ITN use among children under five years of age in Sierra Leone

Research Question 3: Is there an association between household size and ITN use among children under five years of age in Sierra Leone?

*H_0*3: There is no association between the household size and ITN use among children under five years of age in Sierra Leone.

*H_a*3: There is an association between the household size and ITN use among children under five years of age in Sierra Leone.

Research Question 4: Is there an association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone?

*H_0*4: There is no association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone.

*H_a*4: There is an association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone.

Research Question 5: What is the association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone?

$H_0$5: There is no association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone

H_a2: There is an association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone

Research Design and Rationale

This quantitative study investigated the association between risk factors and ITNs as a useful malaria control strategy among children under five years of age. Precisely, this study examined the role of the following independent variables: parental education, economic status of parents, household size, residence (rural vs. urban), and their associations with the outcome of ITNs use (dependent variable) in the control of malaria among children under five years of age in Sierra Leone. The role of the following covariates: side effects of ITN use, gender, and age were also checked on ITN use.

This study utilized a quantitative approach to examine and understand the association between independent and dependent variables. It also included pre-identified secondary data gathered by the Sierra Leone MoHS. The research questions were focused on determining the associations between different independent variables and the dependent variable and the potential effects of some covariates. Employing a quantitative research design had an advantage because I examined the various hypotheses on appraising the changing relationships and predictive capabilities among the independent and dependent variables and the bond of such relationships. A qualitative method was unsuitable as it is generally based on words, not figures, on exploration, not associations (Frankfort-Nachmias & Nachmias, 2008).

A quantitative cross-sectional design was planned for this study. In a cross-sectional study, the investigator gathers information from the whole study population at a single point in time to investigate the association between the variables of interest and disease (Dubois et al., 2019; Ridder, 2017). The cross-sectional study is like a snapshot of the population requires a one-time evaluation of the study's independent and dependent variables, i.e., a disease condition or other health-related characteristics in a population at a given point in time. Findings from a cross-sectional study can be generalized to the population. It also has the advantage of being easy to conduct and fast to execute. I used a cross-sectional study to examine factors that influence the use of ITNs to control malaria prevalence, including socioeconomic status (parental education and income), household size, and residential location (rural vs urban).

Secondary data were used for this study. Secondary data or archival data are data previously collected by another person for a different purpose and now available for use to seek new information. Therefore, the secondary or archival data comprises re-analyzing previous data for added investigation (The Oxbridge Research Group, 2020). The use of secondary data is advantageous as it reduces cost and time. The use of secondary data is usually guided by the following steps: the identification of the research question, identification of a suitable dataset, evaluation of the dataset for reliability and adequacy, and analysis of the data set to answer the research question (Johnston, 2014).

Methodology

Study Area

This study covered the country of Sierra Leone. The country is located on the West Coast of Africa. The typical climate in Sierra Leone is a tropical climate with temperatures ranging from 21^{o}C to 32^{o}C and a mean daily temperature of 25^{o}C. The country has two major seasons, including the wet season (May to October) and the dry season (November to April), with heavy rains in July and August. (MoHS, 2016). According to the MoHS (2017b), the country is subdivided into four administrative regions – the North, East, Southern provinces, and the Western Area, where the capital city (Freetown) is located. Roughly 21% of Sierra Leoneans live in the geographically small Western Area; 35% in the North; 23% in the East; and 20% in the South. These regions are split into 14 districts, and the districts are further subdivided into 152 chiefdoms. Freetown, the capital, is located in the Western Area. According to WHO (2019), Sierra Leone has a total population of 7.8 million people based on the most recent national census led in 2018.

Study Population.

The ownership and use of insecticide-treated nets (ITNs) have been shown in multiple settings across sub-Saharan Africa to reduce clinical episodes of malaria and all-cause child mortality (Bennet et al., 2012). In 2018, children younger than five years were the most vulnerable group affected by malaria. They accounted for 67% (272 000) of the global malaria deaths (WHO, 2020). The target population in this study will comprise of children under the age of 5 years (0 to 59 months) living in Sierra Leone.

Sampling and Sampling Procedures

Sampling is a method that allows researchers to infer information about a population based on results from a subset of the population, without having to investigate every individual. For example, reducing the number of individuals in a study minimizes the cost and workload. It may help obtain high-quality information. However, this needs to be balanced against having a large enough sample size which has enough power to detect a real association. This quantitative investigation employed pre-identified secondary data gathered by the Sierra Leone Ministry of Health and Sanitation (MoHS) from the MIS in partnership with the NMCP and ICF International (MIS, 2016). The sampling strategy stems from the research design and methods (Mann, 2015). For this study, all the 14 districts of Sierra Leone were included. This ensured the representativeness of all the parts of Sierra Leone and enhance generalizability. There are no time constraints or logistic restrictions to access data because the study was secondary data analysis.

Sampling Frame

Archival data obtained from the 2016 SLMIS were used for this quantitative study. The SLMIS was conducted by the National Malaria Control Programme (NMCP) of the MoHS, collaborating with Catholic Relief Services, College of Medicine and Allied Health Sciences University of Sierra Leone, and Statistics Sierra Leone (MoHS, 2016). The 2016 SLMIS was a cross-sectional household survey to estimate demographic and health indicators related to malaria. The study indicators are characterized by the percentage of households with ITN, malaria occurrence between children, treatment, and ITN use between children and pregnant women. The data entry for children younger than five years in the dataset served as the sample frame of this study. The available dataset contains 6720 households, 8526 women identified in the survey with 8,501 women between 15 and 49 years, and 7677 children under five years of age.

Sample Size Analysis

An important aspect of planning a study is calculating the sample size (Kadam & Bhalerao, 2010; Noordzij et al., 2010). The calculation of adequate sample size is the process by which one calculates the optimum number of participants required to arrive at ethically and scientifically valid results (Kadam & Bhalerao, 2010; Noordzij et al., 2010). G*Power statistical power analysis tool was used for sample size determination.

Power Analysis

Determining the optimal sample size for a study assures an adequate power to detect statistical significance. Hence, it is a critical step in the design of a planned research protocol. There are three factors that affects the determination of sample size. The computation of a suitable sample size depends on the choice of three features, including the effect size, statistical power, and alpha level (Suresh & Chandrashekara, 2012). The statistical methods appropriate to the sample size based on these outcomes measure is critical for the study. For example, a larger sample size is required to assess the nominal variable compared to the continuous outcome variable (Suresh &

Chandrashekara, 2012). The alpha is the probability of detecting a significant difference when the treatments are equally effective or risk false-positive findings. For example, the alpha level used in determining the sample size in most academic research studies is either 0.05 or 0.01. Therefore, effect size appraises the numerical strength of the association between the independent and dependent variables. Simultaneously, the power or 1- beta (1- β) is the probability that you will reject the null hypothesis. (and thus, avoid a Type II error) (Suresh & Chandrashekara, 2012). It is generally accepted that power should be .8 or greater. For example, statistical power is positively correlated with the sample size, which means that given the level of the other factors, viz. alpha and minimum detectable difference, a larger sample size gives greater power.

The sample size was calculated by G*Power 3.1.9.4 statistical analysis device (Faul et al., 2009). According to Kadam and Bhalerao (2010) and supported by Noordzij et al. (2010), the sample size for any survey depends on the acceptable level of significance, power of the research, expected effect size, underlying event rate in the population, and the standard deviation. In this study, a medium effect size was employed for sample size calculation to avoid an effect size that is neither difficult nor easy to identity. As there are fewer compromises on the value of statistical power to employ a default power of 95%, this study used a default alpha value of 0.05. The purpose for sample size calculation is to acquire a satisfactory number of study units capable of reflecting unidentified parameters after data collection. Figures 7 and 8 show the sample size calculation details using G*Power sample size calculation software. For this study, the minimum vital sample size was 1188. However, a census was done since every available entry in the database was used for the secondary data analysis. As the sample size increases, the probability of obtaining a result close to the real mean for the population increases. Also, the less the magnitude of the error we accept, the larger the needed sample size. In other words, a larger sample size is the price that we pay for less error and more certainty (Kamangar & Islami, 2013)

Secondary Data Evaluation

This study's secondary data were sourced from the Sierra Leone Ministry of Health and Sanitation (MoHS). The 2016 Sierra Leone Malaria Intervention Survey was conducted by the National Malaria Control Programme (NMCP) in collaboration with Catholic Relief Services, College of Medicine and Allied Health Sciences University of Sierra Leone, and Statistics Sierra Leone (MoHS, 2016).

MIS Study Objectives

The resolution of the 2016 SLMIS was to provide efficient approximations of demographic and health indicators connected to malaria, such as the percentage of households with ITN, malaria occurrence between children, treatment, and ITN use between children and pregnant women. The cross-sectional survey aimed to provide key malaria indicators for the whole country, urban and rural areas, and for each of the four provinces, specifically north, south, east, and west. The broader goal was to improve the country's health and provide estimates of indicators defined in the 2016-2020 National Malaria Strategic Plan. Data collection took place from 29 June 2016 to 4 August 2016.

MIS Sample Design

This survey's sampling frame came from the most recent Sierra Leone National Population and Housing Census conducted in 2015 (MoHS, 2016). The 2016 SLMIS employed a two-stage sample design with estimates of key indicators for the national, urban and rural areas, four regions/provinces (Northern, Southern, Eastern, and Western), fourteen administrative districts (Bo, Bombali, Bonthe, Kailahun, Kambia, Kenema, Koinadugu, Kono, Moyamba, Port Loko, Pujehun, Tonkolili, Western Area Rural, and Western Area Urban) (MoHS, 2016).

Figure 7.

*Calculation of Sample Size Using G*Power 3.1.9.4*

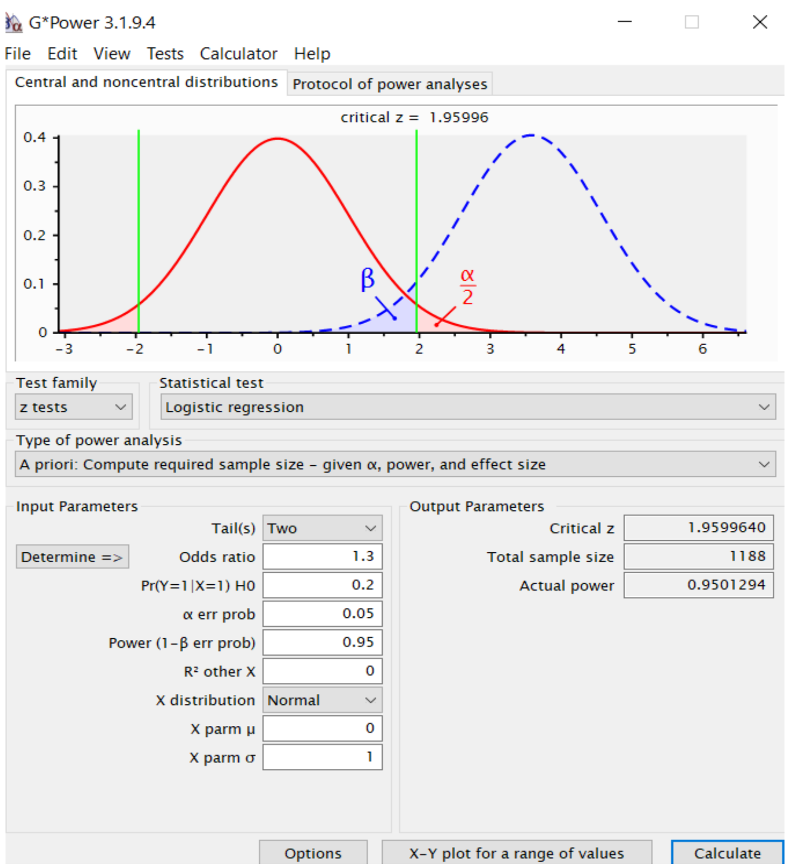
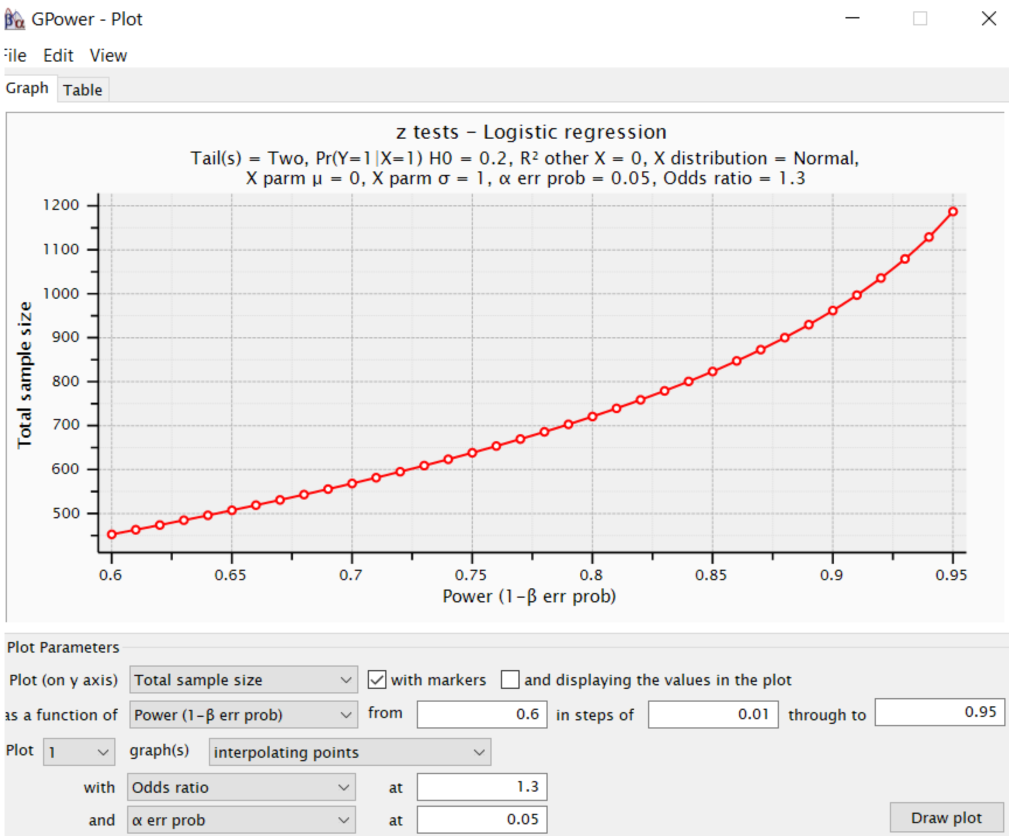


Figure 8.

*Graphic Analysis of Sample Size Using G*Power 3.1.9.4*



The first stage of sampling involved selecting sample points (clusters) from the sampling frame. This study used enumeration areas (EAs) defined by Statistics Sierra Leone for the 2015 Sierra Leone Population and Housing Census (SLPHC) that were used as the sampling frame (SSL 2016). Out of 12,856 enumeration areas (EAs), 336 clusters were selected using the probability proportional sampling method. Of the 336 clusters, there were 237 in rural areas and 99 in urban areas. To achieve statistical representation, the rural areas were oversampled within regions to produce sound estimates (MoHS, 2016).

The second phase of sampling included the orderly selection of households. The households were randomly selected from a household listing of the selected EAs (MoHS, 2016). Twenty households were selected from each EA, giving a total sample size of 6,720 households. There were 8526 women identified in the survey, with 8,501 women eligible between 15 and 49 years and 7677 children under five years of age (Figure 9). The children aged 6-59 months were examined for anemia and malaria infection after seeking their parent's or guardian's consent (MoHS, 2016). The 2016 SLMIS comprised the malaria prevalence between children, the percentage of households with ITN, treatment, ITN use between children and pregnant women. The selected households eligible for the interview included women aged 15-49 and their children under five years. To accommodate sample allocations in proportion to each district’s population, districts with small populations were oversampled. The population of children under five years served as the study population for this research.

MIS Archival Data

Data collection for the SLMIS data were done between June and August 2016 via questionnaires using computer-assisted personal interviewing software programed on tablet computers.

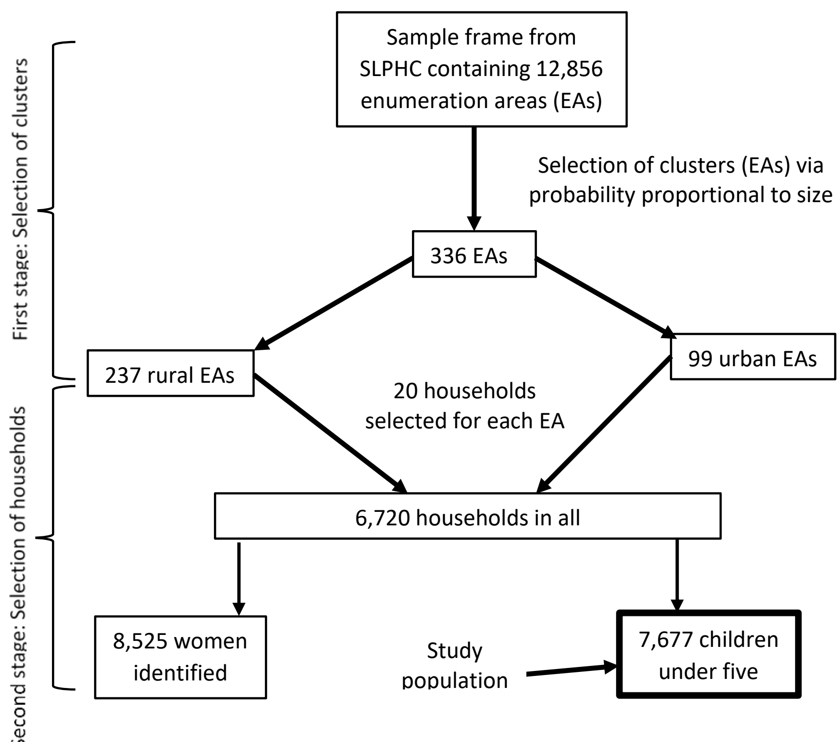
MIS Questionnaire

The questionnaire used for the study was an adaptation of the standardized instrument from the rollback malaria monitoring and evaluation group (RBM-MERG) (Rollback Malaria, 2000). The 2016 SLMIS used three fundamental questionnaires, including the Household Questionnaire, the Woman's Questionnaire, and the Biomarker

Questionnaire, available from the RBM-MERG adapted to reflect the population and health issues relevant to Sierra Leone. The Household Questionnaire collected essential information on each person's household characteristics, including age, sex, income, and education. The questionnaire was completed to gather information on women's age and suitable for the interview, including children age 6-59 months ideal for anaemia and malaria testing.

Figure 9.

Malaria Indicator Survey Design



The women questionnaire, among others, asked the following questions (i) characteristics such as education, media exposure; (ii) birth history and childhood mortality; antenatal care and malaria prevention for most recent birth and pregnancy;

control and treatment of malaria among children under five years; (iv) and knowledge about malaria and mosquito nets. The third, the Biomarker Questionnaire, was employed to document the outcomes of the anaemia and malaria testing of children 6-59 months. Testing for malaria in the study was done using the rapid diagnostic tests (RDT) kit (MIS, 2016). The questionnaires were in English and automated onto tablet computers, allowing computer-assisted personal interviewing (CAPI) for the survey. A copy of the Biomarker questionnaire for children younger than five years is attached as Appendix A

Data Accessibility and Permission

The information regarding the 2016 SLMIS dataset is accessible publicly on the Demographics and Heath Survey Program website and the Sierra Leone Ministry of Health and Sanitation for research resolutions. To be permitted to use these data, the researcher must provide personal information, such as name, address, associated institution, and phone numbers, including the title, purpose, and a brief description of the study for which the data is being requested. I applied for access to the data by securing a data use agreement and letter of confidentially or permission to use the data. A representative from the Sierra Leone Ministry of Health signed the data use agreement, subsequently countersigned by Walden University’s Institutional Review Board (IRB). Appendix B is a copy of the letter of agreement.

Types of Variables and Measurement

In this study, there are seven variables relevant to the dataset. The variable code, variable name, measurement scale, value, and definition of the variables are as shown in Table 6.

Table 6

Variables and Operationalization

Variable name	Variable Label	Measurement scale	Value	Definition
PARENTAL_EDUC	Educational	Ordinal	0	No Education
			1	Primary school
			2	HS & Above
WEALTHINDEX	Income	Ordinal	1	Poor
			2	Middle
			3	Richer
HOUSEHOLD	Household size	Nominal	≤ 5	
			> 5	
RESIDENCE	Residential location (rural VS urban)	Nominal	1	Rural
			2	Urban
AGE_CHILD	Child’s age	Ratio/Continuous	6 -59	Months
SEX_CHILD	Child’s gender	Nominal/Dichotomous	0	Male
			1	Female
ITN _USE.	ITN use to control malaria prevalence.	Nominal/Dichotomous	0	Negative
			1	Positive

Data Analysis Plan

The relevant fields from the secondary data were copied and transferred into the SPSS software. I conducted an exploratory examination of the database employing frequency distributions to search for missing data, omissions, entry mistakes, and double entries to determine the database's appropriateness (Jena & Kar, 2019; Tenneh, 2016). SPSS version 25 software was used for data analysis. Data analysis followed the research questions.

Research Questions

RQ1: Is there an association between parental education and ITN use among children under five years of age in Sierra Leone?

RQ2: Is there an association between parents' economic status and ITN use among children under five years of age in Sierra Leone?

RQ3: Is there an association between household size and ITN use among children under five years of age in Sierra Leone?

RQ4: Is there an association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone?

RQ5. What is the association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone?

The analysis started with a descriptive statistic of all the variables and consisted of central tendencies for continuous variables (age of the children), frequency tables for nominal and ordinal variables. This was followed by simple logistic regression to answer Research Questions 1 to 4 and multiple logistic regression for Research Question 5.

Using the Statistical Package for the Social Sciences (SPSS) version 25, I appraised the data and computed descriptive and inferential statistics to determine whether there was an association between the dependent and independent variables. I examined the association between variables that can either disprove or authenticate the stated hypothesis. Including the application of frequencies and percentages helped with the summarization of the variables. Multicollinearity can affect any regression model with more than one predictor.

Before analyzing logistic regression, the study tested for the assumption of multicollinearity which makes it tedious to assess the independent variables' relative importance highlighting the difference triggered by the dependent variable. Therefore, this study determined the regression model's multicollinearity using the variance inflation factor (VIF), which detects the correlation between independent variables and the correlation's strength. Then, simple logistic regression analysis was used to determine ITN use predictors among children under five years of age. Simple logistic regression is a suitable approach to delineate the relationship between the dichotomous outcome and a group of independent (predictor) variables. In logistic regression, the dependent variable indicates simple or dichotomous features (Tonidandel & LeBreton, 2010). This study conducted all statistical tests at a 5% significance level.

Threats to Validity

Research is a crucial part of current validity, enabling individuals, economies, and communities to progress and grow. The most critical characteristic of quality is research validity, or whether the outcomes of studies are construed and understood acceptably. Both internal and external validity are concepts that mirror whether or not the research outcomes are trustworthy and meaningful (Frey, 2018; Slack & Draugalis, 2001).

Internal Threats to Validity

The question of inadequate training of field workers involved in the survey poses a potential threat to validity when using secondary data. Pretest training took place from 29 April 2016 to 20 May 2016, and 35 people participated in the practice, including four supervisors, four biomarker specialists, four nurses, four data collectors, and four laboratory scientists. Participants were trained to administer paper questionnaires, using computer-assisted personal interviewing (CAPI), and collect biomarkers. The questionnaires were modified based on findings from the pretest to improve the quality of work. There were 28 teams regarding the fieldwork and organized field data collection (interviewing techniques and field procedures). For maximum supervision, all 28 teams were visited by national monitors, mostly the technical working group, at least once every week.

External Threats to Validity

The priority of the survey is maximizing data quality. Therefore, the Demographic Health Survey and Population Commission created a supervisory research team consisting of interviewers, nurses, laboratory scientists, supervisor/editor (team leader), and one driver. These supervisors were responsible for monitoring the work's quality by ensuring and reinforcing appropriate interviewing procedures and followed the testing guidelines. The coordinators were also charged with evaluating fieldwork activities to ensure high data gathering standards and data entry. They reviewed data frequencies and tables to identify data inconsistencies and errors, and these errors were flagged and reviewed for follow up and resolution. Based on the review's outcome, Quality Control staff traced the teams to readminister the surveys, if required, after the fieldwork. This was an effort to enhance the reliability of the tool and the validity of the measurement. Another potential threat to validity could include data entry errors, unclear data, and field workers not following proper interview procedures. These potential threats were minimized on the SLMIS by employing qualified and skilled personnel to oversee data entry activities.

The questionnaires were in English, and they were programmed onto tablet computers, enabling the use of computer-assisted personal interviewing. Staff were trained to work in regions with the same dialect to help community members clearly understand the questionnaire components in the survey to increase validity. Moreover, supervisors were responsible for proper data classification and entry verification, edited reports, tracked progress, and safeguarded the data entry process's quality and appropriateness. The potential for generalizing the study's decisions to the general (ITN use to control malaria) population exists because the study participants were chosen from the ITN distribution campaign intervention in Sierra Leone.

Ethical Procedures

This quantitative study used secondary data collected by SLMIS. This is anonymous data that did not comprise the study participants' identity. The data is publicly accessible data on the Demographics and Heath Survey Program website and de-identified. I sought permission to access the data by securing a data use agreement and letter of confidentially to use the data. A representative from the Sierra Leone Ministry of Health signed the data use agreement, and then, by Walden University's Institutional Review Board (IRB). Appendix B is a copy of the data use agreement, letter of confidentially, and permission to use the data.

As part of the requirement for conducting biomedical research, I submitted my research proposal to Walden University’s IRB. Further work on my study was based on proper assessment and approval from Walden IRB. Walden IRB approval number is: (04-08-21-0169634). Since I worked with secondary data, consent was implied. I ensured that my data analysis does not in any way bring about the identity of any participant. I also ensured that the data were securely kept on my computer, only accessible by a passcode. The data will be deleted from my computer after five years.

Summary

This quantitative cross-sectional study investigated the association between a set of independent risk factors and the use of ITNs as the outcome to control malaria infection among children under five years of age in Sierra Leone. The choice and rationale for the study design were discussed. The study was based on secondary data analysis. The data were sourced from the SLMIS. An evaluation of the source, credibility, and adequacy of the secondary data were done. The proposed variables and their operationalization were discussed. This study's sampling strategy was appraised, the measurement instrument examined, and the proposed data analysis plan.

The threats to the external and internal validity of secondary data were thoroughly discussed, including how to alleviate or mitigate their effect on the study. The study elaborated on ethical procedures and the steps to obtain access to the secondary data and maintain patients confidentially, including approval from Walden University IRB to commence using the secondary dataset. The next chapter narrated the results from the data analysis.

Chapter 4: Results

Introduction

The purpose of this quantitative cross-sectional study was to investigate the association between a set of independent variables (parental education, parents' economic status, household size, and residential location in Sierra Leone) and the use of ITNs as malaria control measures among children under five years of age in Sierra Leone**.** The study results may guide the development of appropriate education and outreach in malaria prevention interventions among children under five years of age. The multiple analyses also included covariates of age and gender.

The study investigated five associations between the independent and dependent variables as stated in the research questions and hypothesis below:

Research Question 1: Is there an association between parental education and ITN use among children under five years of age in Sierra Leone?

$H_0$1: There is no association between parental education and ITN use among children under five years of age in Sierra Leone

H_a1: There is an association between parental education and ITN use among children under five years of age in Sierra Leone

Research Question 2: Is there an association between the economic status of parents and ITN use among children under five years of age in Sierra Leone?

$H_0$2: There is no association between the economic status of parents and ITN use among children under five years of age in Sierra Leone.

*H_a*2: There is an association between the economic status of parents and ITN use among children under five years of age in Sierra Leone

Research Question 3: Is there an association between household size and ITN use among children under five years of age in Sierra Leone?

*H_0*3: There is no association between the household size and ITN use among children under five years of age in Sierra Leone.

*H_a*3: There is an association between the household size and ITN use among children under five years of age in Sierra Leone.

Research Question 4: Is there an association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone?

*H_0*4: There is no association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone.

*H_a*4: There is an association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone.

Research Question 5: What is the association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone?

*H_0*5: There is no association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone

H_a2: There is an association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone

The findings regarding these questions and associated discoveries are enumerated in this chapter. This study used a secondary dataset for analysis. The chapter also explains the different statistical analyses employed for addressing the research questions, and a summary of the results.

Analysis of the Secondary Data

The archival data used for this study were obtained from the 2016 Sierra Leone Malaria Intervention Survey (SLMIS). The SLMIS was conducted by the National Malaria Control Programme (NMCP) of the MoHS, collaborating with Catholic Relief Services, College of Medicine and Allied Health Sciences University of Sierra Leone, and Statistics Sierra Leone (MoHS, 2016). The 2016 SLMIS was a cross-sectional household survey to estimate demographic and health indicators related to malaria. The study indicators were characterized by the percentage of households with ITN, malaria occurrence between children, treatment, and ITN use between children and pregnant women. Data collection took place from 29 June 2016 to 4 August 2016 via questionnaires using computer-assisted personal interviewing software programmed on tablet computers.

The data entry for children younger than five years in the dataset served as the sample frame of this study. The available dataset contained 6720 households, 8526 women identified in the survey with 8,501 women between 15 and 49 years, and 7677 children under five years of age (Figure 9). This data had been de-identified as all information that can lead to a breach of confidentiality had been removed. An assessment of the dataset showed that the relevant variables needed to answer the study's research questions were included. However, of the 7677 data for children under five years, 6213 entries were complete. The minimum sample size determined by G*Power 3.1.9.4 statistical analysis tool was 1188. Some of the variables had to be recoded to fit the needed variable operationalization. Since it was a secondary data analysis and the data were available, the 6213 available entries for children under 5 years were used for data analysis

Results

Demographic Characteristics of Study

Tables 7 and 8 summarize the demographics of the parents and the children included in the analysis. Table 7 shows that most of the parents interviewed were males (78.4%), those with no formal education were 62.8%, and about half (51.7%) of the parents were poor. Nearly all the household size was less or equal to five people (98.1%), and most of these households resided in the rural areas (72.4%).

Table 7

Demographic Characteristics of Parent

Variables	Frequency	Percentage
Gender		
Male	4870	78.4
Female	1343	21.6

Education		
No education	3903	62.8
Primary	906	14.6
High school and above	1404	22.6
Wealth index		
Poor	3214	51.7
Middle	1282	20.6
Rich	1717	27.6
Household size		
≤5	6096	98.1
>5	117	1.9
Residence		
Urban	1717	27.6
Rural	4496	72.4

Table 8 shows that the gender distribution of the children is nearly equal. Likewise, the age distribution of the children is averagely 20% for each age group.

Table 8

Demographic Characteristics of Children

Variables	Frequency	Percentage
Gender		
Male	3126	50.3
Female	3087	49.7
Age of children (months)		
0-11	1342	22.5
12-23	1209	20.3
24-35	1075	18.0
36-47	1174	19.7
48-59	1160	19.5

(Mean age is 23.16 ± 17.28 months)

Research Question 1

This question addressed the association between parental education and ITN use among children under five years of age in Sierra Leone. These are two nominal variables. Pearson Chi-Square statistic for independence was used to test the association between these nominal variables, and simple logistic regression was used to assess if parental education can predict the use of ITNs. The Chi-square test for independence was to check whether the distribution of the nominal variables differ one from the other. Tables 9 and 10 showed the results of these analyses. Table 9 is the result of the Chi-squared analysis between parental education and ITN use. The table shows that those parents without formal education and those with primary education use ITN more than those whose educational level was high school (HS) and above. However, this was not statistically significant χ^2 (2) = 4.88, (p = 0.087).

Table 9

Association Between Parental Education and ITN use Among Children Under Five Years in Sierra Leone

Parental Educational Level	Use Insecticide Treated Net		χ^2	*p*-value
	Yes	No		
No education	2275(97.1)	68(2.9)	4.881	0.087
Primary	531(97.3)	15(2.7)		
HS above	780(95.6)	36(4.4)		

Likewise, Table 10 showed the result of the simple logistic regression of the analysis. Using no formal education as a reference for the analysis, the table showed that those with high school and above have about 30% less odds of using ITN (OR 0.3, 95% CI: 0.04 – 2.6, *p* = 0.278), while those with primary school educational level had 62% less odds of using ITN compared to those without any formal education (OR 0.6, 95% CI: 0.3 – 1.1, *p* = 0.128).

Table 10

Simple Logistic Regression of Parental Education and ITN use Among Children Under Five Years in Sierra Leone

Parental Education	Odds Ratio (OR)	95% C. I. of OR		*p*-value
		Lower limit	Upper limit	
HS & above	0.311	0.038	2.564	0.278
Primary	0.621	0.336	1.148	0.128
No education	1.0			

With the above analysis, I failed to reject the null hypothesis that states there is no association between parental education and ITN use among children under five years of age in Sierra Leone

Research Question 2

Research question addressed the association between parental economic status and ITN use among children under five years of age in Sierra Leone. These are two nominal variables – the economic status being ordinal. Pearson Chi-Square test for independence was used to test the association between these nominal variables, and simple logistic regression was used to assess if parental economic status (reproduced in the table as Wealth Index) can predict the use of ITNs. Tables 11 and 12 showed the results of these analyses. Table 11 is the result of the Chi-squared analysis between parental economic status and ITN use. The table showed that the economic status of parents played a significant role in the use of ITNs. Those parents who were either poor or in the middle economic index use ITN more compared with those who were rich χ^2 (2) = 52.47, (p = 0.001).

Table 11

Association Between the Economic Status of Parents and ITN use Among Children Under Five Years in Sierra Leone

Wealth index	Use Insecticide Treated Net		χ^2	*p*-value
	Yes	No		
Poor	1890(98.0)	39(2.0)	52.467	0.001
Middle	842(98.0)	17(2.0)		
Rich	854(93.1)	63(6.9)		

Similarly, Table 12 showed the result of the simple logistic regression of the analysis. Using the poor as a reference for the analysis, the table shows that those who are rich have about 28% less odds of using ITN (OR 0.28, 95% CI: 0.03 – 2.6, p = 0.001), while those with middle-level wealth index had no statistically significant difference with the poor in using ITN (OR 1.0, 95% CI: 0.3 – 1.1, p = 0.941).

Table 12

Simple Logistic Regression of Parent's Economic Status and ITN use Among Children Under Five Years in Sierra Leone

Wealth index	Odds Ratio (OR)	95% C. I. of OR		*p*-value
		Lower limit	Upper limit	
Rich	0.280	0.038	2.564	0.001
Middle	1.022	0.336	1.148	0.941
Poor	1.0			

Therefore, with the above analysis, I rejected the null which stated that there is no association between the economic status of parents and ITN use among children under five years of age in Sierra Leone.

Research Question 3

The research question addressed the association between household size and ITN use among children under five years of age in Sierra Leone. These are two dichotomous variables. Pearson Chi-square test for independence was used to test the association between these nominal variables, and simple logistic regression was used to assess if the household size can predict the use of ITNs. Tables 13 and 14 showed the results of these analyses. Table 13 is the result of the Chi-squared analysis between household size and ITN use. The table showed that those with household sizes greater than five were more likely to use ITN compared with those whose household size is five or less. Though this was not statistically significant χ^2 (1) = 0.52, (p = 0.471).

Table 13

Association Between Household Size and ITN use Among Children Under Five Years in Sierra Leone

Household size	Use Insecticide Treated Net		χ^2	*p*-value
	Yes	No		
≤5	3525(96.8)	118(3.2)	0.519	0.471
>5	61(98.4)	1(1.6)		

Using households less or equal to five as a reference for the simple logistic regression, Table 14 shows that those with households greater than five were twice more likely to use ITN than the reference group. This finding was however not statistically significant (OR 2.0, 95% CI: 0.28 – 14.86, $p = 0.481$).

Table 14

Simple Logistic Regression of Household Size and ITN use Among Children Under Five Years in Sierra Leone

Household size	Odds Ratio (OR)	95% C. I. of OR		*p*-value
		Lower limit	Upper limit	
>5	2.042	0.281	14.856	0.481
≤5	1.0			

With the analysis above, I failed to reject the null hypothesis that there is no association between the household size and ITN use among children under five years of age in Sierra Leone

Research Question 4

This question addressed the association between residence and ITN use among children under five years of age in Sierra Leone. These are two dichotomous variables. Pearson Chi-square test for independence was used to test the association between these nominal variables, and simple logistic regression was used to assess if the residence can predict the use of ITNs. Tables 15 and 16 showed the results of these analyses. Table 15 is the result of the Chi-squared analysis between residence and ITN use. The table showed that residence had a significant role in ITN use. Those who reside in the rural areas use ITN more compared with those in the urban areas. This was statistically significant χ^2 (1) = 53.16, (p = 0.001).

The simple logistic regression checking the effects of residence on the use of ITN showed that those in urban areas were about 28% less likely to use ITN compared to those in rural areas (Table 16). Rural area was used as the reference (OR 0.28, 95% CI: 0.2 – 0.4, p = 0.001).

Table 15

Association Between Residence and ITN use Among Children Under Five Years in Sierra Leone

Residence	Use Insecticide Treated Net		χ^2	*p*-value
	Yes	No		
Urban	849(93.1)	63(6.9)	53.162	0.001
Rural	2737(98.0)	56(2.0)		

Table 16

Simple Logistic Regression of Residence and ITN use Among Children Under Five Years in Sierra Leone

Residence	Odds Ratio (OR)	95% C. I. of OR		p-value
		Lower limit	Upper limit	
Urban	0.276	0.191	0.398	0.001
Rural	1.0			

With the above analysis, I rejected the null hypothesis that stated that there is no association between residence (rural vs. urban) and ITN use among children under five years of age in Sierra Leone.

Research Question 5

This question addressed the associations between a set of independent variables (parental education, parents' economic status, household size, and residential location in Sierra Leone) and ITNs as malaria control measures among children under five years of age in Sierra Leone. The question also considered the effects of gender and age as possible confounders in the model. A multiple logistic regression analysis was conducted to evaluate how the independent variable affects ITN use among children under five years in Sierra Leone. This was done using a standard logistic regression entry method for the independent variables.

Before running the logistic regression, part of the regression analysis assumptions is to check for multicollinearity among the independent variables. This is important so as not to reduce the explanatory power of the independent variables in the model and avoid reducing the statistical significance of the independent variables in predicting the dependent variable. Multicollinearity can be calculated using the variance inflation factor (VIF), which detects the correlation between one independent variable and another and the strength of such correlation. A value less than 3 is ideal but any value less than 10 is usually considered the absence of multicollinearity (Johnston et al., 2018). Table 17 showed the different VIFs for the independent variables. The table showed that none of the values is up to 3, indicating no multicollinearity and, therefore, ideal for the regression analysis.

Table 17

Variance Inflation Factor Testing for Multicollinearity Among Independent Variables

Independent variables	Variance inflation factor (VIF)
Parental education	1.099
Wealth index	1.531
Household size	1.003
Residence	1.505

Table 18 showed the variables in the multiple logistic regression. The table showed that wealth index (OR 1.45, 95% CI: 1.1 – 1.9, p = 0.008) and residence (OR 0.41, 95% CI: 0.25 – 0.65, p = 0.001) are those predictors that significantly predict ITN use among children under five years in Sierra Leone controlling for the other factors.

Table 18

Association Between the Independent Variables and ITN use Among Children Under Five Years in Sierra Leone

Independent variables	B	S.E.	Wald	df	P	Exp(B)	95% CI for Exp(B) LL	95% CI for Exp(B) UL
Parental education	-0.031	0.111	0.080	1	0.777	0.969	0.780	1.204
Wealth index	0.369	0.139	7.041	1	0.008	1.447	1.101	1.900
Household	-0.791	1.017	0.605	1	0.437	0.453	0.062	3.330
Residence	-0.900	0.240	14.091	1	0.001	0.406	0.254	0.650
Constant	-1.842	1.175	2.456	1	0.117	0.159		

Note: SE = Standard Error; LL = Lower limit; UL = Upper limit; CI = Confidence interval

Having Table 18 as the model logistic regression association between the outcome variable and the predictor variables, Table 19 showed the influences of the proposed confounding variables: gender and age. Table 19 showed that age and gender do not have any appreciable confounding effects on the ORs of the following independent variables in the preceding model: parental education (0.969 vs. 0.943), wealth index (1.447 vs. 1.421), and residence (0.406 vs. 0.392). This is unlike the variable - household where gender and age had a noticeable positive confounding effect on ITN use from 0.453 to 2.059 though not statistically significant ($p = 0.478$). Despite the addition of the possible confounders, wealth index (OR 1.42, 95% CI: 1.1 – 1.9, $p = 0.014$), and residence (OR 0.4, 95% CI: 0.24 – 0.64, $p = 0.001$) were those independent variables that still significantly predicts ITN use among children under five years in Sierra Leone after controlling for the effects of the other independent factors. Therefore, I rejected the null hypothesis that stated that there is no association between parental education, parents' economic status, household size, residential location, and ITN use (controlling for gender and age) among children under five years of age in Sierra Leone

Table 19

Association Between the Independent Variables and ITN use (Confounding for Gender and Age) Among Children Under Five Years in Sierra Leone

Independent variables							95% CI for Exp(B)	
	B	S.E.	Wald	df	P	Exp(B)	LL	UL
Gender	-0.249	0.195	1.633	1	0.201	0.780	0.532	1.142
Age	0.107	0.067	2.561	1	0.110	1.113	0.976	1.269
Parental education	-0.059	0.115	0.264	1	0.607	0.943	0.752	1.181
Wealth index	0.351	0.143	6.077	1	0.014	1.421	1.075	1.879
Household	0.722	1.018	0.503	1	0.478	2.059	0.280	15.153
Residence	-0.936	0.247	14.380	1	0.001	0.392	0.242	0.636
Constant	-3.831	2.160	3.147	1	0.076	0.022		

Note: SE = Standard Error; LL = Lower limit; UL = Upper limit; CI = Confidence interval

The conduct of a backward stepwise logistic regression to prune the possible explanatory variables to be included in the regression model is shown in Table 20. In all the steps, Residence and Wealth index were statistically significant – maintaining fairly the same ORs throughout the different steps in the analysis. The analysis shows that there is no difference between the predictor model in the previous analysis using the enter (standard) logistic regression method compared to the stepwise analysis. Wealth index and the Residence type of the people remained the significant predictors of ITN use among the people.

Table 20

Stepwise Logistic Regression Analysis of Independent Variables and ITN use

Independent variables	p-value	OR	95% C.I. for OR Lower	Upper
Full model				
Gender	0.201	0.780	0.532	1.142
Age	0.110	1.113	0.976	1.269
Educational level	0.607	0.943	0.752	1.181
Wealth index	0.014	1.421	1.075	1.879
Household size	0.478	0.486	0.066	3.576
Residence	0.000	0.392	0.242	0.636
Constant	0.174	0.189		
Step two				
Gender	0.198	0.778	0.532	1.140
Age	0.103	1.115	0.978	1.272
Wealth index	0.016	1.405	1.066	1.852
Household size	0.469	0.478	0.065	3.519
Residence	0.000	0.398	0.247	0.644
Constant	0.167	0.184		
Step three				
Gender	0.200	0.779	0.532	1.141
Age	0.102	1.116	0.979	1.272
Wealth index	0.017	1.399	1.061	1.844
Residence	0.000	0.396	0.245	0.641
Constant	0.000	0.089		
Step four				
Age	0.096	1.118	0.981	1.275
Wealth index	0.017	1.400	1.062	1.846
Residence	0.000	0.398	0.246	0.644
Constant	0.000	0.061		
Step five				
Wealth index	0.009	1.432	1.093	1.875
Residence	0.000	0.408	0.256	0.651
Constant	0.000	0.071		

Summary

This chapter described how the secondary data were prepared and cleaned for data analysis. The findings to the research questions were also outlined. A total of 6213 Sierra Leonean children under five years (and their parents) were included in the data analysis. most of the parents interviewed were males (78.4%), those with no formal education were 62.8%, and about half (51.7%) of the parents were poor. Nearly all the household size was less or equal to five people (98.1%), and most of these households were resident in the rural areas (72.4%).

Nearly all the respondents (96.8%) use ITNs. Parents without formal education and those with primary education use ITN more than those whose educational level was high school (HS) and above, though not statistically significant χ^2 (2) = 4.88, (p = 0.087). The economic status of parents played a significant role in the use of ITNs. Those parents who were either poor or in the middle educational index use ITN more compared with those who were rich χ^2 (2) = 52.47, (p = 0.001). Those parents who are rich have about 28% less odds of using ITN (OR 0.28, 95% CI: 0.03 – 2.6, p = 0.001)

Families with household sizes greater than five were more likely to use ITN compared with those whose household size is five or less. However, this was not statistically significant χ^2 (1) = 0.52, (p = 0.471). Contrariwise, residence has a significant role in ITN use. Those who reside in the rural areas use ITN more compared with those in the urban areas. This was statistically significant χ^2 (1) = 53.16, (p = 0.001). Those in urban areas were about 28% less likely to use ITN compared to those in rural areas (OR 0.28, 95% CI: 0.2 – 0.4, p = 0.001).

In the multiple analysis, only wealth index (OR 1.45, 95% CI: 1.1 – 1.9, p = 0.008) and residence (OR 0.41, 95% CI: 0.25 – 0.65, p = 0.001) were the predictors that significantly predict ITN use among children under five years in Sierra Leone while controlling for the other factors. Gender and age had a noticeable positive confounding effect on household size as a predictor for ITN use (OR from 0.453 to 2.059) though not statistically significant (p = 0.478). Chapter 5 discusses these results.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Children younger than five years are most susceptible to malaria. In 2018, they accounted for about 67% (272,000) of global malaria deaths (WHO, 2020). Despite the significant investments to control malaria infection rates over the years, infection rates among children under five years remain substantial in sub-Saharan Africa (Afoakwah et al., 2018; Nejati et al., 2018). WHO (2019) reported that every two minutes, a child under five dies of malaria, and most of these deaths happened in sub-Saharan Africa (SSA). Malaria is endemic in Sierra Leone, with a stable and perennial transmission in all parts of the country. The infection is currently the principal cause of disease and death in children younger than five years in Sierra Leone (WHO, 2020).

Malaria control remains a public health challenge in Sierra Leone, where the burden of infection is endemic. Several preventive procedures had been employed to control or eliminate malaria. These strategies include malaria awareness and education, the use of insecticide-treated nets (ITNs) (including long-lasting insecticidal nets and insecticidal-treated bed nets), indoor residual spraying, prophylactic drugs, and untreated nets (Wangdi et al., 2018). In efforts to manage and eliminate malaria in Sierra Leone, the National Malaria Control Program (NMCP) was created in 2006 to distribute ITNs every three years. However, despite the massive progress achieved in ITN distribution, malaria remains a public health issue and an endemic disease. Malaria accounted for 47% of outpatient morbidity for children under five years of age, 38% of hospital admissions, and had a case fatality rate of 17.6% (MoHS, 2017a). Therefore, there is a gap as to why

ITNs are not being used extensively despite their free distribution, low health risks, and proven ability to reduce malaria in children under five years. Several randomized controlled clinical trials have demonstrated the efficacy of ITNs in reducing malaria infection (Nuwamanya et al., 2018). The purpose of this quantitative cross-sectional study was to investigate the association between a set of independent variables (parental education, parents' economic status, household size, and residential location in Sierra Leone) and the use of ITNs as malaria control measures among children under five years of age in Sierra Leone**.**

Interpretations of Findings

Parental Education and ITN use Among Children Under Five Years in Sierra Leone

Akinsola (2018) emphasized that the people's level of education is a very important factor that determines people’s attitude to treatment. In the case of malaria prevention, the author added that most preventive approach exhibited by people is largely dependent on their knowledge of the disease and its control. However, exposure to malaria treatment and prevention may not necessarily correlate with a high level of education. Nejati et al. (2018) in an Iranian study was able to show a statistically significant difference in the awareness of the use of ITNs among mothers with high educational levels compared with those with lower levels of education.

More than half (62.8%) of the children's parents under five years in the secondary data had no formal education. Nonetheless, the result of this study shows that those parents without formal education and those with primary education use ITN more than those whose educational level was high school (HS) and above. However, this was not statistically significant. Likewise, compared with parents without any formal education, those parents with primary school education were 30% less likely to use ITNs. In comparison, those with high school education and above were about 62% less likely to use the ITNs. Other studies also showed that educational level was significantly associated with ITN use (Inungu et al., 2017; Nejati et al., 2018; Wright et al., 2013).

Though in this present study, the use of ITNs was higher among those without any form of formal education, a Nigerian Study reported higher use of ITNs among those who had higher educational qualifications (Wright et al., 2013). However, this finding may be related to the proportion of those with high education in the Nigerian study as about 70% of the respondents had a minimum of secondary school education. Other factors proposed for increased use of ITNs by the educated respondents (in the Nigerian study) was possibly the greater awareness of malaria in the town where the study took place and the easy access to malaria preventive measures like the ITNs from healthcare facilities as a fulfillment of the political mandate of the state's leadership (Wright et al., 2013). Contrariwise, in another Nigerian study, uneducated women were found to use ITNs more than their educated counterparts (Idris, 2017). The author explained that their perceived vulnerability could have been the reason for higher use. More so, targeted public health campaigns at such groups of people coupled with the free distribution of the nets can also encourage their use of ITNs.

As earlier stated by Akinsola (2018) that the level of education determines people's response to treatment, Wright et al. (2013) also alluded to this position by adding that higher levels of education, among other factors, is a determinant for the adoption of new concepts and innovations like the introduction of the ITNs. Inungu et al. (2017) reported that women with high school or a higher educational level were 1.3 times more likely to use ITNs than those with primary education. Eteng et al. (2014), in a Nigerian study also found that children were more likely to sleep under an ITN if their parents were more educated and the mother attended antenatal clinics. These literatures are at variance with the findings from this study. Notwithstanding, a Ghanaian study had a similar finding with the results from this study. The authors reported a significant finding that caregivers of five years old with tertiary education were 53% less likely to use ITN than those without any formal education (Konlan et al., 2019). Konlan et al. proposed that with increasing educational level, most women were likely to engage in activities that will reduce their chances of contracting malaria. In this present study, the higher proportion of those who had no formal educational attainment (62%) compared with the parents with primary education and above could explain why more parents without education use ITNs compared with others. However, the influence of education on the use of ITNs was not statistically significant in this study.

Economic Status of Parents and ITN use Among Children Under Five Years in Sierra Leone

The wealth index (or socioeconomic status) of the population is a significant factor in assessing intervention programs. It is necessary to ascertain if the poor in society benefit from such an intervention (Idris, 2017; Kanmiki et al., 2019). Poor people unduly bear a more significant burden of malaria, and intervention programs may not reach them (Eteng et al., 2014). The findings from this study show that parents' economic status played a significant role in the use of ITNs. Previous studies had also documented a significant role of the wealth index of people with ITN ownership and use (Eteng et al., 2014; Singh et al., 2013). Idris (2017) claimed that women with poor household wealth are less likely to use ITN than those from higher socioeconomic classes. Contrariwise, other studies did not find any relationship between the wealth index and the utilization of ITNs (Garcı´a-Basteiro et al., 2011; Graves et al., 2011).

In this study, those parents who were either poor or in the middle economic index use ITN more than those who were rich. Likewise, using the poor as a reference for logistic regression analysis showed that those who are rich are about 28% less likely to use ITNs. Simultaneously, those with middle-level wealth index had no statistically significant difference with the poor in using ITNs. A similar finding was reported in a Nigerian study that stated that the richer the household, the less likely it is to use ITNs (Alawode, 2019). A Ghanaian study also added that respondents in the richest wealth quintile were about 78% more likely to own an ITN but 33% less likely to use the ITN when compared with the poorest wealth quintile (Kanmiki et al., 2019). In the study by Kanmiki et al., the authors explained that the rich usually have access to other preventive measures for man-vector contact and therefore may not use the ITNs even when in possession of such. Also, many of the rich live in well-secured buildings with door and window screens. They thus believe they are protected from mosquito bites and do not require the use of ITNs. On the other hand, those with low socioeconomic status pride themselves in being able to afford or own an ITN and therefore utilize it as a valued property. These explanations may also clarify the findings from this study.

Household Size and ITN use Among Children Under Five Years in Sierra Leone

Mass distribution of ITNs is a strategy to increase household ownership of the nets to combat malaria infection (Mensah & Anto, 2020). Household size has been identified as a significant predictor of ITNs use (Andrada et al., 2019; Maunget al., 2018; Nyavor et al., 2017). For this study, a household was defined as the total number of people living under one roof and consuming food cooked from a kitchen (Maunget al., 2018). A total of 3,705 data fields for households had complete entries and were used for answering the research question. The household size was classified into greater than five and less or equal to five family members. The results of this study showed that those with household sizes greater than five were more likely to use ITN compared with those whose household size is five or less. However, this was not statistically significant. Also, households greater than five were twice more likely to use ITNs than the reference group. This finding was also not statistically significant.

A similar secondary data analysis of ITN use, utilizing the Nigerian Malaria Indicator Survey, showed that household size was the strongest predictor of ITNs use in the northwestern region of the country. ITN use was highest among those living in small-size households and lowest among those living in large-size households. The small-size household was defined as 1 – 4, a medium-sized household was 5 – 7 while the large-sized household was stated as 8 or more (Andrada et al., 2019). Though ownership of ITNs was more among those in middle and large-sized households, ITN use was higher among the small households. Andrada explained that the household's large size might have constrained the use of ITNs as the available number would not go round.

According to Odufuwa (2020), in a Tanzanian study, increased household size is significantly associated with reduced ITN use. The authors advocated that family size should be considered when distributing ITNs. They noted that large families might likely have more children; thus, the limit placed on the number of ITNs given each household should be reviewed in light of these findings for adequate coverage of the community. They also added that in situations (in large households) where two or more people share the ITNs, it tends to reduce the nets' durability due to stretching, thus resulting in early tear, damage, and loss of the nets compared with those in smaller households. Odufuwa et al. added that mosquitoes are attracted to households with many people, therefore the need to provide an adequate number of ITNs to combat malaria.

This study shows that the larger households tend to use ITNs more than the smaller households does not agree with any of the studies reviewed in the literature. It could purely be a chance finding as it was not a statistically significant one. It may also reflect the different classifications of household sizes or how the questions were asked as ownership of ITN is not tantamount to the utilization of ITNs (Inungu et al., 2017).

Residence Type and ITN use Among Children Under Five Years in Sierra Leone

A variation had been observed in the availability and utilization of ITNs in rural and urban areas (Ladi-Akinyemi et al., 2018). Most (72.4%) of the respondents in this study reside in rural areas. The result from this study shows that residence has a significant role in ITN use. Those who reside in the rural areas use ITN more compared with those in the urban areas. Urban dwellers were about 28% less likely to use ITN compared to those in rural areas. The higher utilization by residents in the rural areas may be explained by the better perception of malaria's morbidity risk by rural dwellers. Notwithstanding, their knowledge, attitude, and practice in health-seeking behavior are still weak (Nejati et al., 2018). This finding of this study is unlike the reports from a study in the Democratic Republic of Congo where Inungu et al. (2017) stated that women in the urban areas were 1.2 times more likely to use ITNs than those in the rural areas.

There exists a disparity in the utilization of ITNs between the urban and rural dwellers in Ghana (Kanmiki et al., 2019). Those in rural location were 87% times more likely to own an ITN than their urban counterparts in Ghana. This was because malaria intervention programs and distribution of ITNs targeted rural dwellers more than the urban locations. Konlan et al. (2019) attested to this that since 2002, African countries have been improving the free distribution or subsidizing the cost of ITNs to children under five and pregnant women in the rural areas. However, location of residence was found not to be associated with the utilization of ITNs (Kanmiki et al., 2019).

Naturally, rural dwellers have a lower wealth index than those in urban areas (Kanmiki et al., 2019). As noted above for the role of socioeconomic level and ITN use, those in the lower socioeconomic status have a higher tendency to use ITNs. The proportion of those who reside in the rural areas (74%) in this study, coupled with their potential wealth index (51.7%), could explain why more rural dwellers use ITNs than urban dwellers.

Association Between Parental Education, Parents' Economic Status, Household Size, Residential Location, and ITN use Among Children Under Five Years in Sierra Leone

This study shows that parental education, the parents' wealth index, household size, and the participants' residence are factors that can determine ITN use among children under five years in Sierra Leone. However, the educational level of the parents and the household size were not statistically significant determinants. Nonetheless, when the effects of the independent variables (parental education, the parents' wealth index, household size and the residence of the participants) were used to evaluate potential ITN use among the children under five years, a multiple logistic regression analysis showed that wealth index and residence were factors that significantly predicted ITN use among the children. These were factors that were also independently associated with ITN use. Wealth index had about 45% the odds of predicting ITN use while the residence is about 41% less likely to predict ITN use among the studied population (Table 19).
However, after controlling for age and gender, with the independent variables, only wealth index and residence were still the independent variables that still significantly predict ITN use among the children. They still had similar odds ratio values before the inclusion of the confounders in the regression model. Age and gender are variables that can predict the wealth index of an individual putting in cognizance other factors like education and residence. The independent variable - household had a noticeable positive confounding effect on ITN use from 0.453 to 2.059 after gender and age were added to the model. This signified that household size had twice the odds of predicting ITN use

among the studied population though this finding was not statistically significant. In this study, age and gender did not have any appreciable confounding effects on the following independent variables in the regression model: parental education, wealth index, and residence (Table 19). A backward stepwise logistic regression analysis showed no difference between the predictor model in the previous analysis compared to the stepwise analysis. Wealth index and the Residence type remained the significant predictors of ITN use among children under five years of age in Sierra Leone.

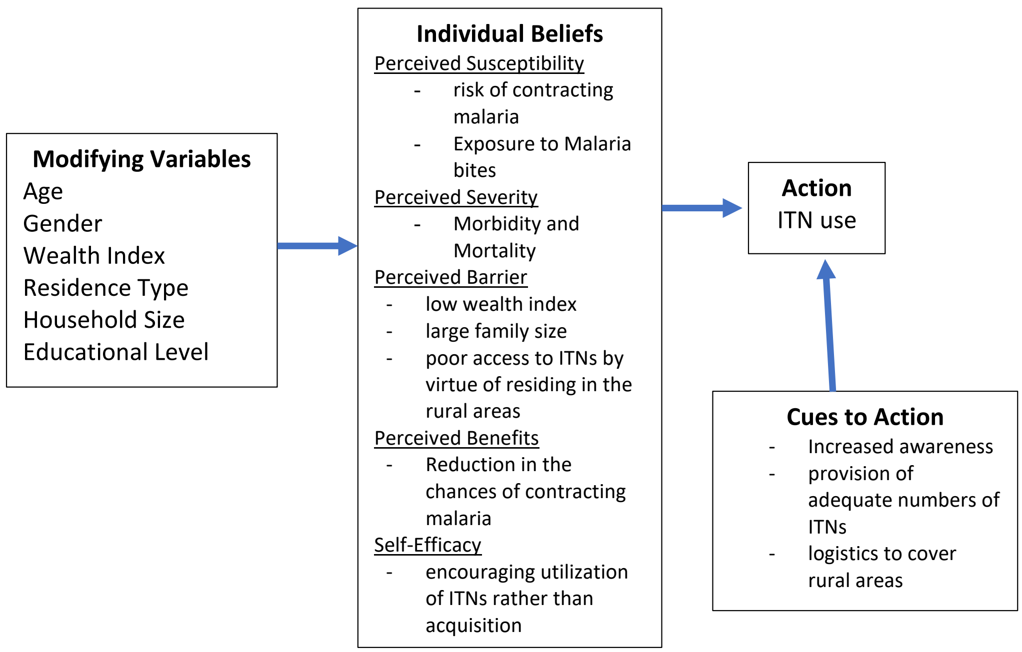
How Findings Relate to the HBM

The HBM is based on the understanding that a person will take a health-related action (in this case, use ITNs) if that person feels that a negative health condition (i.e., malaria) can be avoided; has a positive expectation that by ITN use, he/she will avoid a negative health condition (malaria), and believes that he/she can successfully take a recommended health action (i.e., ITN use). HBM is about motivating people to take positive actions so as to avoid negative outcomes. The model is a linear relationship between the modifying factors (variables), the beliefs of the individual about the negative outcome and the individual behavior (Figure 10).

In the context of this study, the modifying variables are the demographic characteristics of the study population. These are age, gender, educational level, wealth index, residence type and household size. The individual beliefs about the negative outcome are the constructs of the HBM. In line with this study, these are perceived susceptibility – i.e., one's belief of being at risk of contracting malaria as a result of the pandemic nature of the infection in Sierra Leone and exposure to mosquito bites. Perceived severity of the disease which translates to morbidity and mortality secondary to malaria infection.

Figure 10

Relationship of Variables with Health Belief Model



Perceived benefits refer to the belief that using ITN will reduce the chances of contracting malaria. On the other side, perceived barriers are the potential costs in implementing the health behavior. In this study, this includes low wealth index making it difficult to procure ITNs, large family size which also makes it difficult to have enough ITNs to go round, poor access to ITNs by virtue of residing in the rural areas. Cues to action are the recommendations or proposed interventions that will encourage the use of ITNs among the people. Increased awareness on the benefits of ITNs, and provision of adequate numbers of ITNs with logistics to cover the rural areas. Self-efficacy is encouraging the actual utilization of ITNs rather than the acquisition of the nets especially among the poor who see it as a prized asset.

Limitations of the Study

This study's main limitation is that this study's archival data may not incorporate the total picture of malaria infection and ITN uses among children under five years of age in Sierra Leone. So, the study's findings are limited to data in the 2016 Sierra Leone Malaria Intervention Survey (SLMIS). As previously stated, there is no 100% coverage of ITN use by these children. Therefore, this study's findings reflected only those households who have and used ITN for their children. Another limitation is that a potential response bias may have occurred in measuring the children's ITN use as the reports analyzed were responses from their parents. There is no direct way to ascertain such reports as being reflective of the constructs of the study.

This was a cross-sectional study (using secondary data) and could not have considered the seasonal variation of mosquito endemicity at the rainy season when malaria transmission is high due to the higher proliferation of the mosquito vector. This seasonal variation could have significantly influenced ITNs utilization as the desire to prevent the infection could have spurred a higher level of ITN utilization compliance by the respondents. The effect of seasonal variation could have shed more light on the influences of the studied independent variables on the use of ITNs. More so, as a cross-sectional study, it can only report association rather than elicit a temporal association between the studied variables and ITNs use.

Another limitation of the study was that ITN use was based on whether the parents used it for their wards the night before in the survey. This may not be a reflection of continual or daily use and could also affect the validity of the study's responses. Lastly, being a quantitative study, it did not permit the exploration of attitudes, experiences, and practices of the households as it relates to ITNs use. Qualitative data could have supported this study's findings by triangulating why some of the independent variables affect ITNs utilization.

Recommendations

There is a need for continuing education and enlightenment for the people to ensure that the proposed ITNs coverage for Sierra Leone is reached. Mensah and Anto (2020) reported that media exposure to malaria messages and mass distribution of ITNs significantly increased the nets' utilization. Therefore, more efforts should be exerted on the use of the media as an avenue to encourage the use of ITNs by the people. Similarly, it is important to target those households with more than five members with more ITNs. Giving them enough ITNs will ensure that more children are covered and that there is less pressure on the ones they have, so that they can be used for longer periods. Emphasis should also be placed on those in the urban areas by every means possible to encourage ITN use. Therefore, as a recommendation, the mass distribution of ITNs should continue. However, studies should be conducted to address some of the challenges with the nets that discourages use such as the smell, size, shape and color of the nets. This can help ensure that what is distributed is appropriate for use by all and thus improve the coverage plan for ITNs distribution in Sierra Leone. Notwithstanding, using other methods to control malaria should also be encouraged as these would serve as a complementary approach to malaria prevention among the people.

Future studies may employ prospective studies to understand the impact of the different independent factors on the use of ITNs and their relationship with malaria or malaria prevention in children under five years in Sierra Leone. The Ministry of Health in Sierra Leone should also intensify health education campaigns, with customized messages, especially focusing on vulnerable groups and those refusing to use ITNs.

Implications for Social Change

Although ITN use is considered an effective inhibitor against the transmission of malaria, in Sierra Leone, there remain concerns indicating malaria is still endemic in the country (MIS, 2016). Sierra Leone has not reached universal coverage for ITNs which is defined as use of ITNs by 80% or more of a population in an endemic area to have the optimum protection or the proportion of households with at least one ITN for every two people (Kanmiki et al., 2019; Kilian et al., 2013). To manage and eliminate malaria in Sierra Leone, the NMCP engaged in distributing free ITN every three years. This study filled the literature gaps as to why ITNs are not being used widely despite their low health risks and their proven ability to reduce malaria in children under five. This study added to knowledge by identifying some potential risk factors that may be militating against the use of ITNs as a useful malaria control among children under five years in Sierra Leone.

The evidence generated by the study may guide the development of appropriate policies to be used by stakeholders such as public health workers, healthcare professionals, nongovernmental organizations, community leaders, and social policymakers on the impact of ITN interventions. This will support advocacy to increase the use of these free ITNs, thereby reducing morbidity and mortality of children under five years of age in Sierra Leone and other groups affected by this infection. Enhancing the use of ITNs to prevent malaria could increase productivity and attendance at work and school, thereby improving the country's economic growth. This study's social change implication is ultimately a robust malaria control intervention initiative with its attendant benefits.

Conclusions

Children younger than five years are most susceptible to malaria. Despite the significant investments to control malaria infection rates over the years, infection rates among children under five years remain substantial in sub-Saharan Africa (Alawode et al., 2019). Malaria is endemic in Sierra Leone. The infection is currently the principal cause of disease and death in children younger than five years in Sierra Leone (WHO, 2020). Therefore, malaria control is still a public health challenge in Sierra Leone. The purpose of this quantitative cross-sectional study was to investigate the association between a set of independent variables (parental education, parents' economic status, household size, and residential location in Sierra Leone) and the use of ITNs as malaria control measures among children under five years of age in Sierra Leone**.**

The study revealed that ITN use among the studied households was high (96.8%). However, there were some complaints among those who refused to use the ITNs to include the smell, size, shape and color of the nets. Others were that it causes irritation and heat and possibly claustrophobic. Considering the parents of the children's educational level, the result of this study shows that those parents without formal education and those with primary education use ITN more than those whose educational level was high school (HS) and above. Though, this was not statistically significant. However, the following independent variables were significantly associated with ITN use in the studied population: wealth index and the participants' residence (urban or rural).

This study showed that those who were either poor or in the middle economic index use ITN more than those who were rich. Likewise, residence in the rural area was associated with more propensity to use ITNs than urban dwellers. Household sizes greater than five were more likely to use ITNs than those whose household size is five or less. Also, they were twice more likely to use ITNs than those households less than five. However, it was not statistically significant.

It can be extrapolated from the literature that the factors that influence ITNs use are not static. Rather, there are discrepancies from one location to the other. This may be due to how those constructs were measured though there is overlap and similarities with some study findings. Nonetheless, future mass distribution of ITNs should take into cognizance these factors if the desired malaria prevention is to be achieved.

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Appendix A: Biomarker Questionnaire

FORMATTING DATE: 11 May 2016
ENGLISH LANGUAGE: 11 May 2016

2016 SIERRA LEONE MALARIA INDICATOR SURVEY
BIOMARKER QUESTIONNAIRE

SIERRA LEONE
MINISTRY OF HEALTH AND SANITATION, NATIONAL MALARIA CONTROL PROGRAMME
STATISTICS SIERRA LEONE
CATHOLIC RELIEF SERVICES

IDENTIFICATION

LOCALITY NAME ______________________

NAME OF HOUSEHOLD HEAD ______________________

CLUSTER NUMBER . . . .

HOUSEHOLD NUMBER . . . .

BIOMARKER VISITS

	1	2	3	FINAL VISIT
DATE BIOMARKER NAME	______ ______	______ ______	______ ______	DAY MONTH YEAR BIOMARKER NUMBER
NEXT VISIT: DATE TIME	______ ______	______ ______		TOTAL NUMBER OF VISITS
NOTES:				TOTAL ELIGIBLE CHILDREN

LANGUAGE OF QUESTIONNAIRE** 0 1 LANGUAGE OF INTERVIEW** NATIVE LANGUAGE OF RESPONDENT** TRANSLATOR (YES = 1, NO = 2)

LANGUAGE OF QUESTIONNAIRE** **ENGLISH**

**LANGUAGE CODES:

01 ENGLISH	05 MADINGO	09 KISSI	13 KRIM	96 OTHER
02 KRIO	06 LOKO	10 KONO	14 YALUNKA	
03 MENDE	07 SHERBRO	11 SUSU	15 KORANKO	
04 TEMNE	08 LIMBA	12 FULLAH	16 VAI	

INTERVIEWER		SUPERVISOR	
NAME	NUMBER	NAME	NUMBER

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

101	CHECK COLUMN 9 IN HOUSEHOLD QUESTIONNAIRE. RECORD THE LINE NUMBER AND NAME FOR ALL ELIGIBLE CHILDREN 0-5 YEARS IN QUESTION 102; IF MORE THAN SIX CHILDREN, USE ADDITIONAL QUESTIONNAIRE(S).			
		CHILD 1	CHILD 2	CHILD 3
102	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... NAME ______	LINE NUMBER ...... NAME ______	LINE NUMBER ...... NAME ______
103	IF MOTHER INTERVIEWED: COPY CHILD'S DATE OF BIRTH (DAY, MONTH, AND YEAR) FROM BIRTH HISTORY. IF MOTHER NOT INTERVIEWED ASK: What is (NAME)'s date of birth?	DAY .... MONTH .... YEAR ...	DAY .... MONTH .... YEAR ...	DAY .... MONTH .... YEAR ...
104	CHECK 103: CHILD BORN IN 2011-2016?	YES .... 1 NO .... 2 (SKIP TO 130)	YES .... 1 NO .... 2 (SKIP TO 130)	YES .... 1 NO .... 2 (SKIP TO 130)
105	CHECK 103: CHILD AGE 0-5 MONTHS, I.E., WAS CHILD BORN IN MONTH OF INTERVIEW OR 5 PREVIOUS MONTHS?	0-5 MONTHS .... 1 (SKIP TO 130) OLDER 2	0-5 MONTHS .... 1 (SKIP TO 130) OLDER 2	0-5 MONTHS .... 1 (SKIP TO 130) OLDER 2
106	LINE NUMBER OF PARENT/OTHER ADULT RESPONSIBLE FOR THE CHILD FROM COLUMN 1 OF HOUSEHOLD SCHEDULE.	LINE NUMBER ...... (RECORD '00' IF NOT LISTED)	LINE NUMBER ...... (RECORD '00' IF NOT LISTED)	LINE NUMBER ...... (RECORD '00' IF NOT LISTED)
107	ASK CONSENT FOR ANEMIA TEST FROM PARENT/OTHER ADULT.	As part of this survey, we are asking children all over the country to take an anemia test. Anemia is a serious health problem that usually results from poor nutrition, infection, or chronic disease. This survey will assist the government to develop programs to prevent and treat anemia. We ask that all children born in 2011 or later take part in anemia testing in this survey and give a few drops of blood from a finger or heel. The equipment used to take the blood is clean and completely safe. It has never been used before and will be thrown away after each test. The blood will be tested for anemia immediately, and the result will be told to you right away. The result will be kept strictly confidential and will not be shared with anyone other than members of our survey team. Do you have any questions? You can say yes or no. It is up to you to decide. Will you allow (NAME OF CHILD) to participate in the anemia test?		
108	CIRCLE THE CODE AND SIGN YOUR NAME.	GRANTED .... 1 ______ (SIGN) REFUSED .... 2 NOT PRESENT/OTHER . 3	GRANTED .... 1 ______ (SIGN) REFUSED .... 2 NOT PRESENT/OTHER . 3	GRANTED .... 1 ______ (SIGN) REFUSED .... 2 NOT PRESENT/OTHER . 3
108A	PARENT/RESPONSIBLE ADULT SIGNATURE OR THUMB PRINT FOR ANEMIA TESTING CONSENT	SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT
108B	WITNESS SIGNATURE OR THUMB PRINT FOR ANEMIA TESTING CONSENT	SIGNATURE/THUMB PRINT OF WITNESS	SIGNATURE/THUMB PRINT OF WITNESS	SIGNATURE/THUMB PRINT OF WITNESS

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

		CHILD 1	CHILD 2	CHILD 3
	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... NAME ______	LINE NUMBER ...... NAME ______	LINE NUMBER ...... NAME ______
109	ASK CONSENT FOR MALARIA TEST FROM PARENT/OTHER ADULT.	As part of this survey, we are asking children all over the country to take a test to see if they have malaria. Malaria is a serious illness caused by a parasite transmitted by a mosquito bite. This survey will assist the government to develop programs to prevent malaria. We ask that all children born in 2011 or later take part in malaria testing in this survey and give a few drops of blood from a finger or heel. One blood drop will be tested for malaria immediately, and the result will be told to you right away. A few blood drops will be collected on slide and taken to a laboratory for testing. You will not be told the results of the laboratory testing. All results will be kept strictly confidential and will not be shared with anyone other than members of our survey team. Do you have any questions? You can say yes or no. It is up to you to decide. Will you allow (NAME OF CHILD) to participate in the malaria test?		
110	CIRCLE THE CODE, SIGN YOUR NAME, AND ENTER YOUR BIOMARKER NUMBER.	GRANTED .... 1 REFUSED .... 2 (SIGN AND ENTER YOUR BIOMARKER NUMBER) NOT PRESENT/OTHER . 3	GRANTED .... 1 REFUSED .... 2 (SIGN AND ENTER YOUR BIOMARKER NUMBER) NOT PRESENT/OTHER . 3	GRANTED .... 1 REFUSED .... 2 (SIGN AND ENTER YOUR BIOMARKER NUMBER) NOT PRESENT/OTHER . 3
110A	PARENT/RESPONSIBLE ADULT SIGNATURE OR THUMB PRINT FOR MALARIA TESTING CONSENT	SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT
110B	WITNESS SIGNATURE OR THUMB PRINT FOR MALARIA TESTING CONSENT	SIGNATURE/THUMB PRINT OF WITNESS	SIGNATURE/THUMB PRINT OF WITNESS	SIGNATURE/THUMB PRINT OF WITNESS
111	PREPARE EQUIPMENT AND SUPPLIES ONLY FOR THE TEST(S) FOR WHICH CONSENT HAS BEEN OBTAINED AND PROCEED WITH THE TEST(S).			
112	PLACE BAR CODE LABEL FOR MALARIA LAB TEST.	PUT THE 1ST BAR CODE LABEL HERE. NOT PRESENT ... 99994 REFUSED......... 99995 OTHER .... 99996 PUT THE 2ND BAR CODE LABEL ON THE SLIDE AND THE 3RD ON THE TRANSMITTAL FORM AND THE 4TH ON THE MALARIA RDT	PUT THE 1ST BAR CODE LABEL HERE. NOT PRESENT ... 99994 REFUSED......... 99995 OTHER .... 99996 PUT THE 2ND BAR CODE LABEL ON THE SLIDE AND THE 3RD ON THE TRANSMITTAL FORM AND THE 4TH ON THE MALARIA RDT	PUT THE 1ST BAR CODE LABEL HERE. NOT PRESENT ... 99994 REFUSED......... 99995 OTHER .... 99996 PUT THE 2ND BAR CODE LABEL ON THE SLIDE AND THE 3RD ON THE TRANSMITTAL FORM AND THE 4TH ON THE MALARIA RDT

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

		CHILD 1	CHILD 2	CHILD 3
	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... NAME ______	LINE NUMBER ...... NAME ______	LINE NUMBER ...... NAME ______
113	RECORD HEMOGLOBIN LEVEL HERE AND IN THE ANEMIA AND MALARIA BROCHURE.	G/DL ..... __ __ . __ NOT PRESENT ..... 994 REFUSED .... 995 OTHER 996	G/DL ..... __ __ . __ NOT PRESENT ..... 994 REFUSED .... 995 OTHER 996	G/DL ..... __ __ . __ NOT PRESENT ..... 994 REFUSED .... 995 OTHER 996
114	CIRCLE THE TEST CODE FOR THE MALARIA RDT.	TESTED .... 1 NOT PRESENT ...... 2 REFUSED .... 3 OTHER .... 6 (SKIP TO 116)	TESTED .... 1 NOT PRESENT ...... 2 REFUSED .... 3 OTHER .... 6 (SKIP TO 116)	TESTED .... 1 NOT PRESENT ...... 2 REFUSED .... 3 OTHER .... 6 (SKIP TO 116)
115	RECORD THE RESULT OF THE MALARIA RDT HERE AND IN THE ANEMIA AND MALARIA BROCHURE.	POSITIVE 1 (SKIP TO 118) NEGATIVE .... 2 OTHER 6	POSITIVE 1 (SKIP TO 118) NEGATIVE .... 2 OTHER 6	POSITIVE 1 (SKIP TO 118) NEGATIVE .... 2 OTHER 6
116	CHECK 113: HEMOGLOBIN RESULT	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER .... 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER .... 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER .... 6 (SKIP TO 130)
117	SEVERE ANEMIA REFERRAL RECORD THE RESULT OF THE ANEMIA TEST ON THE REFERRAL FORM.	The anemia test shows that (NAME OF CHILD) has severe anemia. Your child is very ill and must be taken to a health facility immediately. (SKIP TO 130)		
118	Does (NAME) suffer from any of the following illnesses or symptoms: a) Extreme weakness? b) Heart problems? c) Loss of consciousness? d) Rapid or difficult breathing? e) Seizures? f) Abnormal bleeding? g) Jaundice or yellow skin? h) Dark urine?	YES NO a) EXTREME WEAKNESS 1 2 b) HEART PROBLEMS 1 2 c) LOSS OF CONSCIOUS. 1 2 d) RAPID BREATHING 1 2 e) SEIZURES 1 2 f) BLEEDING 1 2 g) JAUNDICE 1 2 h) DARK URINE 1 2	YES NO a) EXTREME WEAKNESS 1 2 b) HEART PROBLEMS 1 2 c) LOSS OF CONSCIOUS. 1 2 d) RAPID BREATHING 1 2 e) SEIZURES 1 2 f) BLEEDING 1 2 g) JAUNDICE 1 2 h) DARK URINE 1 2	YES NO a) EXTREME WEAKNESS 1 2 b) HEART PROBLEMS 1 2 c) LOSS OF CONSCIOUS. 1 2 d) RAPID BREATHING 1 2 e) SEIZURES 1 2 f) BLEEDING 1 2 g) JAUNDICE 1 2 h) DARK URINE 1 2
119	CHECK 118: ANY 'YES' CIRCLED?	NO YES (SKIP TO 122)	NO YES (SKIP TO 122)	NO YES (SKIP TO 122)
120	CHECK 113: HEMOGLOBIN RESULT	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 (SKIP TO 122) 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER 6	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 (SKIP TO 122) 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER 6	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 (SKIP TO 122) 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER 6

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

		CHILD 1	CHILD 2	CHILD 3
	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... [ ][ ] NAME ________	LINE NUMBER ...... [ ][ ] NAME ________	LINE NUMBER ...... [ ][ ] NAME ________
121	In the past two weeks has (NAME) taken or is taking ACT to treat the malaria? VERIFY BY ASKING TO SEE TREATMENT	YES .... 1 (SKIP TO 123) NO .... 2 (SKIP TO 124)	YES .... 1 (SKIP TO 123) NO .... 2 (SKIP TO 124)	YES .... 1 (SKIP TO 123) NO .... 2 (SKIP TO 124)
122	**SEVERE MALARIA REFERRAL** RECORD THE RESULT OF THE MALARIA RDT ON THE REFERRAL FORM.	The malaria test shows that (NAME OF CHILD) has malaria. Your child also has symptoms of severe malaria. The malaria treatment I have will not help your child, and I cannot give you the medication. Your child is very ill and must be taken to a health facility right away. (SKIP TO 128)		
123	ALREADY TAKING ACT REFERRAL STATEMENT	You have told me that (NAME OF CHILD) had already received ACT for malaria. Therefore, I cannot give you additional ACT. However, the test shows that he/she has malaria. If your child has a fever for two days after the last dose of ACT, you should take the child to the nearest health facility for further examination. (SKIP TO 130)		
124	READ INFORMATION FOR MALARIA TREATMENT AND CONSENT STATEMENT TO PARENT/RESPONSIBLE ADULT	The malaria test shows that your child has malaria. We can give you free medicine. The medicine is called ACT. ACT is very effective and in a few days it should get rid of the fever and other symptoms. You do not have to give the child the medicine. This is up to you. Please tell me whether you accept the medicine or not.		
125	CIRCLE THE APPROPRIATE CODE AND SIGN YOUR NAME.	ACCEPTED MEDICINE . 1 ________ (SIGN) REFUSED .... 2 OTHER 6	ACCEPTED MEDICINE . 1 ________ (SIGN) REFUSED .... 2 OTHER 6	ACCEPTED MEDICINE . 1 ________ (SIGN) REFUSED .... 2 OTHER 6
126	CHECK 125: MEDICATION ACCEPTED	ACCEPTED MEDICINE . 1 REFUSED .... 2 OTHER .... 6 (SKIP TO 130)	ACCEPTED MEDICINE . 1 REFUSED .... 2 OTHER .... 6 (SKIP TO 130)	ACCEPTED MEDICINE . 1 REFUSED .... 2 OTHER .... 6 (SKIP TO 130)
127	TREATMENT FOR CHILDREN WITH POSITIVE MALARIA TEST	ALSO TELL THE PARENT/RESPONSIBLE ADULT: If [NAME] has a high fever, fast or difficult breathing, is not able to drink or breastfeed, gets sicker or does not get better in two days, you should take him/her to a health professional for treatment right away. (SKIP TO 130)		
128	CHECK 113: HEMOGLOBIN RESULT	BELOW 8.0 G/DL, SEVERE ANEMIA 1 8.0 G/DL OR ABOVE 2 NOT PRESENT 3 REFUSED 4 OTHER 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA 1 8.0 G/DL OR ABOVE 2 NOT PRESENT 3 REFUSED 4 OTHER 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA 1 8.0 G/DL OR ABOVE 2 NOT PRESENT 3 REFUSED 4 OTHER 6 (SKIP TO 130)
129	SEVERE ANEMIA REFERRAL RECORD THE RESULT OF THE ANEMIA TEST ON THE REFERRAL FORM.	The anemia test shows that (NAME OF CHILD) has severe anemia. Your child is very ill and must be taken to a health facility immediately.		
130	GO BACK TO 103 IN NEXT COLUMN OF THIS QUESTIONNAIRE OR IN THE FIRST COLUMN OF THE NEXT PAGE; IF NO MORE CHILDREN, END INTERVIEW.			

DOSAGE SCHEDULE FOR ASAQ FIXED DOSAGE COMBINATION TREATMENT

AGE	WEIGHT	ASAQ COMBINATION	DOSAGE DAY 1	DAY 2	DAY 3
6-11 months	≥ 4.5 kg to <9.0 kg	25mg Artesunate /67.5mg Amodiaquine	1 tablet	1 tablet	1 tablet
1-5 years	≥ 9.0 kg to <18.0 kg	50mg Artesunate /135mg Amodiaquine	1 tablet	1 tablet	1 tablet

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

101	CHECK COLUMN 9 IN HOUSEHOLD QUESTIONNAIRE. RECORD THE LINE NUMBER AND NAME FOR ALL ELIGIBLE CHILDREN 0-5 YEARS IN QUESTION 102; IF MORE THAN SIX CHILDREN, USE ADDITIONAL QUESTIONNAIRE(S).			
		CHILD 4	CHILD 5	CHILD 6
102	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... ☐☐ NAME ______	LINE NUMBER ...... ☐☐ NAME ______	LINE NUMBER ...... ☐☐ NAME ______
103	IF MOTHER INTERVIEWED: COPY CHILD'S DATE OF BIRTH (DAY, MONTH, AND YEAR) FROM BIRTH HISTORY. IF MOTHER NOT INTERVIEWED ASK: What is (NAME)'s date of birth?	DAY .... ☐☐ MONTH .... ☐☐ YEAR ... ☐☐☐☐	DAY .... ☐☐ MONTH .... ☐☐ YEAR ... ☐☐☐☐	DAY .... ☐☐ MONTH .... ☐☐ YEAR ... ☐☐☐☐
104	CHECK 103: CHILD BORN IN 2011-2016?	YES .... 1 NO .... 2 (SKIP TO 130)	YES .... 1 NO .... 2 (SKIP TO 130)	YES .... 1 NO .... 2 (SKIP TO 130)
105	CHECK 103: CHILD AGE 0-5 MONTHS, I.E., WAS CHILD BORN IN MONTH OF INTERVIEW OR 5 PREVIOUS MONTHS?	0-5 MONTHS .... 1 (SKIP TO 130) OLDER 2	0-5 MONTHS .... 1 (SKIP TO 130) OLDER 2	0-5 MONTHS .... 1 (SKIP TO 130) OLDER 2
106	LINE NUMBER OF PARENT/OTHER ADULT RESPONSIBLE FOR THE CHILD FROM COLUMN 1 OF HOUSEHOLD SCHEDULE.	LINE NUMBER ...... ☐☐ (RECORD '00' IF NOT LISTED)	LINE NUMBER ...... ☐☐ (RECORD '00' IF NOT LISTED)	LINE NUMBER ...... ☐☐ (RECORD '00' IF NOT LISTED)
107	ASK CONSENT FOR ANEMIA TEST FROM PARENT/OTHER ADULT.	As part of this survey, we are asking children all over the country to take an anemia test. Anemia is a serious health problem that usually results from poor nutrition, infection, or chronic disease. This survey will assist the government to develop programs to prevent and treat anemia. We ask that all children born in 2011 or later take part in anemia testing in this survey and give a few drops of blood from a finger or heel. The equipment used to take the blood is clean and completely safe. It has never been used before and will be thrown away after each test. The blood will be tested for anemia immediately, and the result will be told to you right away. The result will be kept strictly confidential and will not be shared with anyone other than members of our survey team. Do you have any questions? You can say yes or no. It is up to you to decide. Will you allow (NAME OF CHILD) to participate in the anemia test?		
108	CIRCLE THE CODE AND SIGN YOUR NAME.	GRANTED .... 1 ______ (SIGN) REFUSED .... 2 NOT PRESENT/OTHER . 3	GRANTED .... 1 ______ (SIGN) REFUSED .... 2 NOT PRESENT/OTHER . 3	GRANTED .... 1 ______ (SIGN) REFUSED .... 2 NOT PRESENT/OTHER . 3
108A	PARENT/RESPONSIBLE ADULT SIGNATURE OR THUMB PRINT FOR ANEMIA TESTING CONSENT	______ SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	______ SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	______ SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT
108B	WITNESS SIGNATURE OR THUMB PRINT FOR ANEMIA TESTING CONSENT	______ SIGNATURE/THUMB PRINT OF WITNESS	______ SIGNATURE/THUMB PRINT OF WITNESS	______ SIGNATURE/THUMB PRINT OF WITNESS

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

		CHILD 4	CHILD 5	CHILD 6
	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... ☐☐ NAME ______	LINE NUMBER ...... ☐☐ NAME ______	LINE NUMBER ...... ☐☐ NAME ______
109	ASK CONSENT FOR MALARIA TEST FROM PARENT/OTHER ADULT.	As part of this survey, we are asking children all over the country to take a test to see if they have malaria. Malaria is a serious illness caused by a parasite transmitted by a mosquito bite. This survey will assist the government to develop programs to prevent malaria. We ask that all children born in 2011 or later take part in malaria testing in this survey and give a few drops of blood from a finger or heel. One blood drop will be tested for malaria immediately, and the result will be told to you right away. A few blood drops will be collected on slide and taken to a laboratory for testing. You will not be told the results of the laboratory testing. All results will be kept strictly confidential and will not be shared with anyone other than members of our survey team. Do you have any questions? You can say yes or no. It is up to you to decide. Will you allow (NAME OF CHILD) to participate in the malaria test?		
110	CIRCLE THE CODE, SIGN YOUR NAME, AND ENTER YOUR BIOMARKER NUMBER.	GRANTED .... 1 REFUSED .... 2 (SIGN AND ENTER YOUR BIOMARKER NUMBER) ☐☐☐☐ NOT PRESENT/OTHER . 3	GRANTED .... 1 REFUSED .... 2 (SIGN AND ENTER YOUR BIOMARKER NUMBER) ☐☐☐☐ NOT PRESENT/OTHER . 3	GRANTED .... 1 REFUSED .... 2 (SIGN AND ENTER YOUR BIOMARKER NUMBER) ☐☐☐☐ NOT PRESENT/OTHER . 3
110A	PARENT/RESPONSIBLE ADULT SIGNATURE OR THUMB PRINT FOR MALARIA TESTING CONSENT	______ SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	______ SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT	______ SIGNATURE/THUMB PRINT OF PARENT/RESPONSIBLE ADULT
110B	WITNESS SIGNATURE OR THUMB PRINT FOR MALARIA TESTING CONSENT	______ SIGNATURE/THUMB PRINT OF WITNESS	______ SIGNATURE/THUMB PRINT OF WITNESS	______ SIGNATURE/THUMB PRINT OF WITNESS
111	PREPARE EQUIPMENT AND SUPPLIES ONLY FOR THE TEST(S) FOR WHICH CONSENT HAS BEEN OBTAINED AND PROCEED WITH THE TEST(S).			
112	PLACE BAR CODE LABEL FOR MALARIA LAB TEST.	PUT THE 1ST BAR CODE LABEL HERE. NOT PRESENT ... 99994 REFUSED .... 99995 OTHER .... 99996 PUT THE 2ND BAR CODE LABEL ON THE SLIDE AND THE 3RD ON THE TRANSMITTAL FORM AND THE 4TH ON THE MALARIA RDT	PUT THE 1ST BAR CODE LABEL HERE. NOT PRESENT ... 99994 REFUSED .... 99995 OTHER .... 99996 PUT THE 2ND BAR CODE LABEL ON THE SLIDE AND THE 3RD ON THE TRANSMITTAL FORM AND THE 4TH ON THE MALARIA RDT	PUT THE 1ST BAR CODE LABEL HERE. NOT PRESENT ... 99994 REFUSED .... 99995 OTHER .... 99996 PUT THE 2ND BAR CODE LABEL ON THE SLIDE AND THE 3RD ON THE TRANSMITTAL FORM AND THE 4TH ON THE MALARIA RDT

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

		CHILD 4	CHILD 5	CHILD 6
	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... [ ][ ] NAME ____________	LINE NUMBER ...... [ ][ ] NAME ____________	LINE NUMBER ...... [ ][ ] NAME ____________
113	RECORD HEMOGLOBIN LEVEL HERE AND IN THE ANEMIA AND MALARIA BROCHURE.	G/DL .... [ ][ ].[ ] NOT PRESENT .... 994 REFUSED ....995 OTHER 996	G/DL .... [ ][ ].[ ] NOT PRESENT .... 994 REFUSED ....995 OTHER 996	G/DL .... [ ][ ].[ ] NOT PRESENT .... 994 REFUSED ....995 OTHER 996
114	CIRCLE THE TEST CODE FOR THE MALARIA RDT.	TESTED .... 1 NOT PRESENT ...... 2 REFUSED .... 3 OTHER .... 6 (SKIP TO 116)	TESTED .... 1 NOT PRESENT ...... 2 REFUSED .... 3 OTHER .... 6 (SKIP TO 116)	TESTED .... 1 NOT PRESENT ...... 2 REFUSED .... 3 OTHER .... 6 (SKIP TO 116)
115	RECORD THE RESULT OF THE MALARIA RDT HERE AND IN THE ANEMIA AND MALARIA BROCHURE.	POSITIVE 1 (SKIP TO 118) NEGATIVE .... 2 OTHER 6	POSITIVE 1 (SKIP TO 118) NEGATIVE .... 2 OTHER 6	POSITIVE 1 (SKIP TO 118) NEGATIVE .... 2 OTHER 6
116	CHECK 113: HEMOGLOBIN RESULT	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER .... 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER .... 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER .... 6 (SKIP TO 130)
117	**SEVERE ANEMIA REFERRAL** RECORD THE RESULT OF THE ANEMIA TEST ON THE REFERRAL FORM.	The anemia test shows that (NAME OF CHILD) has severe anemia. Your child is very ill and must be taken to a health facility immediately. (SKIP TO 130)		
118	Does (NAME) suffer from any of the following illnesses or symptoms: a) Extreme weakness? b) Heart problems? c) Loss of consciousness? d) Rapid or difficult breathing? e) Seizures? f) Abnormal bleeding? g) Jaundice or yellow skin? h) Dark urine?	YES NO a) EXTREME WEAKNESS 1 2 b) HEART PROBLEMS 1 2 c) LOSS OF CONSCIOUS. 1 2 d) RAPID BREATHING 1 2 e) SEIZURES 1 2 f) BLEEDING 1 2 g) JAUNDICE 1 2 h) DARK URINE 1 2	YES NO a) EXTREME WEAKNESS 1 2 b) HEART PROBLEMS 1 2 c) LOSS OF CONSCIOUS. 1 2 d) RAPID BREATHING 1 2 e) SEIZURES 1 2 f) BLEEDING 1 2 g) JAUNDICE 1 2 h) DARK URINE 1 2	YES NO a) EXTREME WEAKNESS 1 2 b) HEART PROBLEMS 1 2 c) LOSS OF CONSCIOUS. 1 2 d) RAPID BREATHING 1 2 e) SEIZURES 1 2 f) BLEEDING 1 2 g) JAUNDICE 1 2 h) DARK URINE 1 2
119	CHECK 118: ANY 'YES' CIRCLED?	NO [ ] YES [ ] (SKIP TO 122)	NO [ ] YES [ ] (SKIP TO 122)	NO [ ] YES [ ] (SKIP TO 122)
120	CHECK 113: HEMOGLOBIN RESULT	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 (SKIP TO 122) 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER 6	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 (SKIP TO 122) 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER 6	BELOW 8.0 G/DL, SEVERE ANEMIA ... 1 (SKIP TO 122) 8.0 G/DL OR ABOVE ... 2 NOT PRESENT ...... 3 REFUSED .... 4 OTHER 6

HEMOGLOBIN MEASUREMENT AND MALARIA TESTING FOR CHILDREN AGE 0-5

		CHILD 4	CHILD 5	CHILD 6
	CHECK HOUSEHOLD QUESTIONNAIRE: LINE NUMBER FROM COLUMN 9. NAME FROM COLUMN 2.	LINE NUMBER ...... [ ][ ] NAME ________	LINE NUMBER ...... [ ][ ] NAME ________	LINE NUMBER ...... [ ][ ] NAME ________
121	In the past two weeks has (NAME) taken or is taking ACT to treat the malaria? VERIFY BY ASKING TO SEE TREATMENT	YES .... 1 (SKIP TO 123) NO .... 2 (SKIP TO 124)	YES .... 1 (SKIP TO 123) NO .... 2 (SKIP TO 124)	YES .... 1 (SKIP TO 123) NO .... 2 (SKIP TO 124)
122	**SEVERE MALARIA REFERRAL** RECORD THE RESULT OF THE MALARIA RDT ON THE REFERRAL FORM.	The malaria test shows that (NAME OF CHILD) has malaria. Your child also has symptoms of severe malaria. The malaria treatment I have will not help your child, and I cannot give you the medication. Your child is very ill and must be taken to a health facility right away. (SKIP TO 128)		
123	ALREADY TAKING ACT REFERRAL STATEMENT	You have told me that (NAME OF CHILD) had already received ACT for malaria. Therefore, I cannot give you additional ACT. However, the test shows that he/she has malaria. If your child has a fever for two days after the last dose of ACT, you should take the child to the nearest health facility for further examination. (SKIP TO 130)		
124	READ INFORMATION FOR MALARIA TREATMENT AND CONSENT STATEMENT TO	The malaria test shows that your child has malaria. We can give you free medicine. The medicine is called ACT. ACT is very effective and in a few days it should get rid of the fever and other symptoms. You do not have to give the child the medicine. This is up to you. Please tell me whether you accept the medicine or not.		
125	CIRCLE THE APPROPRIATE CODE AND SIGN YOUR NAME.	ACCEPTED MEDICINE . 1 ________ (SIGN) REFUSED .... 2 OTHER 6	ACCEPTED MEDICINE . 1 ________ (SIGN) REFUSED .... 2 OTHER 6	ACCEPTED MEDICINE . 1 ________ (SIGN) REFUSED .... 2 OTHER 6
126	CHECK 125: MEDICATION ACCEPTED	ACCEPTED MEDICINE . 1 REFUSED .... 2 OTHER .... 6 (SKIP TO 130)	ACCEPTED MEDICINE . 1 REFUSED .... 2 OTHER .... 6 (SKIP TO 130)	ACCEPTED MEDICINE . 1 REFUSED .... 2 OTHER .... 6 (SKIP TO 130)
127	TREATMENT FOR CHILDREN WITH POSITIVE MALARIA TEST	ALSO TELL THE PARENT/RESPONSIBLE ADULT: If [NAME] has a high fever, fast or difficult breathing, is not able to drink or breastfeed, gets sicker or does not get better in two days, you should take him/her to a health professional for treatment right away. (SKIP TO 130)		
128	CHECK 113: HEMOGLOBIN RESULT	BELOW 8.0 G/DL, SEVERE ANEMIA 1 8.0 G/DL OR ABOVE 2 NOT PRESENT 3 REFUSED 4 OTHER 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA 1 8.0 G/DL OR ABOVE 2 NOT PRESENT 3 REFUSED 4 OTHER 6 (SKIP TO 130)	BELOW 8.0 G/DL, SEVERE ANEMIA 1 8.0 G/DL OR ABOVE 2 NOT PRESENT 3 REFUSED 4 OTHER 6 (SKIP TO 130)
129	**SEVERE ANEMIA REFERRAL** RECORD THE RESULT OF THE ANEMIA TEST ON THE REFERRAL FORM.	The anemia test shows that (NAME OF CHILD) has severe anemia. Your child is very ill and must be taken to a health facility immediately.		
130	GO BACK TO 103 IN NEXT COLUMN OF THIS QUESTIONNAIRE OR IN THE FIRST COLUMN OF THE NEXT PAGE; IF NO MORE CHILDREN, END INTERVIEW.			

DOSAGE SCHEDULE FOR ASAQ FIXED DOSAGE COMBINATION TREATMENT

AGE	WEIGHT	ASAQ COMBINATION	DOSAGE		
			DAY 1	DAY 2	DAY 3
6-11 months	≥ 4.5 kg to <9.0 kg	25mg Artesunate /67.5mg Amodiaquine	1 tablet	1 tablet	1 tablet
1-5 years	≥ 9.0 kg to <18.0 kg	50mg Artesunate /135mg Amodiaquine	1 tablet	1 tablet	1 tablet

FIELDWORKER'S OBSERVATIONS

TO BE FILLED IN AFTER COMPLETING BIOMARKERS

SUPERVISOR'S OBSERVATIONS

EDITOR'S OBSERVATIONS

Appendix B: Data Use Agreement

Government of Sierra Leone

Ministry of Health and Sanitation

21st January 2021

Dear Henry Biayemi,

Letter of Cooperation to Research on Insecticide Treated Nets and Malaria Disease in Sierra Leone.

This letter serves to acknowledge your request to obtain permission to research the "Insecticide Treated Nets (ITNs) and Malaria Control Strategy in Sierra Leone," as explained in your doctoral prospectus, has been reviewed and accepted. Based on the review of the doctoral prospectus and confidentiality agreement to protect patients' information in the secondary dataset, I now give you the authorization to access and use the archival data for secondary analysis on ITNs and Malaria disease.

Please examine all circumstances to maintain every information in the dataset confidential. Endeavour not to address or reveal any part of the information in the dataset with others. Moreover, do not perform any unapproved communications, interrogations, alteration, or purging of classified data. I believe the study's outcome and recommendations will add to knowledge by implementing positive social change and identifying the potential factors that may be militating against ITNs as a useful malaria control strategy in Sierra Leone.

Sincerely,

--- THE NATIONAL MALARIA CONTROL PROGRAMME

Dr A.S. Turay
Assistant Programme Manager
National Malaria Control Programme