2019

Family Predictive Factors of Rural Malaria Prevalence in Nsukka, Eastern Nigeria

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This is to certify that the doctoral dissertation by

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The Office of the Provost

Walden University
2019

Abstract

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by

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MPH, Capella University, 2012

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Dissertation Proposal Submitted in Partial

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

Walden University

August, 2019

Abstract

Children in early childhood are still suffering from burdens of malaria-related morbidity and mortality. There have been insufficient studies on how family-level factors may predict the prevalence of malaria (PoM), and negatively impact the control of malaria in rural areas, especially among children. In this study, potential family factors were explored to address the challenges associated with the increase in PoM among the children in rural areas of Nsukka. Socioecological framework guided this study at the interpersonal level. The quantitative cross-sectional study used secondary data from Demographic and Health Surveys (DHS) of 2015 in Nsukka rural communities. Data were analyzed using chi-square analysis and multinomial logistic regression. The result showed a statistically significant relationship ($P<0.05$) between the age group susceptibility among children. There were statistically significant relationships between the family's ownership of land for agricultural use, the family's choice of a treatment facility and socioeconomic status. The couple's extent of effective communication and whether the children in early childhood slept under the mosquito net showed statistically significant results. Positive social change implications depicted organizational level benefit that may help UNICEF and WHO by recruiting representatives in the distribution of preventive, control and treatment of malaria to the rural areas. Empowerment of women in the household to attend to their children during an emergency and standard housing policy initiative such as Family in Children (FIC) address both individual and societal levels, respectively.

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Dedication

This study was dedicated to:

1. God of miracle who gave me reasoning power and good health.
2. All children of underserved population whose parents could not afford to meet up their demands on prevention, control and treatment of malaria in developing nations.

Acknowledgments

This study would have been nothing without the dedicated extraordinary guidance from stages of prospectus, proposal and to the final stage of this dissertation:

1. Dr. Simone W. Salandy (Chair member)
2. Dr. Kelley C. Sams(Committee member)

Others are:

1. Dr. Tammy Roots (program coordinator) who provided adequate moral for this dissertation.
2. Dr. Nancy Rea (program director) who also provided active moral support for the success of this study.
3. Dr. Sara Witty-Form & Style Editor
4. Dr. Vania Bright-Chapter Editor
5. Dr. Aloysius Ibeh who spared his tight schedule to edit the chapters 4 & 5 and offered useful suggestions.

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Chapter 1: Introduction to the Study

Introduction

Globally, malaria remains one of the biggest threats to human lives, especially among the weak and vulnerable populations (children 0–5, pregnant women and immune-compromised individuals). Malaria is a significant public health problem with approximately 207 million cases and 627,000 deaths per year with most of the cases 80.0% and deaths 90.0% occurring in Africa(Arroz & Arroz, 2017; World Health Organization, 2018). Malaria continues to spread through visiting friends and relatives (VFR), immigrants as well as the aircraft that fly from malaria-endemic to non-endemic region throughout the world (CDC, 2018). Malaria is the most prevalence vector-borne disease in the world that claims endemicity in 92 countries (Kamya et al., 2015; Gething et al., 2016; Murungi, Kamuyu, Lowe, Bejon, & Theisen, 2013). Approximately 2million deaths occur worldwide as a result of malaria, half or two third of these are children 0–5 years of age(Martens, 2000; UNICEF, 2016). In the WHO regions, for example, 78% of malaria deaths in 2013 were children 0–5 years of age (WHO, 2014). The children 0–5 years of age are still under the proper care of their parents, and they solely determine their exposure susceptibility to malaria transmission(Azunie, 2017; WHO, 2016). Prevalence of Malaria(PoM) is caused by exposure to female Anopheles bites determined by multiple family predictive factors(Angelo Jada, Bei, & Lina, 2017; Carlucci et al., 2017; UNICEF, 2016). Documentation that about 3.3 billion people in 97 countries are at risk of being infected with subsequent PoM is widely noted (WHO, 2014). Majority of

these people are residing in the rural areas where the malaria control is becoming difficult to handle. In the 2014 world malaria report, sub-Saharan Africa (SSA) where malaria is endemic, a substantial burden associated with morbidity and mortality shows an estimate of 90% of those who contract malaria in SSA die from it (WHO, 2014). While children 0–5 years and other vulnerable population are disproportionately affected by malaria, every 45 seconds, a child dies because of malaria (WHO, 2014). Recent reports showed that preventive and control measures have significantly reduced the number of deaths among children 0–5 years (WHO, 2015). However, the rural areas remain uncontrolled with a subsequent increase in PoM among children 0–5 years. Malaria is prevalent among children 0–5 years and other vulnerable populations living in malaria-endemic countries (WHO, 2015).

In this study, I focused on the families with children 0–5 years of age in rural areas of Nsukka. This study was unlike the traditional communities' interventions; commonly referred as Community-Based Participatory Research (CBPR) (Berkman, Kawachi, & Gymour, 2014; Killeen, 2014; Novick, Shi, & Johnson, 2014). Exploration of family predictive factors such as children 0–5 years of age, occupation, income, could inform policy on new rural epidemiological surveillance. Despite successful studies and interventions conducted on malaria in developing nations, the mortality and morbidity associated with malaria prevalence arguably remain uncontrolled in the rural areas with estimated 445,000 deaths among the children ages 0–5 in 2016; CDC, 2018; Dawaki et al., 2016). This uncontrolled rural malaria prevalence with associated burdens on the vulnerable population 0–5 years of age has undermined the efforts of the WHO,

UNICEF, and other philanthropist organizations fighting for malaria eradication in rural areas of Nsukka, Eastern Nigeria (Kassam, Collins, Liow, & Rasool, 2015; UNICEF, 2016). The battle against malaria continues indefinitely; however, the hope of winning the battle against malaria especially in rural areas remains at large (Dawaki et al, 2016).

Children 0–5 years age in a family are seen as vulnerable from the medical point of view because they are susceptible to malaria transmission with associated outcomes such as severe anemia, cerebral malaria, and hypoglycemia (low glucose level) (WHO, 2018; Kangoye et al., 2014). Children 0–5 years of age have low immunity which make them susceptible to malaria transmission. As the age of the children increases; the immune system tends to increase (Bougouma, Tiono, Ouedraogo, Soulama, & Diarra, 2012; A. Nhabomba, Guinovart, Jimenez, Manaca, & Quinto, 2014).

I could not rule out existing knowledge gap among the families who care for their children but still lack knowledge of environmental impacts and ages of children as determinants for PoM. There were knowledge and communication gaps that exists among the families in establishing the relationship between agriculture, Anopheles mosquitos, and malaria transmission in Nsukka (Janko et al., 2018). Green vegetation creates favorable environment for mosquito breeding which is also seen as an expectation for high yields of crops(El-Zeiny, El-Hefni, & Sowilem, 2017; Hassan, Nogoumy, & Kassem, 2013). In this study, I focused on children 0–5 years in a farming environment to be given adequate protection from mosquito bites. In Nsukka rural communities, the routine malaria preventive and control measures do exist, but how these are being tailored to the families with children depend on the outcomes (Ingabire et al., 2015; Kimbi et al.,

2014; Sumbele, Samje, & Nkuo-Akenji, 2013). The families that fully engage in farming as the primary source of income generation with children 0–5 years of age are constantly exposed to malaria transmission (Headey, 2014; Janko et al., 2018). In previous studies, many researchers suggested how families in active farming practice can protect the vulnerable population - the children 0–5 years of age free from malaria transmission through recommendations (Paaijmans, Blanford, Chan, & Thomas, 2012; Pattanayak & Haines, 2018; Rek et al., 2018).

Background of the Study

Extensive research studies on malaria reflected the problems associated with increasing prevalence of malaria in endemic regions of the world (CDC, 2018; WHO, 2018). The results of prevalence of malaria are associated with burdens of morbidity and mortality especially among vulnerable population such as 0–5 years of age. About 285 000 children died before their fifth birthdays in 2016(Carlucci et al., 2017; UNICEF, 2016). Approximately 306,000 children 0–5 years die due to malaria, and two-thirds of these deaths, occurred in sub-Saharan African(SSA) regions (WHO,2016). The WHO (2016) estimated that malaria caused 9 out of 10 deaths among children 0–5 in SSA, especially in rural areas. The overall health of the vulnerable population in the family inevitably impacted the wellbeing of the family population health(Amek et al., 2015).

Most nuclear families play an essential role in the control of malaria in rural areas by utilizing the necessary knowledge and practices from community awareness program (Singh, Musa, Singh, & Ebere, 2014). However, the effectiveness of this role

depends on the family structure and socioeconomic statuses (CDC, 2018a; Kesteman et al., 2016). My goal for this study was to explore the roles families play towards the addressing the uncontrolled rural malaria among the children 0–5 years. CDC (2018) and Tobin-West and Kanu (2016) elucidated the influence of married women on the proper use of mosquito net three times high odds than the unmarried women with low odds. Heads of households have a network of behavioral influence on each other by applying all strategic malaria control and preventive measures among their children 0–5 years(Azunie, 2017; Musoke, Karani, Ssempebwa, & Musoke, 2013). Low income level status, the high cost of drugs and access to rural health facilities shape the families in treatment of children aged 0–5 years (Iloh et al., 2013; Ricci, 2012). When one or more of their children develop malaria, the mothers who have more direct contact with their babies than their fathers would always wait for the husbands to give an order or discuss when to start any form of malaria treatment(Romay-Barja et al., 2016). This approach constitutes a delay in malaria treatment.

Family can serve as a tool for effective communication within the rural community. The behavioral communication intervention should be tailored to improve knowledge of malaria among the heads of household with children 0–5 years in the rural areas(Romay-Barja et al., 2016; Yaya et al., 2017). The native speakers can effectively communicate to the heads of household using their native language on treatment, control, and prevention among children aged 0–5 years(Mbachu, Uzochukwu, Onwujekwe, Ilika, & Oranuba, 2013).

In this study, I aimed to identify the gaps caused by a less studied family focused malaria intervention from rural areas perspectives. Family predictive factors are controlled easily with a family-focused intervention which may subsequently reduce or eliminates rural malaria prevalence (Litsios, 2015; Rumisha, Smith, Masanja, Abdulla, & Vounatsou, 2014). Malaria attack on one family member, particularly a child that falls within age range of 0–5 years affects all the family members (Jespersen et al., 2016). Malaria in a community setting might go unnoticed for months until more families are affected before the news can spread to the local health authority(Abate, Degarege, & Erko, 2013; Girum, Hailemikael, & Wondimu, 2017). Most of the families, due to the lack of family-focused intervention, fail to report or attend distantly located health facilities in the city(Dhawan et al., 2014). Family-level of malaria intervention broadens the unit of preventive care from a narrow focus on the population health consumer to the broader family system towards rural malaria eradication (Berie, 2013).

Malaria transmission is highly depended on the temperature, humidity, rainfall , and environment such as thick green vegetations during the rainy season (Bastiaens, Bousema, & Leslie, 2014; Hamed & Grueninger, 2012; Yeka et al., 2012). While high temperature and heavy rainfall during the rainy season contribute the highest malaria transmission especially in SSA; little or no knowledge of these factors are shown at the family level in rural areas (Nabyonga-Orem, Ssengooba, Macq, & Criel, 2014; Stuckey et al., 2014). Despite these climatic factors, malaria transmission is mostly driven by farming practices due to constant exposure to female *Anopheles* mosquito bites (Bhatt et

al., 2015b; Kassam, Collins, Liow, & Rasool, 2015). The knowledge of and access to malaria preventive tools and the healthcare services distribution also determine the malaria transmission among the vulnerable population (Kalyango et al., 2013; Mbonye et al., 2013).

The preventive and curative health policies for rural areas are not tailored to control and eliminate malaria(Sundararajan, Kalkonde, Gokhale, Greenough, & Bang, 2013a). This policy only serves as palliative care to the rural population which negatively impact low-income families(Scharff, 2017). Kamat (2013), Bruxvoort, Goodman, Kachur, & Schellenberg (2014) and Palafox et al.(2014) noted that introducing a policy of cost-sharing or implementation of user fees in public health facilities to enhance equity and efficiency failed to consider the poverty-driven families in rural areas.

Problem Statement

Every year, families in rural areas bear burdens of malaria prevalence (Kateera et al., 2015). There is increased risk of malaria associated with age group susceptibility among children aged 0–5 years. Other potential predictive factors include family's ownership of land for agricultural use, the couple's extent of effective communication, whether children 0–5 years slept under mosquito net, and the family's choice of a treatment facility for the children 0–5 years of age.

Generally, families face difficulties in getting their children treated or prevented from malaria transmission as result of distance to a healthcare facility and poor environment respectively in rural areas(Length et al., 2016; Nyavor et al., 2017). These

burdens are observed more among a group of 0–5 years of age than other age groups in a family which require government interventions (Ingabire et al., 2015; Griffin, Ferguson, & Ghani, 2014). The research problem for this study is associated with family-related factors that drive the increase in PoM in Nsukka rural areas of Eastern Nigeria among children aged 0–5 years. Despite a series of interventions which include distribution of free mosquito nets, antimalaria drugs, and malaria sensitization at community levels in rural areas of Nsukka, PoM among children 0–5 years of age continues to rise(Richard et al., 2015; Roberts & Matthews, 2016). Generally, urban areas and cities affected by malaria have decreased or eliminated in the past 50 years; however, malaria control in rural areas is becoming more difficult (Nobelprize, 2014). This difficulty of malaria control in Nsukka rural areas has made this study necessary to utilize family factors in understanding how vulnerable population 0–5 years contribute to rising PoM. This problem posed by malaria in sub-Saharan Africa is associated with a 91% P. Falciparum infection rate occurring more among the children ages 0–5 than adults in rural areas (Cameron et al., 2015 & Kimbi et al., 2014). Through this study, I determined how predictive family factors linked with the vulnerable population can complicate the malaria control efforts in rural areas of Nsukka by increasing PoM among the ages of 0–5 years.

I described how each of these predictive family factors that may predict PoM among the ages 0–5 years in rural areas of Nsukka Nigeria. Pathak et al. (2012) and WHO (2018) elucidated that patterns of age-specific malaria morbidity are common among rural populations living in endemic regions with children 5–10 years of age who

develop immunity to suffer from less PoM than children aged 0–5 years. PoM accounts for approximately 70% of the estimated 429 000 deaths related to malaria worldwide (Nobelprize,2014). There was the likelihood of malaria exposure to a family that practices full-time farming and having children aged 0–5 years to malaria with an increase in susceptibility to infection. Family income and occupation were two levels of socioeconomic status which could combine with sociocultural factors that may predict PoM among children 0–5 years of age (Zingani, Mtonga, Kalungia, Mukosha, & Banda, 2017). Arguably, increase in 0–5 years of age drives increase in PoM especially in a very low-income family (Nkumama, O'Meara, & Osier, 2017; Roucher, Rogier, Sokhna, Tall, & Trape, 2014). As the population of 0–5 years of age increases, so the likelihood the PoM would increase. Lack of family planning exhibited by different families shows significant changes in demographics that reflect family size growth (Adams, Galactionova, & Kenney, 2015). The poverty and affluence can bring negative or positive outcome of the population health of the family respectively concerning increase or decrease in PoM among children (Bottomley et al., 2016; Sedda et al., 2015; Tusting et al., 2016). It was well-documented malaria control, and sustainable development is linked by changing our understanding about how poverty can negatively impact the children health by increasing PoM in a family (Ricci, 2012; Tusting et al., 2016). It is a daunting task for a family with a low-income earning through farming or petty trading to meet the treatment costs of children or themselves with malaria without health insurance coverage in rural areas of Nsukka(Austin, Adikaibe, Ethelbert, Chioma, & Ekene, 2014; Kilama et al., 2014; Ouédraogo et al., 2013). Odeyemi (2014) alerted in his previous

study that Community-Based Health Insurance initiated to include rural people was a total failure in Nigeria due to lack of clear legislative and regulatory frameworks as well as financial support. It would be difficult for these families to meet the treatment cost for about two to three children without government subsidy or free health insurance (Gruber, Hendren, & Townsend, 2014; Palmer, 2014; Xiong et al., 2013). The poverty also links to delay in transport of sick children to the health care facility. Without means of transportation to the treatment facility and poor environmental housing, the burdens of malaria continue to increase among the children.

Purpose of the Study

The purpose of this study was to explore how family with children 0–5 years could contribute to PoM in highly endemic regions. The network of influential factors that exist: such as children's age susceptibility to malaria transmission and family's socioeconomic status and behavioral factors could negatively or positively impact PoM. The significant increase in a population of children aged 0–5 years of age can adversely affect all low-income families by driving an increase in PoM. Appropriate recommendations for the agricultural practices as the primary family occupation malaria and income generation were suggested to reduce high malaria transmission associated with high-risk of exposure to mosquitoes' bites. This study added to the reduction of PoM in rural areas through research and new information regarding family predictive factors in children aged 0–5 years.

Research Questions and Hypotheses

From the summary table of the SEM, there were five levels of SEM, four were excluded in framing the research questions. The remaining other one level was included at interpersonal level was used to frame the research questions: family having children 0–5 years of age group susceptibility, family's ownership of land for agricultural use, the couple's extent of effective communication, whether children aged 0–5 years slept under mosquito net, and the family's choice of a treatment facility for the children 0–5 years.

Research Questions

Research Question1 (RQ1): Is there a relationship between the age group susceptibility among children 0–5 years and prevalence of malaria?

Research Question 2 (RQ2): Is there a relationship between the family's ownership of land for agricultural use and prevalence of among children 0–5 years?

Research Question 3 (RQ3): Is there a relationship between the couple's extent of effective communication and malaria prevalence among children 0–5 years?

Research Question 4 (RQ4): Is there a relationship between whether children 0–5 years slept under mosquito net and prevalence of malaria?

Research Question 5 (RQ5): Is there a relationship between the family's choice of treatment facility for the children 0–5 years and the prevalence of malaria?

Testing the Hypothesis

Research Question1 (RQ_1): Is there a relationship between the age group susceptibility among children 0–5 years and malaria prevalence?

Null Hypothesis (H_o1): There is no relationship between the age group susceptibility among children 0–5 years and prevalence of malaria

Alternative Hypothesis (H_a1): There is a relationship between the age group susceptibility among children aged 0–5 years and prevalence of malaria

Research Question 2 (RQ2): Is there a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children 0-5 years?

Null hypothesis (H_o2): There is no relationship between the family's ownership of land for agricultural use and prevalence of malaria among children aged 0-5 years.

Alternative hypothesis (H_a2): There is a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children aged 0-5 years.

Research Question 3 (RQ3): Is there a relationship between the couple's extent of effective communication and prevalence of malaria among children aged 0-5 years?

Null hypothesis (H_o3): There is no relationship between the couple's extent of effective communication and prevalence of malaria among children aged 0-5 years

Alternative hypothesis (H_a3): There is a relationship between the couple's extent of effective communication and prevalence of malaria among children aged 0-5 years

Research Question 4 (RQ4): Is there a relationship between whether children aged 0-5 years slept under mosquito net and prevalence of malaria?

Null hypothesis (H_o4): There is no relationship between whether the children 0–5 years slept under mosquito net and prevalence of malaria.

Alternative hypothesis (H_a4): There is a relationship between whether children aged 0–5 years and less slept under mosquito net and prevalence of malaria.

Research Question 5 (RQ5): Is there a relationship between the family's choice of treatment facility for the children aged 0–5 years and the prevalence of malaria?

Null hypothesis (H_o5): There is no relationship between the family's choices of treatment facility for the children aged 0–5 years and the prevalence of malaria.

Alternative hypothesis (H_a5): There is a relationship between the family's choices of a treatment facility for the children aged 0–5 years and prevalence of malaria.

Theoretical Framework

The theoretical framework of this study was rooted in the socio-ecological model(SEM). Historically, this theory was initially propounded by Bronfenbrenner in 1979 as ecological systems theory; this was followed by McLeroy putting forward his theory of ecological model of health behaviors in 1988 and finally Stokols's social ecology model of health promotion in 1992 (Glanz, Rimer, & Viswanath, 2015). Family predictive factors link to SEM was noted in the environmental levels of influence that distinguished the ecological model from behavioral models and theories. SEM was previously adapted to emphasize individual characteristics, skills and proximal social impacts associated with family and friends (Glanz et al., 2015). In this study, I framed its research questions from SEM by matching the appropriate level of the available

predictive factors in the dataset.

Summary for Principles of Ecological Perspectives for This Study

There were four core proposed Principles of Ecological Perspectives identified; two were related to this study.

Multiple Levels of Factors that Influence Health Behaviors

Ecological models as a component of SEM, specify that factors at multiple levels include intrapersonal, interpersonal, organizational, community, and public policy can influence health behaviors. Sociocultural and physical environment concepts cut across these levels to apply more than one standard. For example, in rural areas, the physical environment influences malaria transmission among the families with differences in age 0–5 and rest of age group in a family on full-time farming practices (Korenromp, 2012)

Influences Interact across Levels

It stands to reason that variables must interact with each other, they must work together to predict an outcome. An example includes children 0–5 years of the age group in a family has better population health in a family with health insurance coverage than a family with no health insurance coverage(Center for Disease Control (CDC), 2018).

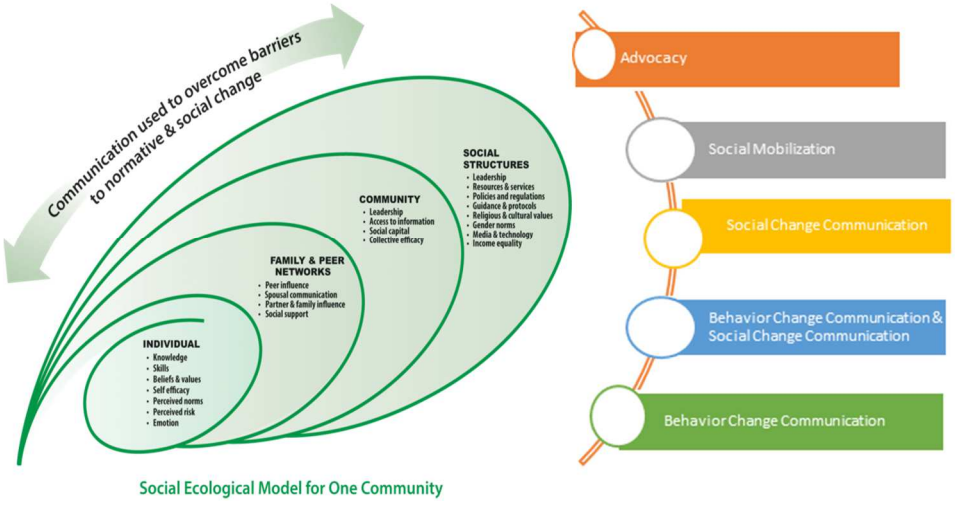
Multiple Level Intervention should be Useful in Changing the Behavior

It means that one intervention cannot effect change in behavior for multicultural families or communities unless policies and environments support the targeted behavior changes. For example, NLG health failed to reduce or eliminate PoM despite community-driven malaria sensitization, control, and treatment. It was because 0–5 years of age family-level of intervention was less researched in NLG(Blas, 2013).

Ecological Models are most Potent when they are Behavior-specific

There was a need to identify environment and policy variables that were specific to each behavior (Glanz et al., 2015). It means tailoring a behavioral intervention to a particular model that was needed for the application to research and interventions (Glanz et al., 2015). Distributing mosquito net in a highly malaria endemic rural areas to families already exposed to female Anopheles mosquito could be a wasteful effort without appropriate anti-malaria drugs to eliminate the malaria parasites in the blood circulation of all infected families.

Figure1. Socioecological Model below is combined with Communication for Development.(C4D) by UNICEF.



This SEM combined with C4D will be adapted from UNICEF ,2008 for this study to explain its application to frame the research Questions and for effective communication on family-related rural malaria control in Nsukka, Eastern Nigeria. https://sbccimplementationkits.org/quality-malaria-medicines/learn-about-sbcc-and-ssffc/what-influences-peoples-behavior/

Table 1
Description of Socioecological Model Levels

SEM Levels	Description
Individual	An individual that influences behavior change includes knowledge, attitudes, self-efficacy, development history, gender, age religious identity sexual orientation, expectations and financial goals.
Interpersonal	Interpersonal is formal and informal, social network. These are social support systems that can influence individual behaviors such as family, friends, peers, co-workers, religious network, customs and traditions.
Community	Any existing organization must have a relationship such as institution and informational network that exist within the defined boundaries. These include built environment(parks), village associations, community leaders, businesses, and transportation.
Organization	Social institutions must have rules and regulations in order to operate properly. These rules and regulations guide the institution or organization in all day today activities.
Policy	The implementations of all the evidence-based public health research are originated from existing health policy within the local, state and federal health departments. These policies direct all the health allocations to the target populations both in emergency, and non-emergency situations.

Note: Adapted from (UNICEF, 2008). A model for influencing behavior at family level to control malaria transmission in rural areas.

Within the context and concepts of rural malaria transmission spectrum, I used SEM to play a significant role in this study by The adoption of specificity intervention was through differences in environmental influences on vector `breeding and transmission using active, passive and reactive detections (Arroz, 2017; Molina Gómez et al., 2017). As the technology increases, SEM was adapted to exonerate urban transmission as a non-empirical evidence-based case that did not warrant intervention. The SEM level of interpersonal relationship defines the family level of response. SEM was used to establish the study of the rural environment in the family predictive factors of malaria prevalence. The use of SEM clearly explained how human interaction with the

environmental influences can elucidate the malaria transmission.

Informing the health policy at local, state and federal health departments on evidence-based cases would be imperative. SEM was previously applied to adopt overall health product allocation and distribution of curative and preventive services (Kraisin, Palasuwan, Popruk, & Nantakomol, 2014; Nabyonga-Orem, Ssengooba, Macq, & Criel, 2014). This study saw through the lenses of demographic, epidemiological, and socioeconomic determinants

Communication for Development synergized with SEM.

The synergistic combination of the SEM and C4D were used as a necessary modification that could benefit this study in addressing possible communication gap for the control of malaria at family-level in rural areas(Elmosaad, Elhadi, Khan, Malik, & Mahmud, 2016; Koenker et al., 2014a; Malenga et al., 2017; Ricotta et al., 2015).

In this study's theoretical framework SEM- and communication model-C4D, I presented and discussed them in more detail in Chapter 2.

Nature of the Study

The nature of the study was a secondary data quantitative approach of a cross-sectional design. This study was designed to quantify the relationship between the potential family predictive factors and PoM-outcome. The outcome was prevalence associated with the increased *P. Falciparum* infection in rural areas of Nsukka in Nigeria; despite the presence of malaria eradication services. In this study, I focused on the demographic, socioeconomic, epidemiological determinants of prevalence of malaria in rural areas. Similar studies were carried out previously in which socioecological and

epidemiological determinants of malaria were extensively described (Chirebvu et al., 2014; Pinchoff et al., 2016).

Definitions of Key Terms for this study

Independent Variables (Predictors)

Age (0–5): Generally, age has been essential factors in contributing to the diagnosis of malaria transmission. Optical microscopy assesses the confirmation of malaria diagnosis at parasitemia levels, and parasites detected by polymerase chain reaction(PCR)(Camargo et al., 2018; Cowman, Healer, Marapana, & Marsh, 2016; Lalremruata et al., 2017). Information on the pre-school age(0-5) is highly needed and calls for malaria transmission alert, and the families with children mostly on this age group that is susceptible to malaria.

Family Occupation (Farming practices): Family occupation determines the malaria exposure to the children 0–5 years. The families that are not engaged in farming practices will have less exposure to malaria transmission. Occupation is one of the levels of socioeconomic status.

Family Income: In rural areas, there is still low, middle and high-income families who engage in petty trading, brick laying/housing construction, civil servants such as security jobs, tax collectors and local police jobs for the municipal. The salary earning ranges from low income 20–50/month middle income > 50,000 Naira/month highest income > 100,000 Naira/month senior rank civil servants.

Education: Education is one of the levels of socioeconomic status. It was explored here because most those that have primary education especially unmarried youths migrate to urban areas in search for jobs; leaving the uneducated families behind.

Wealth index: Family with low income without proper insurance coverage might not meet up in the treatment of the children 0–5 years that requires both anti-malaria drugs and right nutritive foods.

Other predictor variables were: Communication through head of household relationship, sleeping under mosquito net, and sought treatment.

Measuring PoM dependent variable for this study

In this study, measurement of PoM was the magnitude of the malaria problem in a community that used to be mostly from clinically diagnosed malaria cases. The clinically malaria-metric measures are spleen rate, Splenomegaly (enlarged spleen), and parasite rate. The standard malaria-metric measures may provide the needed information such as monitoring the trend of the malaria increase or decrease in rural communities. Other characteristics for malaria-metric indices include severe malaria such as cerebral malaria, and anemia and mortality were associated with deaths from malaria among children 0-5 years. For this study, the prevalence rate was measured to determine the endemicity in rural areas of Nsukka.

Other Key terms for descriptive epidemiology for this study

Epidemiologic Triad of Malaria Transmission: The traditional model of malaria causation is the epidemiologic triad. However, based on the nature of the study, the causal inferences were determined; cause and effect are measured at the same

time(Hulley et al, 2013). This relationship exhibited with the interaction between the host, agent and the environment

Endemicity of malaria: Endemicity (or disease intensity) is a measure of malaria prevalence in a region; and prevalence is calculated as the proportion of people with malaria at a given point in time. Family predictive factors predicted the prevalence of malaria parasites at different locations such as rural or urban areas to provide estimates of endemicity.

Chronicity of malaria: There was an association chronicity of malaria with prolonged infection of the blood by escaping the immune responses directed against several antigens. These antigens exhibit variables epitopes (antigenic determinants); which are generally accepted(Mukry et al., 2017; Vallejo et al., 2015).

*Malaria Life Cycle:*The life malaria life cycle merely the pathways through which the parasites undergo series of transmission steps within the population in endemic areas which occurs between the hosts(humans) and the vectors(mosquitos) bites during blood meal by injecting the parasites into human blood circulation.

Assumptions

The assumptions of this study were based on the articles I reviewed from studies related to the PoM among children 0–5 years of age at family-level in rural areas. It was assumed that families in the rural areas have perceptions of the problems associated with PoM among children 0–5 years. The collaborative study approach of target population brings a better understanding of the problems within them than being studied as a homogenous entity (Bhumiratana, 2013; Koita et al., 2013). It was assumed that any

information obtained from this study could be used to address the difficulty of malaria control in rural areas.

Ideally, there was assumption that family predictive factors such as children 0–5 years of age in a family, family income, family occupation, place sought treatment, couple's extent of effective communication and whether children 0–5 years slept under mosquito net showed strong correlations with PoM among children. Based on this prediction, in this study, I was able to bring to the understanding of how best the family predictive factors that were identified to predict PoM in rural areas of Nsukka. The identified family predictive factors might be used to address the persistent problem of malaria transmission control in rural areas of Nsukka(Durnez et al., 2013). With the family-level of approach, the dynamic changes associated with the rural malaria epidemiology, there was effective control of rural malaria prevalence(Wickramage, 2013). In this study, I assumed that data from DHS from October to November 2015 represented the overall population in Nsukka rural areas.

In this study, I assumed that malaria control, prevention, and treatment in the rural areas of Nsukka continue to remain uncontrolled from the traditional community-based interventional approach. In this study assumption, many researchers argued that family-based interventions would have brought dramatic reduction or elimination of malaria transmission among the children aged 0–5 years in rural areas (Bustos, 2013). In this study, I assumed that the closeness of children 0–5 years of age to their families would bring a better understanding through family intervention than the traditional community malaria sensitization by Nsukka local health department. In a previous study, there was

assumption that family-level would be better understoods the treatment plan than at community level through the clinical presentation to control rural malaria prevalence among children 0–5 years of age (Smith, 2014).

Limitations of the Study

The limitations of this study were based on the available data from Nsukka local government epidemiological surveillance on malaria via DHS. In this study, I relied on secondary data with quantitative cross-sectional study design from DHS on Nsukka rural communities of Enugu State. The available data within the prevalence period was used for this study. In this study, I intended to investigate the relationship between the age group susceptibility among children 0–5 years in a family, family occupation, family income, family's choice of treatment facility, use of mosquito net and PoM. Previous researchers did not used the cross-sectional quantitative design to infer cause and effect instead it measured both cause and effect at the same time(Arul, 2017; Frankfort-Nachmias, Nachmias, & DeWaard, 2015; Hulley, Cummings, Browner, Grady, & Newman, 2013). There was no follow-up in this design; the data collected via DHS only the current values of predictor and outcome variables were measured and often supplemented with historical information(Hulley et al., 2013). Cross-sectional design measured only prevalence(Arul, 2017; Hulley et al., 2013; MacInnes, 2017).

This result was to inform the policy towards prioritization of families with children aged 0–5 to address the persistent uncontrolled malaria in rural areas. This study could be generalizable to family populations in urban areas or applicable to other infectious diseases within rural areas. In this study, I selected data from DHS on the

families with children 0–5 only and excluded other vulnerable population such as pregnant women and immune-compromised individuals. In this study, it could be concluded that results may not have accurately represented every community member and family since only the family with children 0–5 years were included in this study. Since it was a secondary data collection, some vital information needed for this study might be missing.

Delimitation and scope of this Study

In this quantitative study design, I relied on secondary data from the Demographic and Health Survey (DHS) for the Nsukka rural malaria epidemiological surveillance in 2015 from 10/01/2015- 11/30/2015. In this study, I intended to delimit to age group susceptibility among children aged 0–5 years in rural families, family's ownership of land for agricultural use, the couple's extent of effective communication, whether children aged 0–5 years slept under mosquito net, and the family's choice of treatment facility for children aged 0–5 years. Any family without children 0–5 years was excluded for this study.

In this study, all other variables such as participants and conditions were not assessed and hence could not be addressed. Therefore, it was considered beyond the scope of this research study. I also excluded malaria incidence, quality of life of the rural people, deaths of children 0–5 years, the children's state of nutrition and anemic condition in this study.

Significance of the Study

In this study, I strived to explore how to control the vicious cycles of malaria prevalence associated with age group susceptibility and a focus on children 0–5 years. Bousema and Drakeley (2017) suggested that the population level of understanding the malaria transmission creates a window of a better focus for the eradication. The NLG health department had a less focus on family level of intervention with children 0–5 years of age, which could be the problem associated with the vicious cycle of increase in PoM in rural areas of Nsukka. In this study, I strived to suggest the best approach towards a decrease in PoM in rural areas of Nsukka. Shcherbacheva and Haario (2017) noted that family size reduction is a significant factor in malaria eradication; behavioral alteration caused by infected human hosts. I attempted to identify how family factors could be modeled to predict PoM in rural areas by focusing on families with children aged 0–5 years. Family predictive factors provided a better understanding of prevention, control and treatment of malaria in rural areas among children aged 0–5 years that constantly drive an increase in PoM. Family predictive factors such as children 0–5 years of age group susceptibility among children aged 0–5 years, family's ownership of land for agricultural use, couple's extent of effective communication, whether children aged 0–5 years slept under mosquito net, and family's choice of treatment facility for children aged 0–5 years were measured to determine their contribution to PoM. Bizimana, Kienberger, Hagenlocher, & Twarabamenye (2016) and Maharaj et al.(2013).conducted similar studies on involving children under five years but not with family factors. All the local government health departments, Non-governmental organizations such as WHO,

UNICEF and philanthropists would be able to benefit from this study for all rural malaria epidemiological interventions. This study suggested how children aged 0–5 years would receive priority in malaria preventive care delivery in rural areas.

Social Change Implications

Individual Level

Empowering the individual head of households in every family through informal education on children 0–5 years would uncover various predictive factors that undermined malaria control efforts in rural areas of Nsukka. In this study, I suggested that empowerment to the head of each household created the awareness that children 0–5 years were vulnerable to malaria transmission. Prioritization through heads of household's reports identified families at risk with growing evidence of malaria burdens of morbidity and mortality. The combined team of the head of households, the predictive family factors for PoM among children 0–5 years would be controlled by the prioritization of rural preventive malaria delivery.

Organizational Level

The UNICEF, WHO, and other philanthropic organization could use the benefits of the empowerment of the head of each household to integrate distribution of preventive services function to the families at risk with the vulnerable population. The planned strategies of rural malaria control standard may be likely to reduce or eliminate PoM among children 0–5 years. Identification of the families at an individual level (Heads of household), initiation of direct distribution of preventive care at the organizational level

such as UNICEF, WHO, and other philanthropic organizations would effectively break the cycles of uncontrolled malaria in rural areas of Nsukka, Eastern Nigeria. This study presented family as a new lens of focus to effect a change in the distribution of preventive tools such as mosquito nets, prophylactic drugs, and anti-malaria drugs. The families engaged in farming practices would be located and provided with more protective tools than the families who were not into farming practices. The family-related malaria sensitization needed an extension to all rural communities at Nsukka. This approach would make these organizations focus on families by initiating direct supply to those in an emergency in the rural communities. In so doing, providing adequate preventive care to families with children 0–5 through prioritization would see to positive social change actualization in underserved rural areas of Nsukka, Eastern Nigeria. The local health clinics that were directly involved in both treatment and preventive care would benefit from the new family-related malaria control for all rural Nsukka communities' preventive malaria and treatment delivery system. Realization of the positive social change also entails recognizing that each family could always be a group with cultural values to respect.

Societal Level

At the societal level, implementation of new program initiative such as Family Infant Children (FIC) would bring continuity and total elimination of malaria in rural areas especially the children 0–5 years under this study. The communities in a rural area would be sensitized to family values to better address the chronic problems regarding rural malaria reduction and elimination. Positive social change could be achieved by

effectively communicating the communities to focus on each family's protection by prioritization of the children aged 0–5 years who were susceptible to malaria transmission in rural areas. Initiation of FIC program may bring a sustained positive social change in controlling rural malaria not only among children 0–5 years at Nsukka, Eastern Nigeria, and can be generalized to other rural areas in developing nations. Finally, about potential positive social change, this study may contribute to the new idea of malaria control in rural areas and subsequent malaria elimination through galvanized efforts of the families' cooperation and stakeholders' effective communications.

Summary

From the global perspective, as malaria cases had gotten controlled in cities and urban areas, however, the rise in rural communities has remained uncontrolled. Myriads researchers on malaria prevalence have indicated this growing evidence of uncontrolled malaria especially in developing nations like rural Nsukka, Eastern Nigeria(Orimadegun & Ilesanmi, 2015; Sultana et al., 2017b; Sundararajan et al., 2013a). In this study, I strived to investigate how family predictive factors contributed to the vicious cycle of uncontrolled rural malaria among the children 0–5 years. The PoM among the children aged 0–5 years keeps increasing in rural areas of Nsukka. The family factors such as age group susceptibility among children aged 0–5 years, family's ownership of land for agricultural use, couple's extent of effective communication, children aged 0–5 years who slept under mosquito net, and family's choice of a treatment facility for children aged 0–5 years contributed to the PoM was less studied among children 0–5 years of age.

In the Chapter 1 of this study, I discussed the introduction, background, problem statement, and purpose of the study. Identification of the research questions for this study led along with related hypotheses and the theoretical framework. This study chapter comprises the assumptions, limitations, delimitation, and positive social change implication with a brief review. The concluding remark of this chapter also came with a brief statement on the significance of the study and the associated implications for positive social change. The proceeding chapter 2 was composed of the literature review for this study.

Chapter 2: Literature Review

Introduction

This chapter includes peer and non-peer reviewed published articles that were relevant to the context of this study. The family predictive factors undermined the control and prevention program initiatives among children 5 years old and younger in rural areas of Nsukka(Afoakwah, Deng, & Onur, 2018; Afoakwah, Nunoo, & Andoh, 2015). The program initiatives related to malaria by Bill &Melinda Gates Foundation and international organizations such as the WHO and UNICEF (2014) had been successfully carried out in malaria-endemic regions of the world. These organizations include WHO, UNICEF, UNDP and other philanthropic organizations that fight malaria around the world, and in rural Nsukka, Eastern Nigeria. For this literature review, I retrieved literature from 5 years to present; however, I included article within 6 years if they contribute to the points of argument for this study. I relied on articles of some theories and facts regarding malaria transmission and control in rural areas of the endemic regions of Africa, especially in Sub-Saharan Africa (SSA). My focus for this study was on reducing malaria transmission by understanding the family predictive factors and less focused on the burdens of morbidity and mortality among children aged 0–5 years in Nsukka rural areas.

The primary stakeholders such as the WHO, UNICEF and other philanthropic organizations had an enormous impact on malaria control especially in urban areas in

SSA. However, many efforts and preventive strategies are needed to address the control of malaria among rural populations.

In this study, I used the family as a major indicator to address the gaps associated with rural malaria control among the families living with children aged 0–5 years. The family predictive factors such as the age group susceptibility among children aged 0–5 years, family's ownership of land for agricultural use, and couple's extent of effective communication. Others were whether children aged 0–5 years slept under mosquito net and family's choice of a treatment facility for children aged 0–5 years, and the predictive relationship with PoM in rural areas of Nsukka. With a better understanding of the relationship between these predictive family factors, the control and preventive strategies of rural malaria would be accessible. This accessibility might open a new window of successful malaria transmission reduction associated with burdens of mortality and morbidity.

In this chapter, I covered the literature search strategy which included the databases, key terms, and the combination of search terms and described the scope of the literature review. In this chapter, I also provided an overview of the global, regional progress as well as rural malaria control and prevention closely related to Nsukka rural community. In this chapter, I described my adaptation of the theoretical framework-SEM and my rationale for using it in this study. I synthesized the studies related to the research methodology and associated variables. The last section of the literature review consisted of research methodology and my rationale for choosing a cross-sectional design and quantitative analysis of secondary data for this study. In the summary and conclusion

section of this chapter, I provided a concise summary of the significant variables in the literature that highlighted what was known and explained how this study filled the knowledge and communication gaps. Figure 15 showed a model which explained how knowledge and communication gaps were filled in this study.

The Study Search Strategy

I used Walden University library's electronic databases to provide related articles for this study. These databases were CINAHL, MEDLINE, PROQUEST, BMJ, and Pubmed. In this study, I extensively used CDC, WHO and UNICEF websites and UNDP website local articles of Newspaper with a comprehensive report on rural malaria-The Guardian News Paper on the impact of farming on malaria transmission. I also used google scholar to search extensively on articles related to malaria among children under five years with family involvement.

The Major Search Terms

Family-based research on rural malaria in developing nations, poverty, and malaria, family farming and impacts on children under five years, family income and impact on malaria control in rural areas, prevalence of malaria. The search terms include alternative treatment-seeking behaviors, mosquito net use in Nsukka rural areas and malaria, environmental factors, family predictive factors, agricultural practices, malaria effective communication and knowledge gaps.

Search Descriptive Terms

Roll Back Malaria in Nigeria and impact in rural malaria control. Malaria metric, endemicity, chronicity, malaria life cycle, severe malaria cerebral malaria transmission,

elimination, non-health insurance family coverage with children under five years, Immunity and age and the epidemiologic triad of malaria transmission.

The scope of the Literature Review

Significant textbooks on malaria epidemiology and Malaria Journals was incorporated into this study. This scope was based on studies that examined the relationship between age group susceptibility among children aged 0-5 years and PoM and other predictive family factors. Finally, studies published between 2013 and 2018 in all languages and translated into English, and studies published in all regions of the world. Literature reviews were conducted on eligible publications and were synthesized to determine the appropriate theoretical framework. SEM was adapted for this study, which was discussed in the next section.

Theoretical Foundation for this Study

SEM forms the foundation of this study. I used this model to address the complex nature as well as interdependences between socioeconomic, cultural between socioeconomic, cultural political, environmental, organizational psychological and biological determinants of behavior. The SEM had been widely applied in effective communication to impact positive social change in control of malaria and health promotion; especially among single mothers in the rural areas (Azunie, 2017; CDC,2015 and UNICEF,2008). Several researchers had modeled SEM to frame research questions with five bands of influence (Azunie, 2017 and CDC,2015). For this study, I adapted SEM at the level of an interpersonal band of influence that explains family factors impact on malaria control in rural areas of Nsukka, Eastern Nigeria by focusing on children 0–5

years. The version of SEM adapted for this study included UNICEF communication for development (C4D) which synergistically work with the SEM(UNICEF,2015). C4D was modeled to create effective communication with family heads about control and prevention of malaria among children aged 0-5 years in rural communities of Nsukka(UNICEF,2015). SEM model usually used to address factors that often influence individual health at multiple levels such as individual, interpersonal, organization, community and policy (CDC, 2015).

Individual Level

Within the spectrum of SEM, individual level of influence on the heads of the family could be a mother or a father depending on his or her marital status respectively. Most researchers relied on family predictive factors and utilizes each family head as an influential tool despite problems of drawing individual inferences from family data(Berkman, Kawachi, I. & Gymour, 2014). Either father or mother has enormous influence over the children's 0–5 years health condition; however, there was no element of individual level of influence for malaria prevalence(Azunie, 2017). The individual level comprises personal factors which include knowledge, attitude, belief, educational level, sex, and socioeconomic status(Dhawan et al., 2014). These factors could increase or decrease the likelihood of an individual to engage in control and prevention of malaria transmission in rural areas(Azunie, 2017; Singh, Musa, Singh, & Ebere, 2014) In this study I used an individual level of influence through the strategic use of behavior change communication(BCC) which applied targeted messages by tailoring health promotion behaviors to reduce risk-taking(Koenker et al., 2014). Bowen (2013)and UNICEF(2015)

made us believe that BCC was a valuable tool designed to sensitize each of the family heads of household who were at risk of transmission, especially with the vulnerable population. The main argument on individual level tailoring the needed education on children 0–5 years of age did not guarantee rural malaria control. When the heads of household are continuously practicing culturally tailored malaria prevention and control, there could be the likelihood of achieving the set goals in rural areas. In previous studies,the BCC was tailored individually include facilitating identification of children 0–5 years with asymptomatic infection and appropriate treatment(Bowen, 2013; Koenker et al., 2014) Informing individual head of families of optimal timing of malaria control and explaining changing diagnosis such as increasing false negative as parasite density and multiplicity of infections decreases with subsequent treatment guidelines(Bowen, 2013). SEM was an appropriate framework that I used in this study to achieve the aims and objectives of malaria control in rural of Nsukka among children 0–5 years. A useful BCC tailored continuously could promote change at the individual level which could change knowledge of individual attitude as well as behavior and skills(Azunie, 2017; Dhawan et al., 2014). While this BCC was being tailored, it was imperative that the individual cultural belief must always be respected.

Interpersonal

The study research questions were framed at this level in the SEM that comprises family, friends, spouse, culture, and tradition and caretaker behavior. Family was the primary focus of the problem I addressed in this study. At this level, I explored the relationships and interactions between individuals in a community. A significant

influence on individuals who can better understand the control and prevention of malaria among children aged 0-5 years was achieved (Azunie, 2017; Bowen, 2013). Family was the central focus of the interpersonal level of SEM, the interactions within the individual family member can create a positive impact on control of malaria transmission in rural areas. The Johns Hopkins Center for Communication(n.d.) maintained that each family operated at her level of knowledge of the children 0–5 years and malaria transmission. Some wives must take orders from the husbands before even attending to the child who was sick. Effective communication for positive social change was likely to stop risk delay of the sick child for immediate medical attention in rural areas. There was a reason to accept that a good knowledge of signs and symptoms of malaria by the family who received adequate sensitization on malaria which could positively impact the timely treatment of acute malaria attack(Isiguzo et al., 2014). However, a family with low income might not afford the treatment costs; mostly consistent with the poor farmers in rural areas(Cotter et al., 2013). It was noteworthy that for effective social behavior change communications to succeed and for the family to respond accordingly to the vulnerable population-children 0–5 years, free malaria treatment policy must be available for all the target families in rural areas of Nsukka. Family predictive factors such as lack of knowledge of immune system of children 0-5, delay in taking the children to the nearest health facility when the malaria symptoms start; require persistent informal training of the family heads(Manana, Kuonza, Musekiwa, Mpangane, & Koekemoer, 2018; McKee, Becker-Benton, & Bockh, 2014). In this study, I suggested that it was imperative that effective communication be maintained in the native language the

families would understand. The families with children 5 years and younger who arguably had little or no education lower could be mobilized to identify and advocate for the family solution to family problems(Toso, 2018). Developing of online social support networks and how the families may interact with the social communicators face-to-face support networks was likely to influence physical and psychological health outcomes among the children 0–5 years(West et al., 2014).

Community Level

This level has been the traditional target for public health intervention. The common intervention consistent with the community level was known as community-based participatory research(CBPR)(Novick, Shi, & Johnson, 2014). Each family was in the community which shared common customs and tradition with many other families(Lassi, Kumar, & Bhutta, 2016). The village head had an influence on each of the family heads. The village head commanded loyalty from the family head(Allendorf, 2012). Within the spectrum of malaria interventions among the vulnerable population 5 years and younger, influence from the village heads on how to prevent and control malaria could create a positive impact on rural malaria control and prevention that remained unsolved in Nsukka, Nigerian, and other rural areas. The village heads had a role to play in control and prevention of malaria; such as influence on establishment of the rural health facilities for prioritized malaria treatment in rural areas(Lim et al., 2012; Musoke, Karani, Ssempebwa, & Musoke, 2013). The village heads could be influenced by Nsukka health department to address the delay in treatment of the children 0–5 years(Singh, Ebere, Singh, & Musa, 2014). At the community level, the group culture

associated with family-level was readily understood to address predictive factors such as perceptions, beliefs, attitudes about malaria causation, symptom identification, treatment of malaria, and prevention are often overlooked in malaria control efforts(Amoran, 2013; Singh et al., 2014). The village head could influence the family-related cultural behaviors that can negatively impact the rural malaria control and prevention among the children 0–5 years. In rural Nsukka, many communities had one thing in common; such as the enforcement of environmental clean-up of pathways leading farm areas, village squares, and surroundings. This attitude and practices drive away mosquito breeding spots. This network of relationships among the villages enabled them to function to improve their environmental health toward reduction of malaria transmission among the children 0–5 years. Given position of the village heads at the community level, the malaria control program implementers found it easy to create the awareness on how specific contextual conditions affect the building harnessing and mobilizing of social capital (Berkman, Kawachi, & Gymour, 2014; Mensah, 2015). The public health stakeholders strived to influence the village heads who in turn influence family heads to create positive impacts on rural malaria control and prevention (Amoran, 2013; Mensah, 2015).

Organizational Level

For this study, this level under SEM elucidated UNICEF as a powerful organization that influenced the population health of children of all ages. In this study, I

explored how the family predictive factors contributed to the PoM among children. UNICEF and WHO are two major organizations that have common goals for controlling malaria transmission among children 5 years and younger in rural areas of Nsukka, Nigeria. Maternal, Newborn and Child Health and Nutrition (MNCHN) services are provided by UNICEF and WHO to the developing nations in SSA. In Nsukka rural communities, the UNICEF, WHO and other philanthropic organizations provided malaria preventive tools and therapeutic services indirectly through the local health. Despite the obscure provision, the control of malaria among the children 0–5 remained at large. There was a reason to believe that for any organization to function correctly, the set goals to be accomplished must incorporate into the rules and regulations guiding her (UNICEF & WHO, 2015). UNICEF has targeted the children 0–5 years who are one of the most vulnerable groups affected by malaria and WHO towards reduction or elimination of malaria transmission. These organizations had accomplished this goal by meeting up to 65% of children sleeping under the mosquito net (UNICEF &WHO, 2015). Another promising organizational level of SEM is the Johns Hopkins Center for Communication Program that was founded on the belief that social and behavior change(SBCC) as the key to solving the world's most pressing health problem. This problem was uncontrolled malaria among children 0–5 in rural areas of Nsukka in Eastern Nigeria which this study had been explored.

A community-based organization created by WHO and UNICEF can positively impact the control of malaria in the rural area of Nsukka, Nigeria. There was a strong reason to appreciate the idea of community-based killing of mosquito larvae by

organization that successfully controlled malaria transmission in Tanzania (Maheu-Giroux & Castro, 2013). Empowering the community-based organization could create a positive impact on the rural malaria control and prevention.

Policy Level

The policy directed towards prioritization for distribution of preventive and curative care to the vulnerable group such as children 0–5 years would be able to create the positive impact on the rural malaria control especially in Nsukka, Nigeria. Health policy had been a guiding principle to initiate interventional research at local, state and federal levels; this approach can work efficiently at the rural areas(Glanz, Rimer, & Viswanath, 2015). There was a reason to believe that policy should encourage corporation between community health workers and leaders to ensure that any failures in providing malaria preventive and control services in the community must be addressed (Azunie, 2017). In this study, I suggested that policy development on family-based intervention would be by prioritization of the families with children 5 years and younger to address the rural malaria prevalence. Policy directed towards globalization rural malaria intervention and distribution health services would focus on families with low income to address malaria prevalence related health inequalities between "poor family" and "rich family" (Fineberg & Hunter, 2013).

Communication for Development Model (C4D)

This study used the benefit of SEM and C4D combination as shown in the figure to address gap through effective communication at each of the five levels. The families communicate effectively during community-based intervention will determine the

success of the overall intervention. Interpersonal level or family and peer networks of effective communication would create a positive impact on control of malaria transmission among children 5 years and younger. Closing the communication gaps that might exist between husband and wife by proper use of mosquito nets, prophylactic medication for prevention or correct pediatric dose was commendable (Mitiku & Assefa, 2017). There was a reason to believe that behavior change communication (BCC) strived to reach the vulnerable population, identify asymptomatic conditions, and inform the communities of the proper timing for intervention (Koenker et al., 2014). In this study context, an organized community workshop with a concentration on prevention and control of rural malaria among children 5 years and younger had been shown to create a positive impact (Malenga et al., 2017)

Social and behavior change communication (SBCC) included active participation in malaria control and prevention program in which treatment, control, and prevention are maintained (Ingabire et al., 2016). The awareness and necessary skills were tailored to the ill-informed families in order to address rural malaria prevalence (Arroz, 2017; Ingabire et al., 2015). The communication gap between husband and wife would be clearly identified in rural areas while seeking treatment of the children 0-5 years; however with the SBCC, the communication gap could be closed entirely or narrowed(Chukwuocha, Okpanma, Chukwuocha, & Nwakwuo, 2015; Cotter et al., 2013; Killeen, 2014).

Synergistically, SEM and C4D elucidated how this theoretical framework provided a better understanding of rural malaria among the vulnerable population at the family level. The awareness created was likely to enable families with children 0-5 years meet the

standard of control, prevention & treatment. The use of preventive and curative tools such as mosquito bed net(MBN), malaria prophylactic drugs(Pyrimethamine) popularly known as Sunday-Sunday medicine and Artemether (Coatem) ACT was likely to reduce or eliminate malaria in rural areas respectively(Azunie, 2017; EdetUtan et al., 2016; Oluwasogo et al, 2016 ; Kassam, Collins, Liow, & Rasool, 2015). This theory was used to describe the relationship between the predictive family factors and PoM among children 0-5 years of age. The preceding section was to briefly describe the global progress and failures, regional, Lifecycle of malaria transmission, the epidemiologic triad of malaria transmission, understanding the epidemiologic triad in control of rural malaria, burdens of rural malaria and complications among children 0-5 years of age. Next to section was previous studies related to the construct in this study; such as predictive family factors and PoM among children 0-5 with the quantitative cross-sectional design. The last section included implications for past research on the current study, summary, and conclusion.

Global Progress on Malaria and Reasons for Failures in African Regions.

WHO and UNICEF(2015) strived to focus on children under 5 years with integration of other ages of which enormous progress was made. Below showed the map displaying the essential data to prove on the global efforts by WHO and UNICEF.

Figure 2. Map showing Global and Regional Progress in Fight against Malaria.

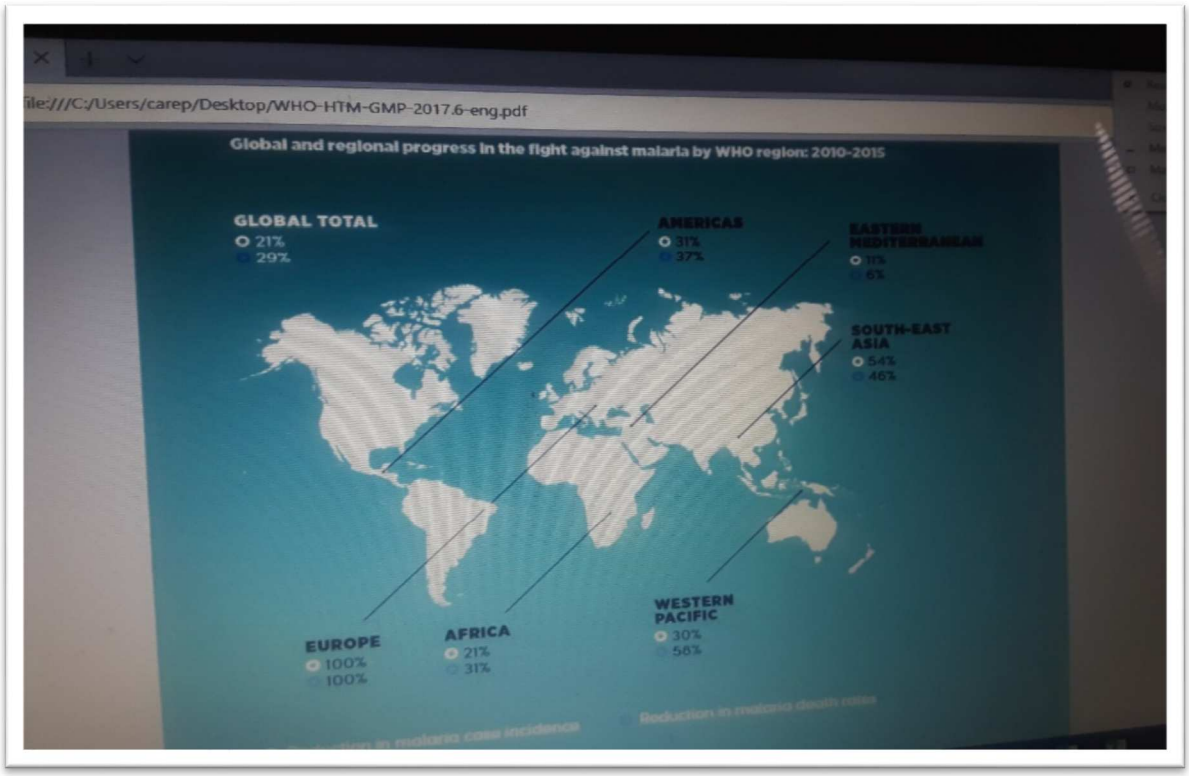


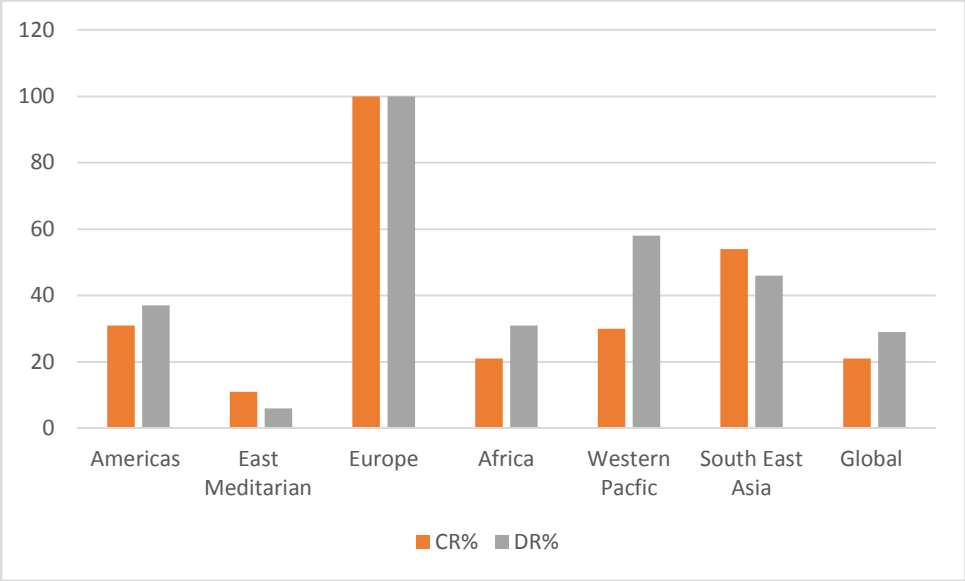
Table 2

The Progress made By WHO and UNICEF in Control of Malaria Continued

Regions & Global	**Case Reduction (CR% Rate)**	**Death Reduction (DR% Rate)**
Americas	31	37
East Mediterranean	11	6
Europe	100	100
Africa	21	31
Western Pacific	30	58
North East Asia	54	46
Global Total	21	29

wqaData provided by(UNICEF, 2015)

Figure 3.Global Progress on Malaria Control By WHO and UNICEF.



Data provided by UNICEF , 2015

Despite the efforts made by WHO and UNICEF on malaria control, there is still a big gap between Europe and other regions by comparison. This gap showed an evidence malaria control inequality which leads to a vicious cycle of health disparities(Cheng, Johnson, & Goodman, 2016; Nabyonga Orem, Mugisha, Okui, Musango, & Kirigia, 2013a). This was depicted in the bar chart. However, globally, the control of malaria had not been significantly achieved because of cultural, social, economic and political differences (Maheu-Giroux & Castro, 2013; Mtenga et al., 2016). The myriads of factors driving the increase in malaria in rural areas of the developing nations had been elusive to the regional stakeholders on malaria intervention. There was a reason for this study to share the similar idea with De Silva and Marshall (2012) by noting that uncontrolled urban expansions from rural areas contribute to an increase in malaria transmission in SSA. The open agricultural practices and poorly-monitored land use, as well as poorly

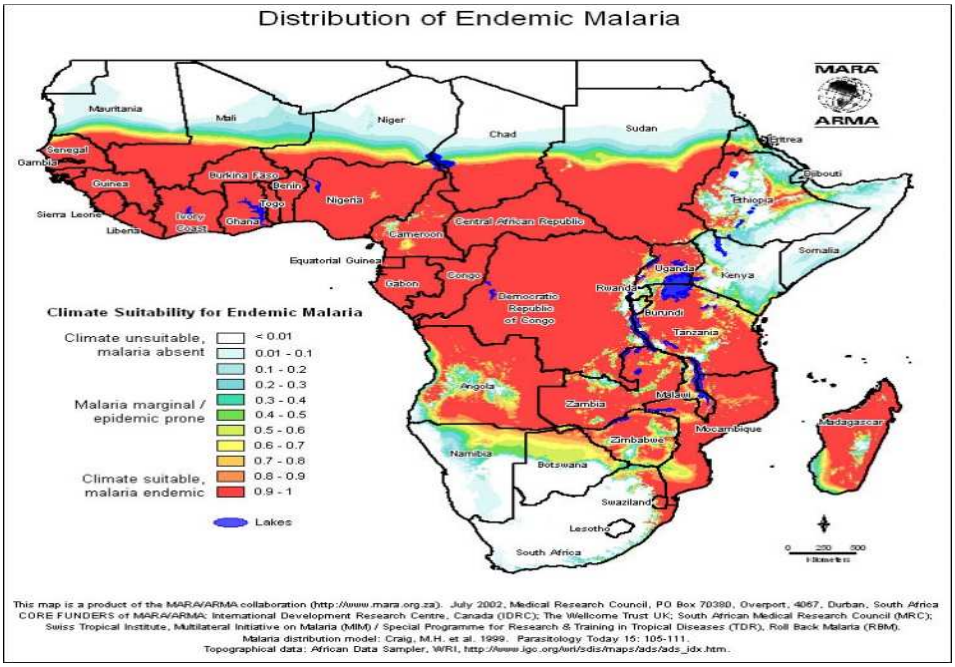
managed waste disposal poor quality housing unpaved roads and reduced access to preventive care, have kept malaria transmission uncontrolled(Molina Gómez et al., 2017; Ricci, 2012a). CDC (2018) provided another reason for this study to agree by pointing that malaria occurs mostly in poor tropical nations as well as the subtropical areas of the world and noted that children 0–5 years bear the burdens. CDC(2018) opined that the costs of treatment of malaria were a major contributing factor to uncontrolled malaria in rural areas especially among families with children 0–5 years.

Regional Africa and SSA Malaria Distribution with Climate control in Africa.

This study data was obtained within one of the rural areas of SSA; that was Nsukka rural area of Eastern Nigeria in West Africa. In this study, I focused on families with children 0–5 years in this malaria endemic region of Africa. There was a reason to believe that human behaviors contribute to the climate change (Bizimana, Kienberger, Hagenlocher, & Twarabamenye, 2016a). This climate change was exacerbated by land use change, population growth, urbanization migration, and changes in economic development (Caminade et al., 2014; Onyango, Sahin, Awiti, Chu, & Mackey, 2016). Mayala et al. (2015) remarked that families engaged in farming as a means of livelihood have little or no knowledge of "climate change" which has negatively impacted the preventive and control strategies for malaria transmission among the vulnerable children 0-5 years in the rural area. Many researchers had studied on strong beliefs on the wealth status of a child's family where a wealthy family in farming practice could fail to control or prevent malaria transmission among the children due to the knowledge gap (Mfueni Bikundi & Coppieters, 2017; Moshi et al., 2017). The little knowledge of

malaria prevention and control might be there, but the pressures from farming activities and stress have compromised this knowledge.

Figure 4. Map depicted Distribution of Endemic Malaria in Africa Regions.



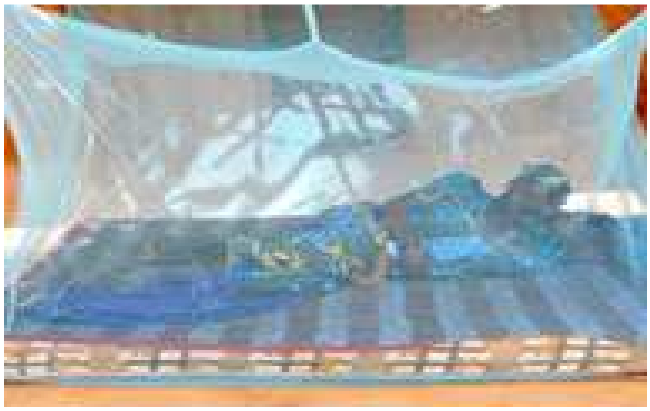
Courtesy of *Mapping Malaria Risk in Africa*(MARA)

A close look at the above map, SSA falls within the red zone (endemic region) is located under the North African regions. This was where data for this study was collected. According to Mapping Malaria Risk in Africa(MARA)(n.d.), starting from North African down to the SSA, the malaria distribution increases and represented in a white zone(climate unsuitable for female Anopheles mosquito). This distribution increases further down represented in light sky blue to deep blue and green to yellow and finally to the red zone as a full-blown malaria endemic region (MARA, n.d.). The white area in far North Africa is natural control of malaria transmission from the Sahara Desert. There is no water or vegetation for a mosquito to breed in Sahara Desert regions.

Further down south of Sahara commonly called SSA is the rainforest region where the climate is suitable for the mosquito breeding ground. The whole of Nigeria falls into the red zone (endemic area) as well as other West African countries (MARA, n.d.). South Africa indicated an unsuitable climate for mosquito breeding, and this has shown that tremendous progress towards total elimination of malaria is offing. Unlike in North African where the Sahara Desert has enormous influence on malaria control naturally, South Africa national spray campaign has made the mosquito climate unsuitable(Maharaj et al., 2013). Despite prominent pocket of malaria transmission in two provinces, South Africa's malaria elimination agenda and control strategies should be extended to other Africa regions(Maharaj et al., 2013). Africa leaders should have one common agenda on malaria preventive and control strategies to remove endemicity tag from the map. This study agreed with suggestions made on treatment approaches, control and preventive strategies that did create positive impact on the overall health system of South Africa(Coetzee et al., 2013; Maharaj et al., 2013; Ukpe et al., 2013) This approach serves as a motivation to other African leaders fighting to control malaria in their countries. There was a strong reason to believe that each family with or without children 0-5 years has different perceptions of malaria transmission and association with climate, knowledge, preventive practices, treatment of malaria, and control(Dhawan et al., 2014; Kimbi et al., 2014).

WHO and UNICEF recommended control tool in malaria endemic regions

Figure 5. A woman sleeping under the mosquito net with her baby.

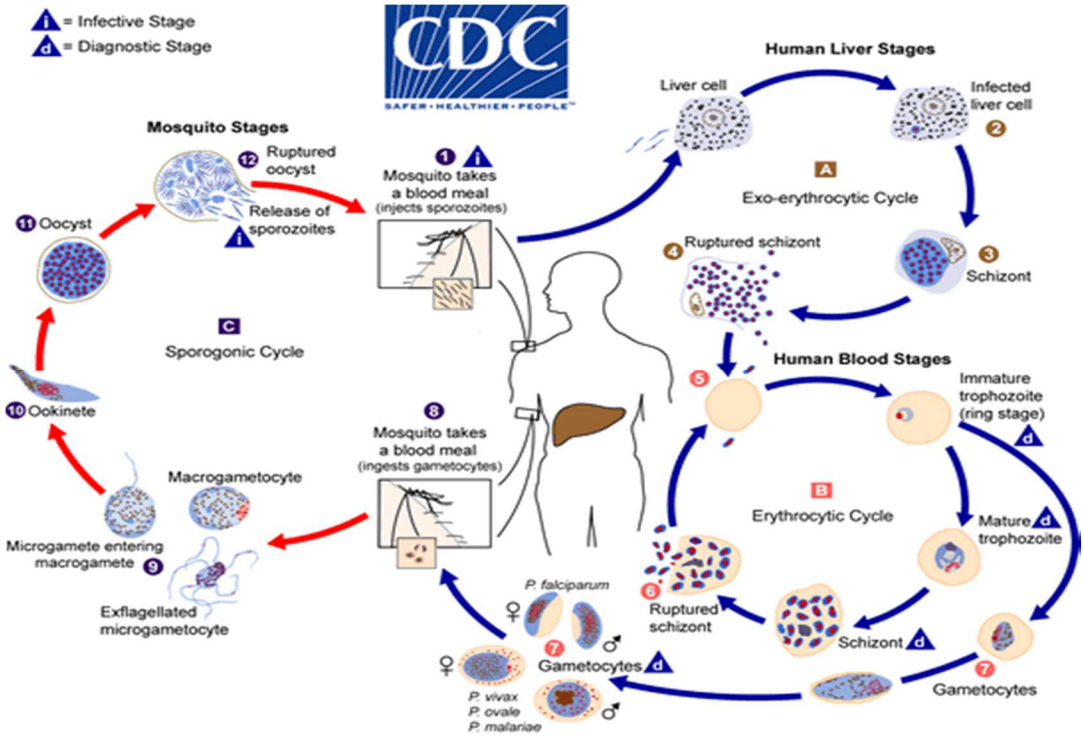


WHO and UNICEF(2015). A woman sleeping under the mosquito net with her baby.

Joint efforts of WHO and UNICEF (2015) among under five from global setting both in developed and underdeveloped and developing nations (Insecticide-treated nets are the gold standard for malaria control in endemic regions). Myriads of researchers gave their reasons on the mosquito net use or misuse in the rural areas, but there were similarities in each reason. Such reason includes misuse of the mosquito net, perceptions on the use of the net all these boiled down to lack of adequate risk communication that are culturally appropriate to the families at risk in rural areas(Guerra, de Sousa, Ndong-Mabale, Berzosa, & Arez, 2018; Kassam, Collins, Liow, & Rasool, 2015). This study focused on families with children 0-5 years which is less researched; many researchers have focused on communities which face cultural barriers at the family level(Bedford & Sharkey, 2014; Kepha et al., 2016; Sundararajan, Kalkonde, Gokhale, Greenough, & Bang, 2013b).

In this regard, the family factors created a better understanding than the community in addressing the vicious cycle of uncontrolled malaria prevalence in rural areas associated with children 0–5 years. Tailoring effective risk communication to the families with children 0–5 years creates the positive impacts on the malaria control, prevention, and treatment in rural areas(Fatungase, Amoran, & Alausa, 2012; Li, Han, Guo, & Sun, 2016; Tweneboah-Koduah, Braimah, & Otuo, 2012).

Figure 6. Life Cycle of Malaria.



Adapted from (CDC,2015)

Malaria Life Cycle

There are five species of malaria parasites of Plasmodium: P. falciparum, P. vivax, P. ovale P. malariae and P. Knowleski. The P. Knowleski is now recognized in human as a zoonotic transmission through (long-tailed macaques-monkey) resulting from deforestation and sharing familiar environment with monkeys(Imai, White, Ghani, & Drakeley, 2014) Among these species, only P. falciparum is commonly found in SSA where this study will be conducted; and hence will be explained more in this review than other species. Life cycle of malaria creates a better understanding of each of the species of human malaria parasites.

Historically, malaria life cycle discovery was believed to cause infection through inhalation of dirty water at the end of 19th century(Animalresearch, 2014). Biological researchers such as Manson, Koch, King, and Lavern developed separate theories which maintained that bites from mosquito were linked to the malaria manifestation(Ross, Manson, Ross, & Manson, 1897). However, there was insufficient evidence from the theory of causation supporting this idea of mosquito bites. Manson waved into action for further research by proving that a mosquito bite drew blood from an infected person and the parasites were absorbed into the mosquito(Animalresearch, 2014). Manson concluded that parent cells in the blood gave rise to small motile filaments which were visible in the blood of infected people who were, in turn, infected by mosquito bites (Animalresearch, 2014). Ross finally disproved other Biologists who claimed that mosquito larva infected people in the water and upheld Manson Theory of malaria causation through mosquito bites only (Ross et al., 1897). Cox (2010) noted that Ross elucidated the malaria

transmission cycle which exhibited the characteristics of the each of the species that led to an overall understanding of the malaria parasites' clinical manifestation of illness.

The impact of malaria life cycle for this study.

Understanding the incubation period of the significant species such as P. falciparum would end delay in treatment of the children 0–5 years and subsequent control of malaria in rural areas of Nsukka, Eastern Nigeria(Eziefula et al., 2014; Ohm et al., 2016). Extrinsic Incubation Period (EIP) is the time it takes malaria parasites to develop within mosquito which shown to be a critical parameter influencing transmission intensity(Ohm et al., 2018). For this study, *P. falciparum* is the only species that is being referred to; the incubation period is about 9-14 days, and other species are from 18 -40 days (Heymann, 2014).

Simplifying the complex malaria life cycle

There are two hosts: human and female Anopheles mosquito (Heymann, 2014 & Ohm et al.,2016). The mosquito ingests gametocytes original form of the parasites during a blood meal then undergo a series of cell division known as meiosis in the gut of the mosquito to form oocyst(CDC, 2017). The Oocysts migrate to the wall of the mosquito releases sporozoites to salivary gland CDC,2017). During next blood meal mosquito injects sporozoites into human blood circulation(CDC, 2017; Nelson & Williams, 2014). Sporozoites then migrate to liver cells where it goes series cell division to form schizonts which release merozoites that are capable of invading red blood cell(CDC,2017). Inside the red blood, cell mitosis occurs which form ring forms, trophozoites, and gametocytes

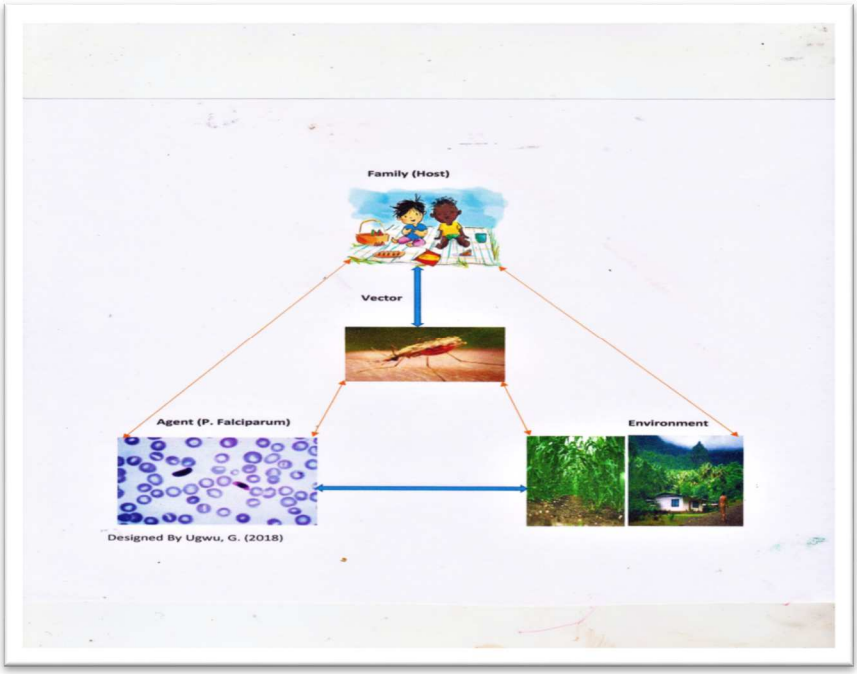
released into circulation to complete the full life cycle(CDC,2017). Diagnostic stages include:

- Ring form (which signifies acute malaria)(Tille, 2017)
- Gametocytes (which signifies chronic malaria)(Tille, 2017).

These two stages are diagnosed by visualizing stained thin-filmed red blood cell under the light microscope.

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

Figure 7. Epidemiologic Triad of Malaria Transmission Model.



Contributors to this model

1. Johns Hopkins Malaria Research Institute (n.d.). Retrieved from http://www.malaria.jhsph.edu/

2. CDC(n.d.) Retrieved from http://www.cdc.gov/malaria

3. Canstockphoto(n.d.) Retrieved from https://www.canstockphoto.com/pregnant-mother-with-baby

4 Federal Ministry of agriculture & rural development(n.d.) Retrieved from https://www.agrinigeria.com/directory/listing/federal-ministry-of-agriculture-rural-development.

Factors that Influence Malaria Transmission.

This was modeled to creates opportunities for Malaria transmission interruption. The theory of causation cannot be clearly explained here because both cause and effects are measured together (Hulley, Cummings, Browner, Grady, & Newman, 2013) Epidemiologic triad or triangle is a tradition for all infectious diseases (Center for Diseases Control and Prevention (CDC, 2015). The above model is composed of an external (agent) Plasmodium falciparum, susceptible (host) the children 0–5 years, and a conducive(environment) which is the Nsukka rural community that bring the host and agent together (CDC, 2015). Subsequently, this model disease manifests from the interaction between the agent and the susceptible host children 0–5 years in a conducive environment that supports the transmission of the agent from the source to the host children 0–5 years.

Importance of this model in public health practice: developing appropriate practical and effective public health measures to prevent or control rural malaria requires assessment of all the three components and their interactions is imperative (CDC,2015).

Brief explanations of the components for this model and its Application to Families in Rural Nsukka, Eastern Nigeria.

Agent: originally referred as infective P. Falciparum; this must be present in host's blood circulation for malaria to manifest (Heymann, 2014). Asexual forms of the *P. falciparum* are the infective stage for malaria transmission which are called sporozoites while the diagnostic stage are gametocytes (CDC,2015). See figure 6 malaria cycle. This study refers only to the characteristics of *P. Falciparum* which is only types of malaria parasites in the rural Nsukka. Within the scope of this study, it strived to suggest the best way to avoid or reduce the transmission of malaria and its prevalence in the rural areas. Gametocytes are shown in the Giemsa stained thin film red blood cells in figure 4

*Host***:** refers to the human who are susceptible to the malaria transmission of infective *P. falciparum*-the gametocytes(Beck-Johnson et al., 2013). This is influenced by the following (intrinsic factors) behavioral risk factors: such as sexual practices, hygiene, children's age 0-5 years and immune response differences, pregnant women), genetic composition, and medication (CDC, 2015;Abraham, Massebo, & Lindtjørn, 2017; Tiono et al., 2013). The children picture shown are vulnerable to the malaria transmission in figure 7.

Environment: refers to extrinsic factors that affect the agent and the opportunity for exposure (CDC,2015). Environmental factors are the geology, climate, biologic factors such as the vectors that transmit that transmit the agents, socioeconomic factors such as crowding (family size growth), windows and doors without screen, insufficient mosquito net, and humidity (Abraham et al., 2017;CDC, 2015). An environmental condition was illustrated with Amazon forest region where malaria transmission was noted to be at high risk (Endo, 2017). Quantifying the contribution of the environmental factors, malaria transmission dynamic, the following factors must be considered: the importance of the home location concerning the vectors' breeding sites (bushy growing farm crops surrounding the houses during the rainy season such as the maize, greenly vegetables, and cocoyam farms). The mosquitos(vectors) breeding grow in a geometrical progression which manifests high malaria transmission. A house shown in the picture represented rural people living in farming areas surrounded by growing crops as in figure 7

The contribution of the vectors to the Epidemiologic Triad

The vector female Anopheles mosquito is a pivot in which the wheel of triad revolves: the vector bites the human(host) children 0−5 years to inoculate the agent (*P. Falciparum*); so that the malaria infection will manifest (Nelson & Williams, 2014). The female Anopheles mosquito needs conducive environment greenly vegetation or the farm areas to breed more vectors to grow in geometrical progression for high transmission of these pathogens (*P. Falciparum*). Vector is an

organism that injects the malaria infection through human (host) bites for a blood meal see figure 7

General Equation of host and agent relationship.

Agent + Host(Children 0−5)= Malaria infection.

Agent + Host (Adults) ≠ Malaria infection

The first equation holds for children 0−5 who are highly vulnerable to malaria transmission in the rural areas. The lower the age, the higher susceptibility and vulnerability to malaria transmission. There is substantial scientific evidence from previous studies that noted the existence of a strong correlation of lower age with vulnerability to malaria transmission (Mbepera et al., 2017). This study focuses on the proper use of vector control and *P. falciparum* prevention tools in families with children 0−5 years for a better understanding of the malaria transmission epidemiology (Talisuna, Noor, Okui, & Snow, 2015).

The second equation is only false when the condition such as pregnancy and immune suppressed individuals are involved (Stanisic et al., 2015a). There is substantial evidence to believe that two decades of study have elucidated a strong correlation between HIV□related immunosuppression with increased malaria infection, burden, and treatment failure, as well as malaria complications irrespective of immune status (Bhumiratana, 2013; Van geertruyden, 2014). The above equations mostly depend on the vulnerability of the hosts; consistent with the children 0-5 years of age under this study(CDC,2015). Other vulnerable populations

such as immune-compromised individuals and pregnant women have a share of the above equation (Pimenta et al., 2015). The active adults who have been exposed to the *P. Falciparum* from birth and have developed immunity against it, have little or no contribution to this equation (Osier et al., 2014; Persson et al., 2013; Stanisic et al., 2015b). The higher the age, the less susceptibility, and vulnerability to malaria transmission (Clayton, Dong, & Dimopoulos, 2014; Murdock, Moller-Jacobs, & Thomas, 2013).

Malaria Burdens among Children 0–5 and Measurement of PoM

Measuring PoM burdens and associated malariometrics such as malaria parasitemia, spleen rates, and anemia commonly evaluated in children aged 0-5 years (Howes et al., 2016; Udoh et al., 2013). Within the spectrum clinical presentations of malaria, diagnosis can be made by the supporting evidence from peripheral blood smears with the aid of a light microscope (Stevenson et al., 2015) Other diagnostic instruments include Rapid Diagnostic Test(RDT) commonly used in endemic regions and Real-Time Polymerase Chain Reaction (PCR) commonly used in asymptomatic nonendemic regions(Helb et al., 2015; Laban et al., 2015; Tusting et al., 2016).

Table 3

Measuring Development of Malaria and Diagnostic Methods of Detection Continued

Authors	Type of diagnosis	Instruments	Principles	Detection/ sensitivity	Specificity	Costs of Testing	Application
Graz et al(2011); WHO (2015.)	Clinical Symptoms	Physical Examination	Symptomatologic	30-50%	No	None	Emergency treatment

CDC(2018) &WHO. (2018)	Laboratory	RDT	Anti- gene/Ant-body reaction	71%	Yes	No Required Skill	Mobile diagnosis for treatment
Mukry et al. (2017)&Reller et al (2013)	Laboratory	PCR	Enzyme Replication of DNA.	100%	Yes	Highly Skilled	Good for Non-Endemic Regions. Asymptomatic
Krampa et al(2017) & Pirnstill & Coté (2015)	Laboratory	Microscope	Image Visualization Through Lenses.	99.1%	Yes	Skilled	Confirmation of Malaria in endemic Regions (Gold Standard)

Malaria epidemiology is closely related to its transmission intensity(Howes et al., 2016; Nkumama, O'Meara, & Osier, 2017). Without malaria transmission there will be no prevalence of malaria and hence no control, however, this shows that malaria control is guided by estimating the clinical burden and its transmission intensity(Bretscher et al., 2013; Pothin, Ferguson, Drakeley, & Ghani, 2016). The direct measurement of transmission intensity is estimated by entomological inoculation rate (EIR)(Bottomley et al., 2016; Kilama et al., 2014; Tusting, Bousema, Smith, & Drakeley, 2014). Researchers use the metrics of malaria to estimate the burden of the disease such as number of cases, both asymptomatic and symptomatic with prevalence(Korenromp et al., 2017; Wong et al., 2014). Prevalence is defined as the measure of occurrence of malaria; calculated as the proportion of individuals with a malaria at time divided by population at risk of malaria (Guest, 2013). PoM is the measure of occurrence of malaria in rural areas(WHO, 2018). PoM can be calculated as prevalence for period of one year; this is known as point prevalence(Crowell, Yukich, Briët, Ross, & Smith, 2013; Touré et al., 2016)

Severe malaria and family-related factors among children 0-5 years.

Cerebral Malaria is associated with severe infection of the brain (cerebral malaria) and characterized with seizures, confusion, and increase in tiredness that lead to coma and death(Mutombo et al., 2018). The affected children often die within less than 72hrs after the onset of the symptoms (Mutsigiri-Murewanhema et al., 2017). The SSA is the most affected region which contributes over 80% of deaths mostly Children 0–5 years(Mutsigiri-Murewanhema et al., 2017; WHO, 2015). The major cause of deaths among children 0–5 is associated with severe malaria and represent 77% malaria deaths globally (WHO,2015).

Anemia is a condition when the blood cell lacks healthy red cell or hemoglobin(WEBMD, 2018). Malaria generally, might not be incriminated for anemia among children 0–5 years in malaria endemic zone as the sole cause, however chronic stage points to its association with malaria(Ncogo et al., 2017a). This was because other family related factors such as poor nutrition, intestinal parasites due to contamination such as hook worm and bacterial infection were common in tropics, can contribute to anemia in children(Ricci, 2012). Anemia is a silent killer among children in rural areas commonly witnessed among busy parents that are fully into farming practice(Manning, Laman, Davis, & Davis, 2014; Njunda et al., 2015; Ricci, 2012).

Splenomegaly is the enlargement of spleen commonly observed among children who are suffering from sickle cell disease in malaria endemic region(Tubman & Makani, 2017). The malaria is more severe with anemia that precipitate to sickle cell crisis which can be fatal(Ardiet et al., 2014). There is a reason to believe that sickle cell disease can

exacerbate the vulnerability of children to high malaria transmission due to early loss of splenic function(Tubman & Makani, 2017).

Summarily, these three-deadly severe-related diseases of malaria are preventable and controllable by understanding each family's cultural orientation. The factors such as farming practices, income, income related self-seeking treatment have complicated burdens among children 0–5 years at family level. In rural communities of Nsukka, Eastern Nigeria, co-infections do complicate the children health condition especially when the family head failed to recognize the early malaria symptoms.

Determination of the Malaria Endemicity level by Malariometric Indices among Children.

This study was determined the endemic level in rural areas of Nsukka, Eastern Nigeria by assessing the any of these malariometric indices. However, many of them are not specific to malaria. Many tropical diseases such as tropical eosinophilia and sickle cell disease contribute to the increase in indices(Doumbo et al., 2014; Lemaitre, Watier, Briand, Garcia, & Hesran, 2014). Cerebral malaria rate shows more specificity to malaria than splenomegaly rate because spleen enlargement among children 0–5 years(Heymann, 2014). The malaria burdens are estimated based on malariometric indices such as prevalence of malaria parasitemia among children 0–5 years(Sumbele et al., 2015). The level of endemicity with focus on family predictive factors presented better understanding of the specific burdens with respect to each family under study. The

family with children 0–5 years having hemoglobin variants such as sickle cell traits " "AS" and "AC" is potentially protected from malaria while family with SCD "SS" and "SC" is potentially susceptible to high risk of malaria transmission(Bougouma, Tiono, Ouedraogo, Soulama, & Diarra, 2012).

Table below will elucidate the importance of malariometrics in endemic rural areas.

Table 4
Common malariometrics among children in rural areas. Continued

Measurement	Confounders	Clinical Outcome	Description
Spleen Rate	Sickle Cell disease	Splenomegaly	When the function of the spleen has failed it becomes enlarged.
Hematocrit	S. Haematobium	Anemia	This form of anemia is iron-deficiency. The hemoglobin content in red blood cell very low.
Cerebral Malaria(CM)	Brain injury	Comatose	This common among busy families. The delay in treatment of severe malaria can lead to CM
Entomological inoculation rate	Acquired immunity / Infectious Mosquito density	DM	The number of infectious mosquito bites are estimated. Accurate count of bites can be obtained from family level

Effective Risk communication to the families with children 0-5 years on the Delay in Malaria treatment.

In this study, to pointed out the reasons why children aged years in rural Nsukka or elsewhere could be driven into complications of malaria despite families and stakeholders and researchers focus on their preventive and curative health. There is a strong reason to believe that researchers and policymakers agree that delay in seeking for malaria treatment for children aged 0–5 years in rural areas results in severe

complications, and sometimes death (Kamat, 2013). These complications such as cerebral malaria, severe anemia, and enlargement of the spleen can lead to the death of the affected children (Mutsigiri-Murewanhema et al., 2017). The question left to be answered was; how the effective risk communication was tailored to the families with children aged 0–5 years? Anderson, McCrindle, Kruger, and McNeill(2018) made us believe that risk communication on malaria prevention and treatment in young children could be better achieved by tailoring culturally appropriate song about malaria to help young children protect themselves. However, their argument in this regard was only limited to children within school age not preschool age which this study strived to explore. For this study, family involvements have an active role to play in order to achieve this goal.

Most nuclear families with children whose wives do rely on the orders from the husbands who are the heads of the family to initiate treatment of their children in the rural areas could take up to 24hrs (Kamat, 2013). There is always waiting for the orders from the husbands who usually come late from work constitute delays in treatment of malaria among the children. Increase in population of the under five children in a family, non-proximity of treatment facilities, engaging into active farming especially during the rainy season increase delays in treating the children at risk(Kassile, Lokina, Mujinja, & Mmbando, 2014). In Nsukka rural communities, there are some patent medicine vendors(PMV), rural health centers within reach by the families with children 0–5 years. How equipped and effective malaria medicines in these facilities to meet the demands of these families with children? Delays in treatment of the children are determined by the

socioeconomic background of the families such as low income (Sonko et al., 2014). The sources of drug supply to the PMVs in rural areas have been one of the major determinants delays in treatment because the fake anti-malaria drug would complicate the overall treatment(Chaudhry & Stumpf, 2013; Karunamoorthi, 2014).

Timely administering of the antimalaria drugs with correct dosages to the children, early knowledge of symptoms of malaria with close observations will create positive impact by eliminating the complications of malaria in children aged 0–5 years associated with delays in rural Nsukka(Apiku, 2015; CDC, 2018 & WHO, 2018).In previous study, there was partial reason to believe that improving community-level knowledge about malaria using culturally-appropriate health education tools by making traditional healers partners in malaria control(Sundararajan, Kalkonde, Gokhale, Greenough, & Bang, 2013). However, recognizing the family with children aged 0–5 years as a robust cultural group in our society can create a better understanding in addressing the malaria control in the rural community especially in Nsukka, Eastern Nigeria.

Stratification of the families with children by the perceived risk of malaria

In this study, I concentrated on families with children 0–5 years and the strategic approach needed to achieve this goal was to stratify the families within the rural areas in malaria-endemic regions. The cultural beliefs of the families were stratified based on income level, possession or ownership of the mosquito bed net(MBN), the extent of couple's effective communication, and family's ownership of land for agricultural use. Other family predictive factors for this study were age group susceptibility among children aged 0–5 years, and family's choice of a treatment facility for children aged 0–5

years. The number of children aged 0–5 years with accurate headcount could break all hidden barriers associated with malaria control in rural areas. The old-school approach that researchers have over researched keeps rural malaria with increasing prevalence at the community level. This study agreed with the assertion made by Chen et al. (2017) that individuals are hardest to reach in rural areas. In this study, I focused on families with children that could create an impact on malaria control and prevention by effectively tailoring the culturally appropriate messages to each family head after stratification. Myriads of researchers keep giving erroneous impression on malaria eradication especially in Africa where children aged 0–5 years are dying of malaria in a million every year (UNICEF, 2016; WHO, 2016). Some researchers failed to recognized that African population health is shaped by political, social, cultural and economic factors which made malaria eradication impossible(Stepan, 2015). Every family has her problem, and that problem must be taken into consideration during tailoring education on malaria control among the vulnerable children 0–5 years. There was a reason to believe that considering the socioeconomic, demographic and biological/disease-related factors that determine the vulnerability of the population of children aged 0–5 years at risk in each family is imperative(Bizimana, Twarabamenye, & Kienberger, 2015; Bizimana, Kienberger, Hagenlocher, & Twarabamenye, 2016b).

Understanding the culture of the families with children aged 0–5 years and integrating their culture into the control could mitigate the family related barriers. Some families' common belief might be that once the once their wives are still at reproductive age, they will keep having children whom they cannot correctly feed or even given full of

medical attention(Nabyonga Orem, Mugisha, Okui, Musango, & Kirigia, 2013b). Cooperating with these groups of families and offering some government free treatment care as well as preventive care could positively create an impact on rural malaria control in Nsukka, Eastern Nigeria. The low-income families at risk recognize should receive sensitization on both family planning and malaria control. The should be advised that having more than four children means more costs in food, medicine, and treatment is imperative which will positively reduce the cultural barriers (Zgambo, Mbakaya, & Kalembo, 2017). Distributing mosquito bed net according to the number of children in each family not just per family that has failed to control rural malaria at Nsukka, Eastern Nigeria (Victor et al., 2014). Some families may decide not to use treated mosquito bed net because they believe that the smelling chemical used to treat the bed net can kill children; their perceptions on the treated bed net must be respected. Issuing the families with non-treated bed net can solve this problem of beliefs and perceptions on treated bed nets utilization.

Power of head of household relationship to the family and effective communication for malaria control and prevention.

In Nigeria, there are several languages spoken in rural areas as first or mother tongue. Their second language is the English language which is acquired by formal education. The health workers are knowledgeable of two languages of communication during malaria preventive intervention. Tailoring the control and prevention of malaria through mother tongue language is advertently more effective communication approach than through English language (Amoran, 2013; Azunie, 2017). In the rural areas the

ability to communicate using mother tongue language constitutes an effective communication; otherwise, it is a language barrier to communication (Quora, 2017). There is a reason to believe that rural people especially the heads of household who attends to their children 0–5 years acquire integrated cultural orientation on malaria control and prevention through the mother tongue education(Quora, 2017; Schwartz et al., 2014).

Previous Studies Related to the Construct of Current study

Nyarko & Cobblah (2014) conducted quantitative cohort study by using secondary data from Ghana Demographic and Health Surveys(GDHS) with a selection of 2,725 women who had children within the five-year period preceding the survey. This study was for two months survey; between September 8 and November 2008. The authors' study aim for this study was to obtain information on women's exposure to malaria during their most recent pregnancy in the five years of preceding the survey and malaria treatment. The data collection method was a structured household questionnaire. The authors sought to assess the sociodemographic factors that determine the development of malaria among children under five years in Ghana.

Analytical Approach

The authors applied STATA software in analyzing the data. They used bivariate analysis and complementary log-log regression models to examine the determinants of malaria prevalence among children under five years in Ghana for the period of the study. The different proportion of malaria cases determined the first level of analysis while the

second log-log regression was applied to study the factors that determine the malaria cases among children under five years. This approach was also applied to predict the odds of malaria cases among children under five years.

The authors were able to arrive at the following results: The highest prevalence of 26% was found among children aged 1–1 ¾ years while 2–2 ¾ years was recorded as 24% prevalence. The prevalence was recorded low among children less than one year with the prevalence of 12% and children four years and above with prevalence of 16%. The authors also recorded male children had a higher prevalence than female counterparts. The authors found that children whose mothers were older (40–49 years) 23.8% had the highest proportion of malaria while children whose mothers were between 15–19 years had the least proportion of malaria. The authors arrived with a logical conclusion that special preventive education should be tailored to all regions by the National Malaria Control Program to reduce malaria prevalence among children under - five years of age in Ghana.

Constructive criticism comparing with the current study

While the authors did a great job in data collection and analysis, one major digression was a failure to align the result with the conclusion. The authors pointed out that children from mothers aged 40-49 had a higher proportion of malaria than children from mothers aged 15-19 years (Nyarko & Cobblah, 2014). Going by the authors' conclusion on environmental education, it will not create a much-needed impact on addressing the prevalence of malaria among children under five. The current study saw

environmental education recommended by the authors as a cultural barrier prone in comparison to the family level of approach within the regions of Ghana. Tailoring the education to women at a family level within their bearing age will break the cultural barriers associated with the malaria prevalence among children aged 0-5 years. Immunity indicator based on older mothers that the authors pointed out could be better understood at the family level of malaria prevention education among children under five (Anderson, McCrindle, Kruger, & McNeill, 2018b; Dlamini et al., 2017).

Review Related to the Key Constructs, Methodology, and Variables

Chukwuocha et al. (2015) conducted the quantitative cross-sectional descriptive study from January to October 2013 in four rural communities in Eastern Nigeria. The authors aimed to investigate the influence of social characteristics of mothers on time is taken to seek treatment for their children upon the development of malaria.

Data collection and Statistical Analysis

The authors used primary data by deploying structured pre-tested questionnaire instrument for the collection. They used 738 consenting mothers within childbearing age (15-49 years). The authors gathered data from the respondents and were checked manually for completeness and then entered Epi-Info version 6.04. Descriptive analysis was conducted using SPSS version 20.0 as well as comparative analysis using Chi-Square methods.

Results

This showed that 22% sought treatment within 24hrs upon children's 0-5 years development of malaria. More than half of the mothers (51.5%) sought treatment after 24 hours which constituted delay because they had to watch for the children for some days. The rest of the mothers(21.4%) went further treatment delay on the financial difficulties ground. The socio-demographic characteristics such as age group of 22-28 years (32.8%) with married/monogamous mothers formed the greater portion of the respondents of 350 (47.4%). The common occupation of the mothers was farming 252 (34.1%) followed by trading which was 185(25.1%). Education level: 336(45.5%) mothers had primary education, and 259(35.1%) had secondary education and Bachelor of Science degree and above formed 119(16.1%). Those without formal education formed 24 (3.3%). Income level: low income earning mothers were high with 418(56.6%) while middle income earning mothers were 190(25.8%) and lastly high-income mother was 130 (17.6%).

Conclusion

The authors noted that more than two-thirds of the mothers were engaged in forms of delay based on wrong choices while seeking treatment for their children whereas less than one-third instituted early treatment for their children aged 05 years. They recommended health education as the major solution to the problem.

Constructive criticism comparing with the current study

The current study strongly agreed with the authors in statistical analysis and the methodology; however, there is a strong suspicion of sampling bias and research area

manipulations. From the results and sampling of the participants that the authors assumed to come from rural communities, the inclusion of 119 graduate degree mothers showed evidence of sampling bias(Chukwuocha et al., 2015). The authors failed to clarify whether urban or sub-urban mothers were included in the study. These graduate mothers created doubt about the location of the participants whether they were from suburban and rural areas or only in rural areas. Therefore, the research area was not well defined in this study. There was a reason to believe that scientific culture, researcher training, impact factors should be explored to reduce publication bias in any scientific research(Carroll, Toumpakari, Johnson, & Betts, 2017).

Review related to variables, theoretical framework, and methodology

Afoakwah, Deng, and Onur (2018) applied the socioecological model with quantitative cross-sectional design in urban areas. These authors applied all tools including the participants that this current study is using except the research area. They conducted a multilevel intervention on children under five years involving both rural suburban and urban areas that made up regions. The authors utilized independent variables such as Insecticide Treated bed Net (ITN), Indoor Residual Spray (IRS) and Behavior Change Communication (BCC) and dependent variable as the prevalence of malaria among the children under five years of age in Ghana.

These authors used Cross-sectional secondary data on 2, 449 children aged ½ -5 years of age who were tested for malaria through Rapid Diagnostic Test(RTD) from Ghana Demographic and Health Surveys 2014.

Statistical Analysis

The authors used a logit model to analyze the different association between control measures and malaria transmission among children under five years of different age cohorts and statuses of household poverty.

Results

The authors claimed that IRS offers more protection than ITN utilization; interesting to read from their results section. They went further to state the following odds of malaria infection among children who slept in IRS room and showed significantly lower odds ratio [OR] = 0.312; 95% CL- 1.47-0.81; p =000) compared to those who were not protected. ITN use failed to have a significant association with malaria infection among children except children whose mothers had at least secondary school education. In this category of mothers, the odds of malaria infection were significantly lower with ([OR] = 0.545; 95%CL = -0.84 -0.11; p = 0.011) compared to those who were protected. The BCC strategies in which television was found to create a positive impact in tailoring much-needed education showed a significant reduction of malaria infection with ([OR] = 0.715 95% CL= -0.55-0.00;p=0005) compared to those who could not receive malaria education via television. BCC strategy through print media showed, but protection for children was limited among educated mothers.

Conclusion

The authors concluding remark on their study was weighed towards lack of proper utilization of ITN among the rural people. They suggested that IRS should be an effective preventive measure for the control of malaria in rural areas.

Constructive criticism comparing with the current study

The authors obtained statistical significance which might not be closely related to practical significance. IRS is used as spraying preventive tool against female Anopheles mosquitos that may have the highest duration of 12 hours, but ITN will kill any mosquito that perches the net and will not even get to the host (children). The authors might be statistically correct but might be practically wrong (Ellis, 2014). Statistical significance relates to whether an effect exists while practical significance refers to the magnitude of the effect (Frost, 2018). Frost (2018) suggested that the best approach should be the application of subject area knowledge and expertise to determine whether this effect would be significant enough to be meaningful in the real world. Afoakwah, Deng & Onur (2018) performed the statistical analysis for their cross-sectional study by using odds or odds ratio which was suggested by Bhopal (2016) as not being necessary for the design.

Review related to the problem statement, independent and dependent variables, place and methodology of the current study.

Carlucci et al. (2017) researched on 2540 children under five years by targeting the mothers who were head of households in rural areas. The median age of the female (5%) was two years. The survey was conducted during the rainy season between April

and May. The measurement involved the primary outcome of interest which was self-reported symptomatic malaria defined as the female head of the household report. The structured questionnaire was close-ended which means that the study was quantitative cross-sectional design.

Method

The authors linked their study to a broader initiative known Ogumaniha project funded by the United States Agency for International Development (USAID). This study focused on improving the health and livelihood of children. The authors utilized data elements relevant to malaria.

Statistical Analysis

The authors grouped the statistical analysis of their study into three steps: descriptive statistics, specific responses, and multivariate logistic regression. The descriptive analysis involved attributes of the respondent female heads of household, their children and their households. The continuous variables were reported as weighted estimates of the median while the categorical variables were reported as percentages. Each observation was weighted as the inverse of the household or child sampling probability. Comparisons between focus districts were made using Chi-square test, and the effects of clustering were ignored. The third and final step was a multivariate logistic regression with robust variance estimation to account for clustering within the households and enumeration area. This study was used to identify factors associated with self-

reported symptomatic malaria among children and compared with those who had symptomatic malaria confirmed by rapid diagnostic test(RDT).

The authors noted that 60% of children who slept under a bed net the night before the survey range (49- 89%; p< 0.001). 43% of children reported fever in the past 30 days, 91% of those seeking care at a nearby health facility. Only 67% met the case definition of self-reported symptomatic malaria. Significant differences in prevalence of fever($p<0.001$), health-seeking ($p<0.001$) and diagnostic rapid testing (p= 003). The authors noted that having fewer young children in the household ([OR] 1.56; 95%CL 1.11-2.22) and higher income([OR] 1.25;95% CL 1.01-1,56) were independently associated with having a child with symptomatic malaria.

Conclusion

This study was brought to a logical conclusion by these authors by noting that self-reported symptomatic malaria was highly prevalent in rural areas and varies significantly in other areas. The authors suggested their study called for the allocation of health resources where the demands were high.

Constructive criticism comparing with the current study

In the current study, I agreed with the authors in a choice of methodology, statistical analysis and in line with the study area. However, their concluding remark needs more clarifications on the statement that claimed all the rural areas knew how to report symptomatic malaria. This current study cannot entirely agree to the assertion

based on statistically significant findings. The authors relied on self-reported cases that might not be enough to bridge gaps in knowledge and risk communication which current study strongly stand for in the control and prevention of malaria.

The implication of past research on the current study

There is a limited study on the association between family predictive factors and rural malaria prevalence in developing nations and rural Nsukka communities. This study is to investigate the relationship between family predictive factors and PoM among children aged 0–5 years. Researchers on rural malaria had measured these variables in their previous studies both in rural and urban settings. The predictor variables are the age group susceptibility among children aged 0–5 years, family's ownership of land for agricultural use, couple's extent of effective communication, children aged 0–5 years who slept under mosquito net, and family's best choice of a treatment facility for children aged 0–5 years

Most of the researchers either isolate the mothers (heads of household) or isolate the children aged 0-5 years before conducting their studies. Afoakwah, Deng, and Onur (2018), Chukwuocha et al. (2015) and Nyarko & Cobblah (2014) all contributed to about 85% of context and concepts to this current study. Myriads of research studies on malaria conducted in SSA contributed to this study range from 20% to 85% of context and concepts. The studies below 85% of context and concepts stand exclusion from this literature review.

Carlucci et al. (2017) studied that closely related, but the heads of household were only women failed to include men as having an impact on the family. It was an extensive rural study involving women only with children 0-5 years. They reported accurately on symptomatic malaria that was statistically significant. The authors were compelled to conclude that allocation of resources based on symptomatic malaria report should be adopted. This study also has a similar approach and similar problem statement. The little deviation was intervention was targeting assumed female heads of household that excluded men. This current research study has filled essential knowledge and communication gaps by analyzing the family-focused predictive factors. These factors have a potential influence on rural malaria prevalence among children 0-5 years(Roberts & Matthews, 2016). In a family setting, there are positive and negative influences that can improve or complicate the children's population health respectively. There is a strong reason to believe that Parents Make Difference (PMD) will create a positive impact on quality of parent-child interactions towards malaria prevention and control behaviors in rural Nsukka, Eastern Nigeria (Puffer et al., 2015; Roberts & Matthews, 2016). Family influential factors are driven by emotions of love especially when children are involved in rural areas (Baldassar, 2016). These emotions of love can always compel the mothers to respond to malaria preventive education being tailored to families with children (Gosling et al., 2015; Hay, Smith, & Snow, 2008; Kabaghe et al., 2018). Myriads of authors and those included for this review focus on community to tailor education on malaria by using BCC (Koenker et al., 2014). In this current study, I focused on families for more effective risk communication. The family approach broke all forms of family-

related cultural barriers on malaria control by tailoring the culturally appropriate education to the family heads in rural areas of Nsukka and beyond.

In this study, I used a quantitative cross-sectional family-focused/household survey through secondary data collection. This design is commonly used in social, biosocial and science of epidemiology to investigate the relationship between family predictive factors and the PoM among children 0–5 years. For this study, the family level predictive factors used were children's age, family's ownership of land for agricultural use, extent of effective communication among the couple, whether the children slept under a mosquito net and the family's choice of a treatment facility for their children in early childhood.

Summary

Children 0–5 years of age have the highest burdens of morbidity and mortality associated with malaria in the world (UNICEF, 2016; WHO, 2018). Family predictive factors can further complicate the children's population health because of their vulnerability to malaria transmission (Bhumiratana, 2013;Hagenlocher & Castro, 2015; Ouédraogo et al., 2013) The family influences could be positive or negative due to the lack of effective BCC or tailoring culturally appropriate malaria education to the heads of households(Amoran, 2013; WHO, 2015).

In SSA, most of the studies conducted utilized different methods such as cohorts, retrospective, and cross-sectional studies. Also, some researchers applied the socioecological model of influential behaviors by integrating BCC into control and

prevention of malaria in rural areas. The model includes five levels: Individual, Interpersonal(family), Community, Organization, and Policy. This current study framed its research questions from the interpersonal level of behavioral influence. The combination of SEM and C4D have created a positive impact in tailoring effective risk communication to the heads of families with children 0–5 years in rural areas of Nsukka, Eastern Nigeria.

The review of the literature showed enough evidence that predictive family factor such as the age group susceptibility of children aged 0–5 years can negatively impact the rural malaria control. Other major predictive factors include family's ownership of land for agricultural use, couple's extent of effective communication, children aged 0–5 years who slept under mosquito net, and family's best choice of a treatment facility to impact rural malaria prevalence that subsequently remains uncontrolled. Review of malaria cycle and epidemiologic triad were to bring to a basic understanding of interactions between the host(human) and host(vector) in a familiar environment; and how the behavioral influence and biology of malaria transmission contribute to uncontrolled malaria in rural areas. Epidemiologic triad model elucidated the interactions between the hosts and the agent with subsequent malaria transmission and a window of opportunities for elimination.

The variables which contributed to the uncontrol of malaria in the rural areas, especially among children 0–5 years, were discussed. This current study was to help in the understanding of how positive family influences could decrease the burdens of mortality and morbidity among children 0–5 years. PoM outcome variable was described

without much detail on causes due to the limitation of the cross-sectional design. A review of similar studies in literature for this current study, I used secondary data from the DHS for Nsukka rural malaria surveillance from October to November, 2015. In this study, I examined the relationship between the dependent and independent variables. The dependent variable was PoM which was the same as presence of malaria. The independent variables were: age group susceptibility among children aged 0–5 years, family's ownership of land for agricultural use, couple's extent of effective communication, whether children aged 0–5 years slept under mosquito net and family's choice of a treatment facility predict PoM among children aged 0–5 years. These variables were further discussed in Chapter 3, describing the design and methodology that was used in the current study.

Chapter 3: Research Method

Introduction

Researchers have applied different research methods to reduce malaria in endemic areas of the developing nations like Nigeria (UNICEF, 2016; WHO, 2013). The purpose

of the quantitative cross-sectional study design was to use DHS secondary data from October to November of 2015 for Nsukka rural communities. The aim was to investigate the relationship between potential family predictive factors and the PoM among children aged 0–5 years. Other potential family predictive factors were: family's ownership of land for agricultural use, couple's extent of effective communication, whether children aged 0–5 years slept under mosquito net and family's choice of a treatment facility for children aged 0–5 years. I used the SEM to frame the research questions at the interpersonal level of behavioral influence.

In the first section of this chapter, I described the research design and rationale. I proceeded the section by restating the research questions and described variables used. I discussed the cross-sectional design connection to the research questions and the constraints related to the chosen design. The methodology used in this study, the target population, procedures for secondary data collection, sampling, and the data collection instrument used by the original study were depicted in Figure 8. In this study, I discussed threats to internal and external validity, and how to mitigate them. I concluded this chapter by discussing the ethical concerns of this study.

The rationale behind the Research Design

I applied the cross-sectional design study to investigate potential family predictive factors in rural Nsukka. The cross-sectional design was used by many researchers in malaria-endemic regions of SSA. This study fell within the SSA regions,

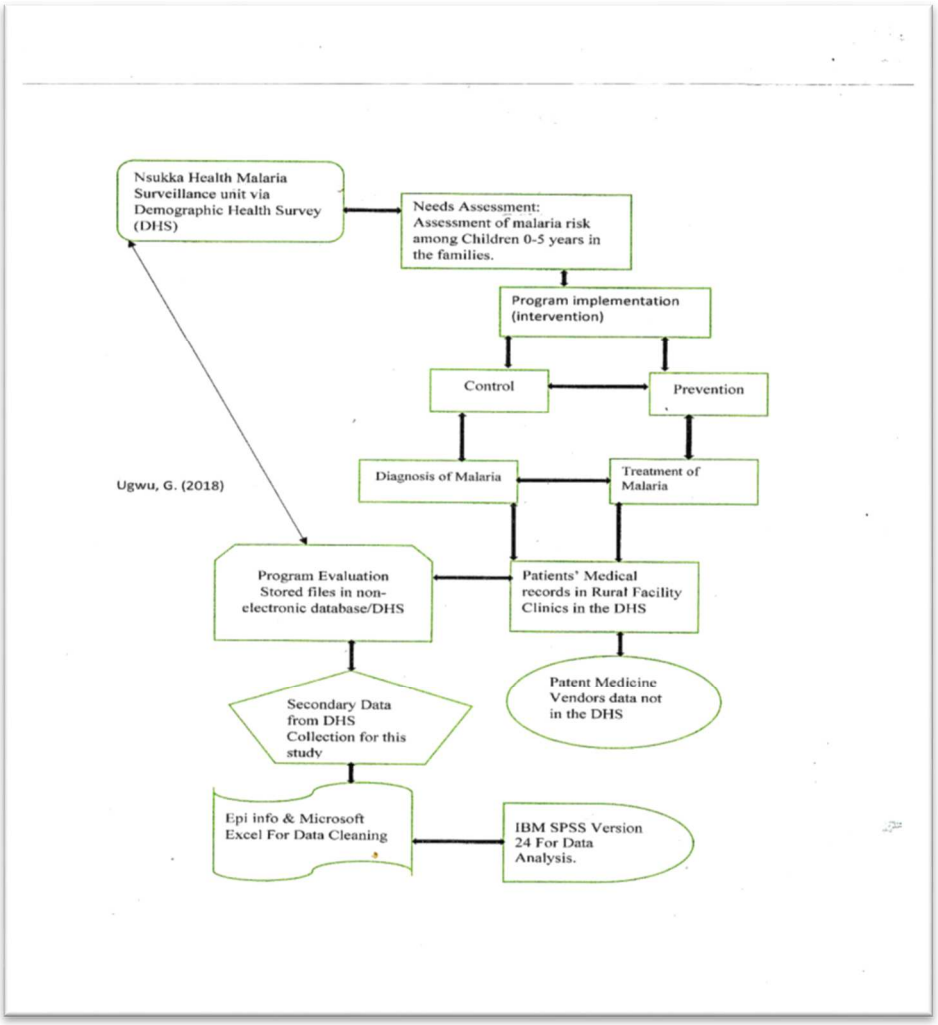
geographically. Bhopal (2016) elucidated the importance of cross-sectional study by describing it as a geographically defined representative sample of the population studied in a narrowly sliced time and space. Given timeframe of the original data collection by DHS –from October to November of 2015, the data collection for Cross-sectional design was less ambiguous and less time consuming. In previous studies, the researchers applied the quantitative research approach based on measuring and analyzing the relationship between independent variables and the dependent variable using statistical data (Creswell & Creswell, 2018). There was strong evidence that an excellent quantitative research design usually involves a customized mix of data gathering methods such as online surveys (web, mobile, and email), direct email, and point-of-purchase surveys (Steber, 2017). Through the assistance of Demographic Health Survey (DHS), I accessed this study data from malaria-endemic of rural Nsukka communities. In this study, I relied on the use of data obtained from DHS to investigate the relationship between family predictive factors and PoM among children aged 0–5years quantitatively.

Generally, most health policies relied on quantitative research designs for accurate data but posed problems in a small population to address health disparities (Korngiebel, Taualii, Forquera, Harris, & Buchwald, 2015). This small population problem limits the use of the quantitative design in addressing major public health problems such as underserved populations and overall preventive health initiatives (Crump, Etz, Arroyo, Hemberger, & Srinivasan, 2017; Korngiebel et al., 2015). Using the quantitative cross-sectional study design, researchers do determine cause and effect instead they determine the correlational relationship between predictors and outcome

(Arul, 2017; Bhopal, 2016; Hulley et al., 2013). The major limitation of the cross-sectional design is its temporality (Okoli & Enna, 2014). The cross-sectional design could not be used to manipulate the subjects to influence the outcome of this study, and an experimental design was not be appropriate. In a cross-sectional design, there is no need for a "follow-up" that encourages missing of participants. In previous studies, researchers used cross-sectional design to engage in data collection at a single point in time (Gordis, 2014; MacInnes, 2017a). I used cross-sectional design for the analysis of secondary data from Nsukka rural areas via DHS. In this study, the statistical methods used were chi-square and multinomial logistic regression analyses. In cross-sectional design, both cause and effect are determined at the same time (Arul, 2017).

Methodology

Figure 8. Origin of this study -Assumed Primary data collection via DHS and finally for Secondary data.

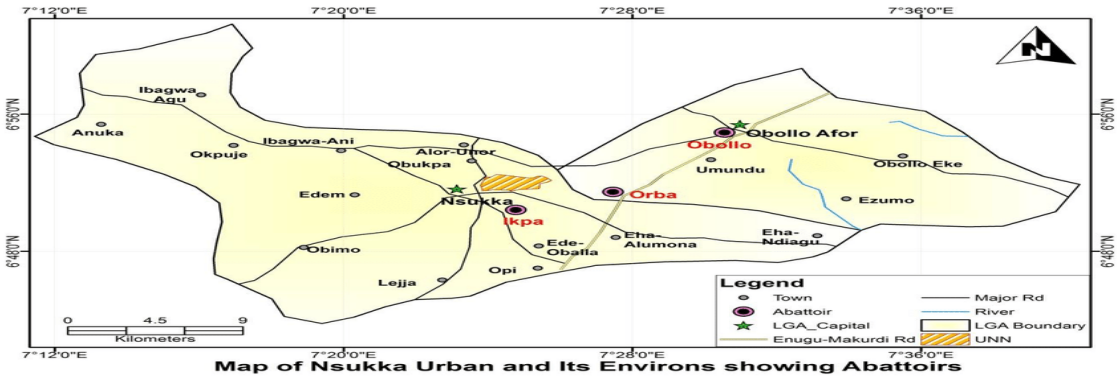


In Figure 8, I clearly explained the origin of this study as the presumed primary data collection from the rural areas of Nsukka via Demographic and Health Surveys (DHS). These steps include: needs assessment, program implementation, control & prevention, diagnosis and treatment, and patients medical record. I achieved program evaluation by conducting a study by using secondary data archived in the DHS. I collected the secondary data from DHS and used quantitative cross-sectional design to quantify the relationship between the potential family predictive factors and PoM-outcome among

children aged 0–5 years. The outcome was prevalence associated with the increased *P. Falciparum* infection in rural areas of the NLG in Nigeria; despite the presence of malaria eradication services.

In previous study, many authors focused on the demographic, socioeconomic, epidemiological determinants of prevalence of malaria in rural areas (Chirebvu et al., 2014; Pinchoff et al., 2016). Secondary data was DHS data driven via NLG health Surveillance unit on rural malaria. After data collection, I used the data was prepared for analysis by following these steps: sorting tests, matching data files, selecting cases, and other required tasks in the IBM-SPSS Version 24. I assessed the secondary data source for validity and reliability. Validating and cleaning the data using excel software before uploading into the IBM-SPSS version 24 for analysis, was the necessary step needed for this process (Salkind, 2010).

Figure 9. Map of Study Area Nsukka, Eastern Nigeria.



Geographically, Nsukka is located at 6.86o North latitude, 7.39o East longitude and 456 meters above sea level(maps-Streetview, n. d.). The DHS data from the rural

Nsukka communities was selected, cleaned and finally upload into IBM SPSS version 24 for the following steps of analysis.

Study Population

I obtained the secondary data source through DHS. The world population reviews noted that the overall population of Nsukka is estimated to be 262,017 (Worldpopulationreview, 2018). In this study, I drew sample from rural population as a secondary data from DHS database which was estimated to be one-third of the overall population. There was a strong reason to believe that 85% of the overall local government population is in urban areas while the remaining 15% are in the rural areas (Ajaero, 2014).

I collected samples from families with children aged 0–5 years who were surveyed from October to November in Nsukka rural communities in 2015. I used this population sample to estimate the relationship between the potential family predictive factors and PoM among the children aged 0−5 years in the rural areas of Nsukka, Eastern Nigeria. These predictive factors include the age group susceptibility among children aged 0−5 years, family's ownership of land for agricultural use, couple's extent of effective communication, children aged 0−5 years who slept under mosquito net, and family's choice of a treatment facility for children aged 0−5 years. The primary outcome of this study was based on the number of children aged 0−5 years who were exposed to malaria and subsequent PoM at the family level.

The Data Sources and Collection

The DHS is funded by United States Agency for International Development (USAID) and it is publicly available data requiring elements of registration and request for permission to use as a secondary research study (DHSprogram,n.d). In this study, I relied on the DHS dataset driven by core questionnaires. Historically, DHS evolved from World Fertility Surveys and Contraceptive Prevalence Surveys implemented in the 1970s and 1980s(Short Fabic, Choi, & Bird, 2012). The DHS was later upgraded to cover a wider range of population and health topics in developing countries. The DHS project receives funds from the USAID with support from donor host countries and has conducted over 230 nationally comparable household surveys in more than 85 countries since its inception in 1984(Short Fabic et al., 2012). Nsukka local government is under Enugu state which is in southeastern Nigeria. This study depended fully on DHS surveys on malaria from Nsukka rural communities between October and November 2015 for the secondary data analysis. Figure 8 was a model designed to explain the original collection for DHS in developing nations. The DHS is a comprehensive survey data on tropical diseases that linked to both urban and rural areas of all the states in Nigeria and other African countries.

Research Questions and Hypotheses

Research Question1 (RQ_1): Is there a relationship between the age group susceptibility among children 0–5 years and malaria prevalence?

Null Hypothesis (H_o1): There is no relationship between the age group susceptibility among children 0–5 years and prevalence of malaria

Alternative Hypothesis (H_a1): There is a relationship between the age gr–oup susceptibility among children aged 0–5 years and prevalence of malaria

Research Question 2 (RQ2): Is there a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children 0–5 years?

Null hypothesis (H_o2): There is no relationship between the family's ownership of land for agricultural use and prevalence of malaria among children aged 0–5 years.

Alternative hypothesis (H_a2): There is a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children aged 0–5 years.

Research Question 3 (RQ3): Is there a relationship between the couple's extent of effective communication and prevalence of malaria among children aged 0–5 years?

Null hypothesis (H_o3): There is no relationship between the couple's extent of effective communication and prevalence of malaria among children aged 0–5 years

Alternative hypothesis (H_a3): There is a relationship between the couple's extent of effective communication and prevalence of malaria among children aged 0–5 years

Research Question 4 (RQ4): Is there a relationship between whether children aged 0–5 years slept under mosquito net and prevalence of malaria?

Null hypothesis (H_o4): There is no relationship between whether the children 0–5 years slept under mosquito net and prevalence of malaria.

Alternative hypothesis (H_a4): There is a relationship between whether children aged 0–5 years and less slept under mosquito net and prevalence of malaria.

Research Question 5 (RQ5): Is there a relationship between the family's choice of treatment facility for the children aged 0–5 years and the prevalence of malaria?

Null hypothesis (H_o5): There is no relationship between the family's choices of treatment facility for the children aged 0–5 years and the prevalence of malaria.

Alternative hypothesis (H_a5): There is a relationship between the family's choices of a treatment facility for the children aged 0–5 years and prevalence of malaria.

Choice of Software- Instrumentation

IBM-SPSS version 24.0: The IBM-software was used for the analysis of secondary data. IBM SPSS Statistics was manufactured for Microsoft Windows as Version 24.0 in Armonk, NY: IBM Corp. The reason for this choice was that the SPSS version 24.0 defines the theoretical basis for estimation and inference procedures; this software created a room for assumption defaults based on robust (Heeringa, West, & Berglund, 2017).

I calculated sample and power size manually and were used to estimate the sample size for this study.

Excel Software: This was used to clean the data from DHS database. Microsoft Excel contains a useful field validation tools that can facilitate data entry and minimize errors(Arul, 2017). Excel software was very resourceful at the initial stage of the data collection despite its limitation in handling large data (Arul, 2017).

Statistical Analysis Plan

Inclusion and Exclusion Criteria.

Inclusion criteria

Only families with children aged 0−5 years was included in this study. This study also focused on nuclear the families such as husband, wife, and their offspring (children). This criterion was to create a better understanding of the potential family factors and PoM among children 0−5 years, aimed at reversing uncontrolled of malaria in Nsukka rural areas.

Exclusion criteria

From the DHS, all other families such as foster, step-parents (father and mother) and the children were excluded. Families with children 0−5 but not biological parents were excluded from the study during data collection.

Sample Size Estimation and Power

At this stage, the sample size and power estimation are the important approaches for a combination of descriptive and predictive cross-sectional study of this kind (Holmes, 2009)

The formula for one proportion:

$n = Z2 \times p \times q/d2$

n = sample Size

z = alpha risk expressed in Z-score

p = the expected prevalence

q = 1- p

d = the desired /absolute precision. For the courtesy of (Holmes, 2009).

For power estimation.

Sullivan (2008) suggested that sample size estimates for hypothesis testing are based on achieving 80% or 90% power.

80% power = Z0.8 = 0.84

90% power = Z0.9 = 1.282

Quantitative Analysis of the Secondary data for this study.

Table 5
The Main Variables in the study

A-Independent variables	Level of Measurement	Description
Age	Continuous	The "age" for this study is the primary determinant for this study. As the age of children increases, the immune system increases then the vulnerability to malaria transmission decreases(Grissom & Kim, 2014; Roberts & Matthews, 2016; Sultana et al., 2017a).
Farmland ownership	Nominal	The families that depend on farming as the main livelihood will have to battle with the environmental influences associated with the farming practices such as growing crops, fish ponds, and others. Living in farmlands means more risk of exposure to malaria transmission
Relationship to household Head	Nominal	Effective communication means tailoring the message of malaria prevention in culturally appropriate manner. This approach will help in reaching to the grassroots level of malaria prevention, control and treatment in rural areas. Husbands and wives, Sons and daughters form a family that is closely related and can easily understand any form of education on control and prevention of malaria.
Children under 5 Slept under bed net	Nominal	Yes or No response from the heads of household will explore the risk of exposure to mosquito in the rural areas. The primary control of malaria transmission depends on the proper use of mosquito net(Azunie, 2017).
Place Sought treatment	Nominal	The place of treatment and time it takes to treat malaria among children determine the adequacy of early treatment of malaria. Early treatment of malaria prevents complications associated untreated or poorly treated malaria among children 0-5 years.
B. Dependent variable	Level of Measurement	Description
P. Falciparum Presence/Result	Nominal	Response of "Yes "or "No" thorough answer to the research questions on the Development of Malaria among children 0-5 is predicted by the independent variables. The Yes or No response drives the methodology of Binary logistic regression analysis. There are two outcomes:

of Malaria test-Yes/No/Rapid Diagnostic Tests Yes/No	presence of malaria and absence of malaria. The reasons why some children have malaria and some do not have malaria although the risk of exposure to malaria transmission has been implicated by many factors such as hemoglobinopathies- sickle cell disease and sickle cell traits(Roberts, 2018).

There were two steps for overall analysis. The steps include: descriptive statistical analysis and inferential statistical analysis which comprises categorical analysis, and multinomial logistic regression analysis (Field, 2013)

Descriptive Statistics

This step involved stating the frequencies, a measure of central tendency consists of Mean, Median, and Mode (Warner, 2013). There was a measure of spread or dispersion that consists of standard deviation, mean deviation, variance percentile quartile and interquartile range (Field, 2013; Warner, 2013). There was also a measurement of normal distribution involving skewness and kurtosis (Warner, 2013). This step provided a useful summary of the overall data collected. The descriptive statistics were represented in histograms, bar charts or pie chart (MacInnes, 2017). The descriptive statistics only attempted to describe the data but was not used to make inferences from the sample to the overall population(Warner, 2013). It stood to reason that descriptive statistics was not developed based on probability theory like inferential statistics(Field, 2013)

Inferential Statistics

The inferential statistics was concerned with statistical inference and estimation (Warner, 2013). In this type of statistical analysis, this study strived to make predictions by using independent variables to predict the dependent variable from the data (Arul, 2017). The following tests were the inferential tests.

Categorical Analysis

This method involved checking if two variables were normally distributed, if it fails Pearson correlation becomes obsolete, then alternatively, the Spearman rank correlation was considered (Holmes, 2009). Holmes (2009) noted that correlational analysis could be conducted to determine whether there is no association or relationship, a strong positive suggest that the relationship is directly proportional. Chi-square test will be used for all the categorical variables.

Multinomial Regression Analysis

Binary logistic regression was the methods deals with many variables to analyze not enough observations and could be used as powerful model validation techniques based on bootstrap (Harrell, 2015). The two outcomes/targets were from the analysis of yes or no response from the heads of household on the presence or absence of Falciparum among the children 0–5 years of age. The steps for the analysis involve: Analyze → Regression and → Binary Logistic using IBM-SPSS software version 24.

The measure of association between the independent variables were the initial step taken before multiple regression analysis. The secondary data quantitative analysis the in-depth of the predictor variables to determine which predictor contributed more to the model in predicting PoM (SPSS-Tutorial, n.d.). In this study, I relied only on multiple nominal regression model and not multivariate regression where many dependent variables could be used to model a research study which showed stricken differences in approach to statistical analyses(Dattalo, 2013; Hidalgo & Goodman, 2013).

A choice was made between factorial/two-way ANOVA and Multinomial Logistic Regression. There was only one outcome PoM with five independent/predictor variables.

Threats to Validity

Assessing the quality of data collected for this study was based on the sources and handling of the collection process. Why this study depended on the secondary data, the perceived threats to the quality of the variables cannot be estimated here. There was a strong reason to believe that Epidemiologists who collected their data(primary) have sound knowledge of the quality of data; however, this was not true for secondary data analysis (Bhopal, 2016).

Internal and external validity were the two essential concepts used in evaluating research findings in a research study (Azunie, 2017). The internal validity entails establishing that there is a causal relationship between dependent and independent variables (Azunie, 2017; Frankfort-Nachmias, Nachmias, & DeWaard, 2015). External validity is associated with the ability to generalize the findings of a study beyond the study sample(Azunie, 2017; Frankfort-Nachmias et al., 2015). The validity of the data for this study was to meet the standard for secondary data analysis. Any deviation from the study protocol poses a threat to the validity(MacInnes, 2017b). The generalizability of this study to any rural areas in the developing nation is imperative. The DHS linked the data through the state level to the rural level of an interventional survey by using reliable and standard instruments. Therefore, the external validity showed the degree to which the results could be generalized beyond Nsukka rural communities and the children aged 0–5

years in the family to other rural communities in Nigeria and developing nations(Frankfort-Nachmias et al., 2015; Warner, 2013).

Ethical Procedures for this Study

The ethical issues associated with protected health information (PHI), this study strived to minimize these problems by using secondary data of 2015 Nigerian DHS. This DHS covered from the Enugu state level to other local government health departments and the Nsukka rural communities in Eastern Nigeria. DHS survey was conducted with strong emphases on ethical issues at the collection and collation stages (Azunie, 2017). The DHS survey met all the international standards; there is no risk of breaking interview confidentiality (Azunie, 2017). This study avoided all these deviations and violations associated with primary data collection. The DHS mission statement noted that all DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey (DHSprogram, n.d.).

There was documentary evidence of permission to use the DHS data for secondary data analysis for this study. There was a strong reason to believe that participants were assured that their information would be treated as confidential and would never be shared (Frankfort-Nachmias et al., 2015). The ethical concerns had been taken care of for this study as I strived to use data from an organization that maintains all ethical standards in data collection. Intuitional Review Board (IRB) of the Walden University saw that all the ethical concerns were not met before the actual secondary data collection for this study (Walden University Academic Guides, n.d.). The policies and procedures related to the ethical standards in research were monitored by the Walden IRB

of which this study met the requirement. The utilization of secondary data collected via the DHS program in Nigeria removed the fear of any unethical concerns associated with foreign research studies.

Summary

In this chapter, I explained research studies such as research design and rationale of the methodology. The methodology comprised target population, study participants, data sources and sampling were clearly illustrated in a model as figure 7. In this study, I relied on the use of quantitative cross-sectional design study and secondary data from October to November, 2015 for Nigerian DHS data.

In this study, I strived to assess internal validity because based on the nature of the design- the cross-sectional study measures both the cause and effect at the same time without further inquiry on reasons for the cause (Hulley et al., 2013). The external validity (generalizability) was supported since the sample size has enough power(Azunie, 2017; Frankfort-Nachmias et al., 2015; Warner, 2013). I explained the ethical implications related to the data source and human participants was also clearly explained as well as the summary of the Walden University IRB ethical procedures and policies in research. I discussed the Walden University IRB authorization. The proceeding chapters 4 and 5 comprised of the data analysis, the results and interpretation of this study respectively.

Chapter 4: Results

Introduction

The purpose of this study was to establish the relationships between age and susceptibility to malaria among children in early childhood, and the variables of family's ownership of land for agricultural use, family's choice of a treatment facility, the couple's extent of effective communication and whether the children slept under mosquito net. I used a quantitative cross-sectional design, to analyze the data from a DHS comprehensive survey. This survey called Malaria Indicator Survey (MIS), documented household responses from October to November 2015 in rural communities of Eastern Nigeria, including Nsukka in the Enugu state.

Initially, the target population for the survey was 4,301 households in rural areas. However, about 4,225 were identified during the study and successfully interviewed by DHS researchers from October to November, 2015. A subsample of 3,687 heads of household was composed of 93.7% of men and 6.3% of women. These groups were made up of family such as single and two-parents couples; (Harma, 2013; Thoughtco, n.d.). DHS researchers used three different types of questionnaires: heads of household questionnaires, individual women questionnaires and men questionnaires who were heads of households. I used IBM-SPSS version 24 to analyze the following research questions and hypotheses; using Chi-Square for an association and multinomial logistic regression.

Research Questions and Hypothesis

Research Question1 (RQ_1): Is there a relationship between the age group susceptibility among children in early childhood and the prevalence of malaria?

Null Hypothesis (H_o1): There is no relationship between the age group susceptibility among children in early childhood and the prevalence of malaria.

Alternative Hypothesis (H_a1): There is a relationship between the age group susceptibility among children in early childhood and the prevalence of malaria.

Research Question 2 (RQ2): Is there a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children in early childhood?

Null hypothesis (H_o2): There is no relationship between the family's ownership of land for agricultural use and prevalence of malaria among children in early childhood.

Alternative hypothesis (H_a2): There is a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children in early childhood.

Research Question 3 (RQ3): Is there a relationship between the couple's extent of effective communication and prevalence of malaria among the children in early childhood?

Null hypothesis (H_o3): There is no relationship between the couple's extent of effective communication and prevalence of malaria among the children in early childhood

Alternative hypothesis (H_a3): There is a relationship between the couple's extent of effective communication and prevalence of malaria among the children in early childhood.

Research Question 4 (RQ4): Is there a relationship between whether children in early childhood slept under mosquito net and prevalence of malaria?

Null hypothesis (H_o4): There is no relationship between whether the children in early childhood slept under mosquito net and prevalence of malaria.

Alternative hypothesis (H_a4): There is a relationship between whether children in early childhood slept under mosquito net and prevalence of malaria.

Research Question 5 (RQ5): Is there a relationship between the family's choice of treatment facility and the prevalence of malaria among children in early childhood?

Null hypothesis (H_o5): There is no relationship between the family's choice of treatment facility and the prevalence of malaria among children in early childhood.

Alternative hypothesis (H_a5): There is a relationship between the family's choice of a treatment and prevalence of malaria and the prevalence of malaria among children in early childhood.

This chapter contains the data collection process which explained the representatives of the sample to the population. I also discussed the use of various statistical tests performed and their use in this study. I reported the results from tests performed in line with the research questions.

Data Collection

I used the DHS dataset for Nigeria from October to November, 2015 and focused on rural areas by selecting only those cases from Nsukka. The secondary data from DHS was publicly available and can be obtained through permission from the DHS website. The topic of this dissertation was registered at the DHS website and required approval.

My study was approved within 48 hours of online submission. A letter of approval to use the dataset was sent via email.

The original DHS sample was collected using multistage sampling from all the 36 states of Nigeria including their rural areas. The stratified multistage sampling took place from October to November of 2015 by DHS researchers. The sampling involved assessment of all major rural diseases such as malnutrition related poverty, malaria, tuberculosis, poliomyelitis and other diseases common among children. DHS researchers conducted interviews only on the heads of household and who had children in early childhood. The DHS researchers confirmed for the presence or prevalence of malaria (PoM) by performing tests on each child after obtaining informed consent from the head of household who was either a single parent or part of a couple (Manti and Licari. 2018).

Potential family-level factors that may predict PoM in rural areas such as children's age, family's ownership of land for agricultural use, extent of effective communication among the couple. I used these potential family predictive factors to test hypothesis on PoM. Other potential family factors that I used in the analysis were whether the children slept under a mosquito net and ascertaining the family's option of a treatment facility for their children in early childhood.

The DHS trained field workers used the International Council for Harmonization (ICH) which explained the ethical principle on informed consent. The DHS trained field workers stipulated the review of the setting for obtaining informed consent from the vulnerable populations commonly observed in developing nations (ICH,2018).

The Rationale for Using Demographic Survey and Health Data

I used DHS data based on its comprehensiveness in data collection strategies. The methods were stratified samplings with cross-sectional design in all rural areas of the 36 States of Nigeria. The DHS used a consent form that reflected international standards of informed consent. ICH derived informed consent was required for data collection from the vulnerable population which involved children and low-income families in the developing nations. A reliable more in-depth analysis of malaria among children in early childhood in rural areas of Nsukka was obtained from the DHS dataset. I obtained the latest malaria indicator survey (MIS) of 2015 from DHS dataset for this study. The DHS applied IBM-SPSS software in the analysis of the data during the cross-sectional study from October to November of 2015. I used IBM-SPSS version 24 to open and analyze the DHS dataset.

The important details of data from each of the developing country institutions for the MIS of 2015 were maintained by the researchers' during collection and the data collected was sponsored by USAID (WHO, n.d.). Each institution received technical assistance from DHS to ensure data quality and international comparability (DHS program, n.d.). Finally, all DHS data files and final reports on MIS are publicly available through DHS (DHS program, n.d.).

Data Exclusion and Sample Size calculation

For this study, each research question had exclusion criteria so that the analysis could be limited to valid datasets. The datasets still had adequate data for analysis (more than the minimum sample size of n= 108 and to obtain maximum validity for the study of the results, a sample size calculation was performed.

The formula was as follows: $N=Z^2(P(1-P)/d^2$

N= sample size, Z = Statistics for level of confidence (1.96). P = expected prevalence or proportion among the children, P = 57.72% = .5772 = 0.6.d. = precision (0.05). Substituting the formula, the estimated sample size for prevalence of malaria:

N= 1.96x1.96 (1-0.6)/0.05x0.05 and sample size N = 369.

For the RQ1, the age group susceptibility among the children in early childhood in months and Rapid Diagnostic Test (RDT) obtained for the children were the only two inclusion criteria used to filter the secondary datasets. I excluded children such as 6 years and above from malaria testing as well as those who did not take part in the survey during selection of cases. Furthermore, I also excluded households without children from this study during case selection.

Data Inclusion and Sampling Representation

Of estimated 16,652 rural dwellers and survey of 4301 households about 4225 were successfully interviewed (DHSprogram, n.d.). There are about 262,017 people that made up the population of Nsukka urban and rural (Worldpopulationreview, 2018). There were only 886 households who were eligible for this study. They were made up of single and two parents' family structures. There was a total number of 1,492 children distributed in these households. Women within childbearing age 15 to 49 years were among the household's population eligible for this study. In this study, I focused on the potential family-level factors that may predict PoM among the children in early childhood.

Reliability of Statistical Tests and Variables

Following the statistical plan in Chapter 3, there were two statistical tests: I used chi-square and multinomial logistic regression to analyze the sample for this study. Based on the nature of this study as a secondary data-driven, there were challenges in using linear, binary and multinomial logistic regressions in SPSS software. Some results were showing statistical significance. The five independent variables were regressed individually on the dependent variable with statistically significant *P*-value at a critical value of 0.05. The statistically significant regression was at a critical level of ($P < 0.05$) for the regression to be considered significant (Field, 2015). The smaller the *P*-value in the result, the more significant the model was likely to predict the outcome variable (Field, 2013).

I used multinomial logistic regression to predict the probability of an observation being in one of the two categories of the dichotomous dependent variable based on two independent variables. I also used multinomial regression to determine the relationship between the couple's extent of effective communication and education attainment outcome. The data supported the assumption of the model (categorical dependent variable, independent observations, large sample size. no multicollinearity, and no outliers (Frankfort-Nachmias, Nachmias, & DeWaard, 2015). This approach was similar with previous analysis conducted using the same design cross-sectional (Frankfort-Nachmias, Nachmias, & DeWaard, 2015). I used chi-square test for the analysis when the logistic regression failed to produce valid results.

The Validity of Statistical Tests and Selection of Variables

The measurement of the variables used for this study was nominal (categorical and dichotomous) and the scale(continuous). There were five independent/predictor variables and five covariates to answer the research questions. All variables were nominal(categorical/dichotomous). Each research question was required to determine the relationship between groups of independent variables and one or more dependent variables. This requirement and the measurement scale of the data (nominal) presented logistic regression as the most suitable statistical test. Previous research study used chi-square because it had the advantage of measuring the strength of the relationships and provide deductions on the independent variables that had the highest prediction of the dependent variables (Hulley et al.,2013; MacInnes, 2017). The potential family-level factors that may predict PoM had large samples; the enough sample size used in each analysis. The sample size was calculated based on the value of point prevalence of malaria among the children in early childhood.

Table 6
Major Variables' Relationship to the Research Question (RQ) Continued

Name	Label	Values	Measure	RQ
HML16A	*Age in Months for Children <5 years*	1= 0-9, 2 = 10-19, 3= 20-29, 4= 30-39, 5 = 40-49, 6= 50-59.	Categorical/ Nominal	RQ1
HV244	*Owns land usable for agriculture*	0 = No, 1 = Yes	Nominal	RQ2
HV101	*Relationship to head of household*	1= Head, 2= Wife or Husband, 3 =Son and daughter and so on.	Nominal	RQ3
HV230	*Children under 5 years slept under mosquito net*	0= No, 1= All Children, 2= Some	Nominal	RQ4

		children, 3= No net in the Household		
SH15	*Place first sought treatment for fever*	1= Government Hospital, Government Health center, Private hospital Chemist/ Patent Medicine Vendors and so on.	Nominal	RQ5
HML35	Result of Malaria Rapid Tests	0=Negative, 1= Positive	Nominal	Covariate with RQ1 &RQ2
HML32A	P. Falciparum	0 = No, 1= Yes	Nominal	Covariate with RQ1
HV10	Educational Attainment	0= No Education, 1 =incomplete primary, 2 =complete primary, and so on	Nominal	Covariate with RQ &RQ3
S502A	Malaria Knowledge Symptoms of Fever	0=No, 1 =Yes	Nominal	Covariate with RQ5& RQ3
V137	Number of children 5 and under in household members	None	Nominal	Covariate with RQ4
V190	Wealth Index	1= poorest, 2= poorer, 3=Middle, 4=Richer, 5 = Richest	Nominal	Covariate with RQ2

Results Presentation Based on Cross-Sectional design for this study

The prevalence of malaria was calculated among children in early years in rural Nsukka. I also statistically measured relationship between dependent variables and the potential family-level factors that may predict PoM by using hypotheses/tests generated. I measured the PoM statistically without comparison to any group in the dataset.

Table 7
Showing the valid cases, Missing data and the maximum Sample size to each Research Question Continued

Name	Label	Research Question	Valid Cases	Missing data	Sample size N
HML16A	*Age in Months for Children <5 years*	RQ1	836	3,465	369
HV244	*Owns land usable for agriculture*	RQ2	4301	0	369
HV101	*Relationship to head of household*	RQ3	4301	0	369
HV230	*Children under 5 years slept under mosquito net*	RQ4	4225	76	369
SH15	*Place first sought treatment for fever*	RQ5	1406	2895	369

Note that*: All the variables in this study showed that missing data was excluded case-wise, this means that all records without data for the variables under study were eliminated from the analysis.*

Descriptive Statistical Analysis

Descriptive analysis was performed to examine potential family-level factors that may predict PoM. The PoM was calculated among the children in early years in Nsukka rural area. The total number of children <5 years for RDT was = 712. The number of children found positive of malaria was = 411 and the total number of children found negative of malaria was = 301.

The point prevalence was calculated by dividing the number of children found positive of malaria by total number of children <5 years for RDT. The point prevalence of malaria in a rural area of Nsukka for the period between October and November 2015 was = 411/712 x 100% = 57.72%.

There were also 85% of the respondents that were into the farming occupation while 15% of respondents were not into farming as an occupation. Males accounted for 93.7% as heads of the household while females accounted for 6.3%. The mean age of heads of household was 41.3 and that of children 29.38 in months. The percentage of *P.*

Falciparum in rural population was 98.3%. The sex of the children in the households were 50% each; meaning they were equal in number.

Other potential family-level factors that may predict PoM were shown from Tables 7 to 9; presented to explain the level of: educational attainment, income, and occupation. 54.5% of rural households virtually had no education. There were 3.2 % of the rural household that had higher education. Therefore, 57.3 % very low-income level in Nsukka rural area was 11times higher than the high-income level with 4.9 %.

Table 8
Result of Malaria Rapid Test Continued

Results	Frequency	Percentage	Valid%	Cumulative%
Negative	301	7.0	42	42.3
Positive	411	9.6	57.7	100
Total	712	16.6	100	

Note that the percentage of malaria rapid among the children 0-5 years in Nsukka rural area was 9.6% positive and 7.0% negative.

Table 9
Presence of species: P. Falciparum (Pf) in rural Nsukka Continued

Responses	Frequency	Percentage	Valid %	Cumulative %
No	6	.1	2.6	2.6
Yes	222	4.8	97.4	100
Total	228	5	100	

Note that the percentage distribution of P. Falciparum in Nsukka rural area according to Nigeria DHS of 2015 was 4.8% presence recorded as"Yes" while 0.1% was recorded "No."

Table 10
Sex of the head of household Continued

Sex	Frequency	Percentage	Valid%	Cumulative%
Male	4032	93.7	93.7	93.7
Female	269	6.3	6.3	100
Total	4301			

The sex of heads of household was 93.7% male and 6.3% female.

Table 11
Sex of the Children Participant in the study Continued

Sex	Frequency	Percentage	Valid%	Cumulative%
Male	2150	50	50	50
Female	2151	50	50	100
Total	4301			

The sex of children's participants for this study were equal in percentage (50% each)

Table 12
Educational attainment In Nsukka Rural Continued

Education Level	Frequency	Percent	Valid%	Cumulative%
No Education	2342	54.5	54.5	54.5
Incomplete Primary	295	6.9	6.9	61.3
Complete Primary	543	12.6	12.6	73.9
Incomplete Secondary	499	11.6	11.6	85.5
Complete Secondary	486	11.3	11.3	96.8
Higher	136	3.2	3.2	100.0
Total	4301	100	100	

Note that in rural Nsukka, there were 54.5% of the household without education and highest education was 3.2%

Table 13
Wealth Index Continued

Wealth level.	Frequency	Percent	Valid %	Cumulative%
Lowest	1133	26.3	26.3	26.3
Low	1333	31.0	31.0	57.3
Middle	975	22.7	22.7	80.0
Higher	651	15.1	15.1	95.1
Highest	209	4.9	4.9	100
Total	4301			

Note that the poverty level was recorded in Nsukka rural areas 57.3% Middle class to richest was 4.9%.

Table 14
Owns Land Usable for Agriculture Continued

Occupational level	Frequency	Percent	Valid %	Cumulative %
No	645	15.0	15.0	15.0
Yes	3656	85.0	85.0	100.0
Total		100.0	100.0	

The primary outcome variable was the PoM had two categories of "Yes or No." In table 6, there were six dependent variables that covariate with the predictor variables to answer the research questions. This was depicted in table 6. Variable is a covariate if it is related to the dependent variable; and an explanatory variable of the dependent variable (Peng & Matsui, 2015).

Data Analysis Results

In answering the five research questions, I used two statistical tests: Chi-Square analysis and multinomial logistic regression. These tests had a combination of results that determined if there were relationships between the independent and dependent variables. I measured the predictability of the dependent variables by the potential family-level factors by using the IBM-SPSS version 24.

HML16A-(Age in Months for Children< 5years) and the outcome variable (Results of Malaria Rapid Tests)

Research Question1 (RQ1): Is there a relationship between the age group susceptibility among children in early childhood and the prevalence of malaria?

Null Hypothesis (*Ho1*): There is no relationship between the age group susceptibility among children in early childhood and the prevalence of malaria

Alternative Hypothesis (*Ha1*): There is a relationship between the age group susceptibility among children in early childhood and the prevalence of malaria

I coded the ages of children in months 1 to 6 and categorized them. The results of Malaria Rapid Test were selected and used to answer RQ1. A total of 836 children with age in months 0–59 months. I statistically randomized selection of 369 children for malaria rapid tests (MRT) for Chi-Square analysis from the DHS data file. I used the

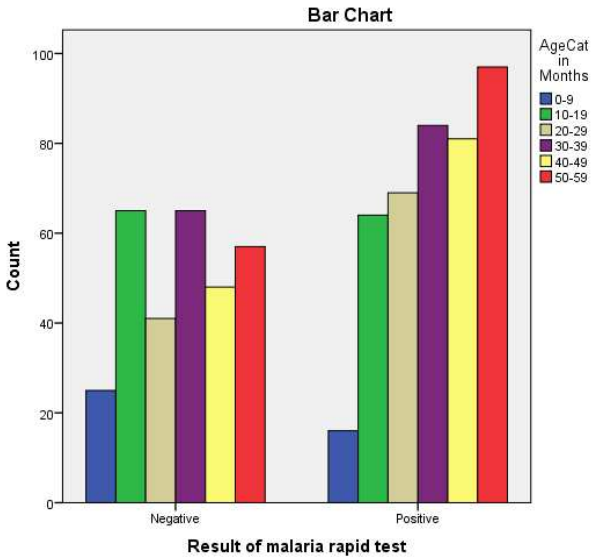
Chi-Square analysis to determine the relationship between predictor variable-HML16A(Age in Months for Children< 5years) and the outcome variable(Results of Malaria Rapid Tests) with a critical level of significance *P*-value set at 0.05. Table 10 depicted a statistically significant relationship between age group susceptibility among the children in early childhood in the household and their results of rapid malaria tests. The result also showed the presence of malaria through malaria rapid testing. $\chi 2(5) = 13.697$ at $P = 0.018$.

Table 15
Chi-Square Analysis on RQ1 Continued

□[2] Tests	Symmetric Mea	Value	df	Asymptotic Sign.(2-sided)
Pearson-Chi-Square(χ^2)		13.697	5	0.018
Likelihood Ratio		13.619	5	0.018
Linear-by-Linear Association		8.821	1	0.003
	Phi	0.139		0.018
	Cramer's V	0.139		0.018

Note that 1. *Chi-square analysis showed statistically significant relationship between age differences in category among children 0-5 years and results of malaria rapid tests*($\chi^2(5) = 13.697$ at $P = 0.018$).

Figure 10. The Bar Chart Supported the Result.



The higher age the children from 0-59 months the higher the risk of exposure to malaria.

I, therefore rejected the null hypothesis and concluded that there was a statistically significant relationship between the age group susceptibility among children in early childhood and the prevalence of malaria.

HV244 -Owns land usable for agriculture (Predictor) and Wealth index (outcome) variable

Research Question 2 (RQ2): Is there a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children in early childhood?

Null hypothesis (*Ho2*): There is no relationship between the family's ownership of land for agricultural use and malaria prevalence among children in early childhood.

Alternative hypothesis (*Ha2*): There is a relationship between the family's ownership of land for agricultural use and the prevalence of malaria among children in early childhood.

From the DHS data file, I selected the potential family-level factors that predict may PoM to determine the relationship between HV244-owning a land usable for agriculture

(outcome) and V190-wealth index(predictor) that contribute to the prevalence of malaria in a rural area of Nsukka. I used chi-square to conduct this analysis. There was a statistically significant relationship between the family's ownership of land for agricultural use and PoM through income level. The sample size was n= 369. I used statistical test to determine the extent to which family highly exposed to malaria transmission especially during the farming season. This showed a critical level of significance *P*-value set at 0.05. Table 16 showed a statistically significant relationship between the family's ownership of land for agricultural use and income level: $\chi 2(4) =$ 733.416 at *P*= 0.000.

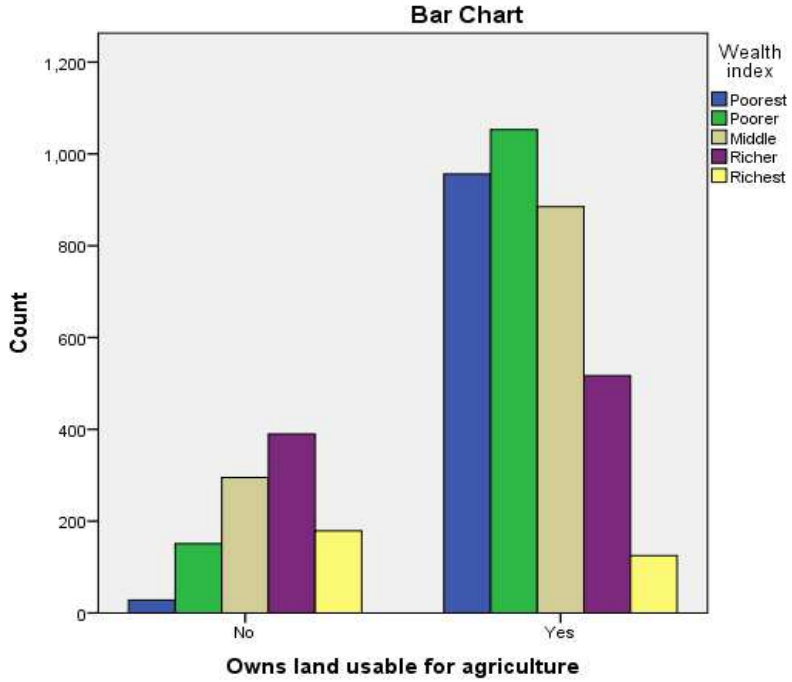
Table 16
HV-244-Owns Land usable for Agriculture and Wealth Index

Chi-Square Tests	SymmetricMeasures	Value	df	Asymptotic Sig. (2-sided)
Pearson- χ^2		733.416	4	0.000
Likelihood		771.829	4	0.000
Linear-By-Linear Association		719.527	1	0.000
	Phi	0.400		0.000
	Cramer's V	0.400		0.000

Note that: 1. Chi-square test between owns land usable for agriculture and wealth index as dependent showed statistically significant relationship of $\chi^2(4) = 733.416$ at P = 0.000.
2.Cramer's V was measured to determine the strength of the association between the variables: Cramer's V =.400 at P =0.000

The result was represented in Figure 11 as Bar Chart. The number of high-income farmers was very few compare to low-income farmers who have vulnerable children that were exposed continuously to malaria transmission.

Figure 11. The Bar Chart to Support Result.



There was a shred of empirical evidence to reject the null hypothesis. I, therefore concluded that there was a statistically significant relationship between family's ownership of land for agriculture use and PoM through the level of their income.

V149- Educational attainment(predictor) & Knowledge Malaria Symptoms-S502A and V150-Relationship to the head of household (dependent variable)

Research Question 3 (RQ3): Is there a relationship between the couple's extent of effective communication and prevalence of malaria among children in early childhood?

Null hypothesis (H_o3): There is no relationship between the couple's extent of effective communication and prevalence of malaria among children in early childhood

Alternative hypothesis (H_a3): There is a relationship between the couple's extent of effective communication and prevalence of malaria among children in early childhood

I selected the potential family-level factors such as V149, S502A, and V150 from DHS data files for multinomial logistic regression analysis. I calculated sample size manually based on the point prevalence as 369. I performed multinomial logistic regression analysis to determine if there was a statistically significant relationship between the couple's extent of effective communication, the educational attainment and knowledge of malaria symptoms at the critical level of significance *P*-value set at 0.05. Table 17 depicted a statistically significant relationship between educational attainment, knowledge of malaria symptoms and the couple's extent of effective communication: V149-□2(60)= 319.453 at *P*=0.000 and S502A- □2(12) = 27.814 at *P* =0.006.

Table 17
Multinomial Regression RQ3 Continued

Ind. Variable	**Dep. Variable**	**df**	**Chi-Sq.**	**Nagelke. R^2**	**Predict. Accuracy**	***P*-values with Interpretion.**
V149 and	V150	60	319.453	0.108(10.8.7%)	85.7%	V149- *P*= 0.000 & S502A- *P* = 0.006. Both V149 & S502A significantly predicted V150. It explained 10.8% (Nagelkerke R^2) of Variance in V150 and correctly classified 85.7% cases.
S502A		12	27.814			V149-□^{2}(60) = 319.453 at P=0.000 S502A- □^{2}(12) = 27.814 at *P* =0.006

This result was supported by the figures 12A and 12B below in Bar Chart. This showed that there was a strong relationship between the educational attainment and relationship to head of household. There was also a strong relationship between malaria knowledge, symptoms of malaria fever and relationship to head of household.

Figure 12A. The Bar Chart to Support Result.

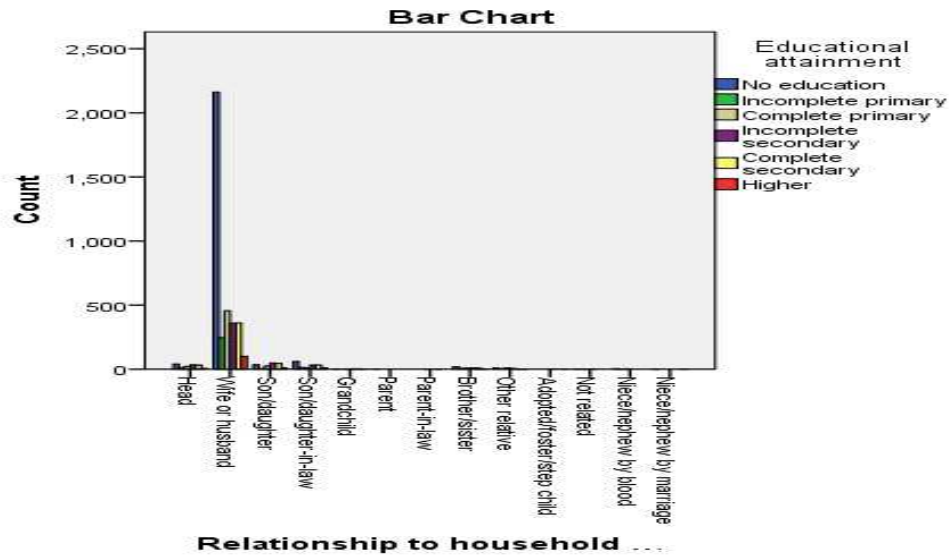
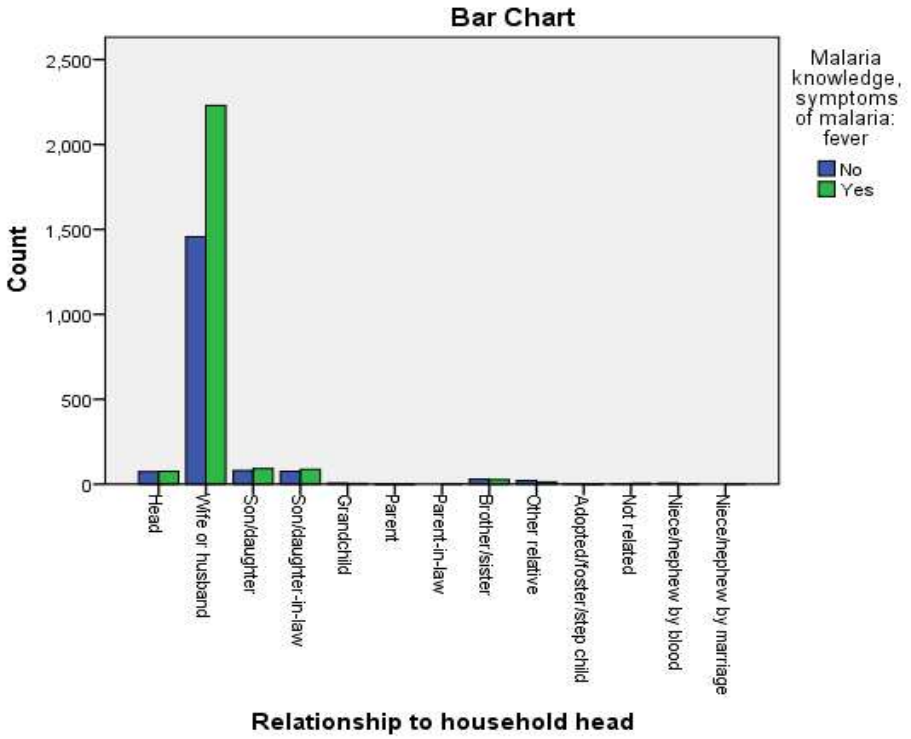


Figure 12B. The Bar Chart to Support Result.



I had enough evidence to reject the null hypothesis and moved to conclude that there were statistically significant relationships between attainment of education, malaria knowledge, symptoms of malaria fever, and the couple's extent of effective communication.

V137-No of Children 5 and under in the household & V190-wealth Index (predictors) and V460-Children under 5 years slept under a mosquito net (dependent variable)

Research Question 4 (RQ4): Is there a relationship between whether the children in early childhood slept under mosquito net and prevalence of malaria?

Null hypothesis (H_o4): There is no relationship between whether the children in early childhood who slept under mosquito net and prevalence of malaria.

Alternative hypothesis (H_a4): There is a relationship between whether children in early childhood slept under mosquito net and prevalence of malaria.

For the RQ4, I selected V137-Number of children in early childhood in the household and V190 income level of household the from DHS data files for multinomial regression analysis. The following independent variables were selected: V137-Number of children in early childhood in the household and V190 wealth index (income level) and made to determine if there was a statistically significant relationship with V460 – children in early childhood who slept under a mosquito net at a critical level of significance *P*-value set at 0.05.

The sample size was 369. As shown in figures 13 A & 13B; there was a statistically significant relationship between whether children in early childhood in a household slept under a mosquito net. There was also a statistically significant relationship between income level and the number of children in early childhood who slept under a mosquito net at a critical level of significant *P*-value set at 0.05. V137-□2(24) =613.028 at *P*=000 & V190-□2(32) = 138.682 at *P* =000 respectively. These results supported the figures 13A and 13B below.

Figure 13A. The Bar Chart.

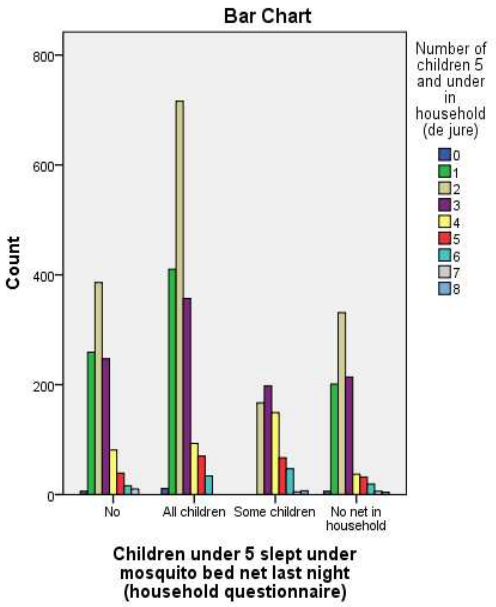


Figure 13B. The Bar Chart.

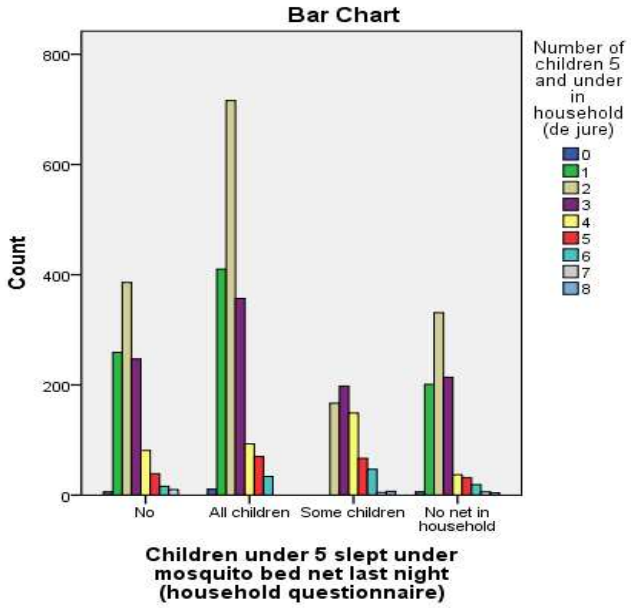


Table 18
Multinomial Regression RQ4 Continued

Ind. Variables	Dep. Variables	df	Chi-Sq.	Nagelker-R^2	Predictiv Accur.	*P*-Values with Interpretation
V137 & V190	V460	24 24	613.028 138.682	0.174(17.4%)	38.5%	V137-P =0. 000 &V190-P=000. Both V137 & V190 significantly predicted V460. It explained 17.4% (Nagelkerke R2) of variance in V460 and correctly classified 38.5% cases. V137-$\square^2(24)$ =613.028 at *P*=000 V190-$\square^2(32)$ = 138.682 at *P* =000

I rejected, the null hypothesis and concluded by upholding the alternative hypothesis which said that there was a relationship between whether the children in early childhood slept under a mosquito net number of children in a household as well as the income level.

HV109-Educational Attainment, HV270-Wealth Index (Predictors) and SH15-Place first Sought for fever treatment (dependent variable)

Research Question 5 (RQ5): Is there a relationship between the family's choice of a treatment facility and the prevalence of malaria among children in early childhood?

Null hypothesis (H_o5): There is no relationship between the family's choice of a treatment facility and the prevalence of malaria among children in early childhood.

Alternative hypothesis (H_a5): There is a relationship between the family's choice of a treatment facility and the prevalence of malaria among children in early childhood.

I selected NGPR71FL.SAV for RQ5 from DHS data file and used two independent variables -HV109 -educational attainment and HV270-income level to determine their predictability for SH15-family's choice for a treatment facility for malaria related fever among children in early childhood. The sample size was n- 369. Both educational attainment and income level were able to predict the family's best choice of a treatment facility for the children in early childhood. There was a statistically significant relationship between socioeconomic status and the family's choice of a treatment facility at a critical level of significant *P*-value set at 0.05. The educational attainment depicted HV109-□2(84) = 158.680 at *P*=000 while income level showed V270-□2(56) = 643.744 at *P* =000.

Table19

Multinomial Regression RQ5 Continued

Independent Variable	Dependent variable	*df*	Chi-Square	Nagelkerke R^2	Predictive Accuracy	P-value and Interpretation
HV109- & HV270-	SH15	84	158.680			HV109 at P =000 & HV270 at P=000. Both HV109 &HV270 significantly predicted SH15. It explained 12.9% (Nagelkerke R^2) of variance in SH15 and correctly classified 51,7%cases. HV109-$\square^2(84)$ = 158.680 at *P*=000 HV270-$\square^2(56)$ = 643.744 at *P* =000
		56	643.744	0.129(12.9%)	51.7%	

Figure 14A. These results agreed with the bar chats below.

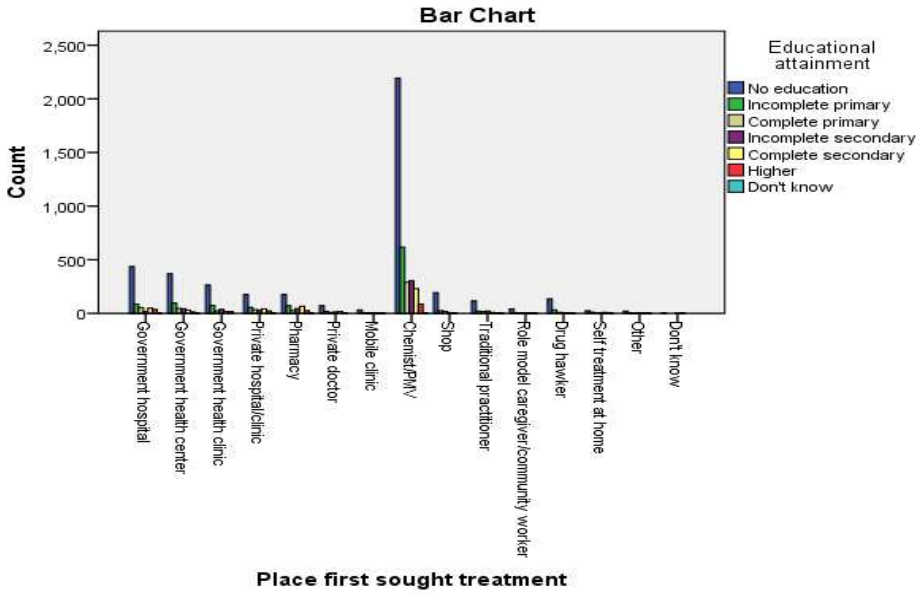
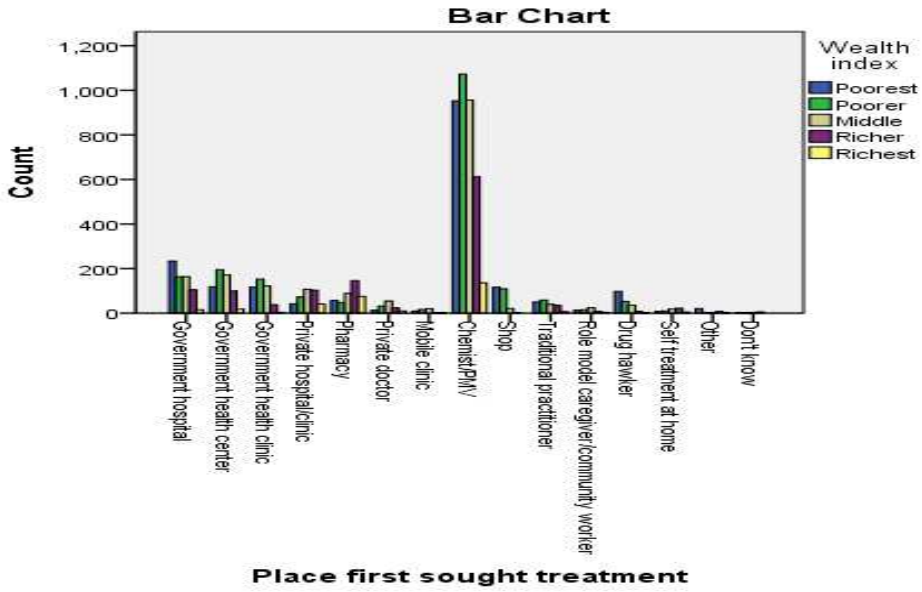


Figure 14B. These results agreed with the bar chats below.



I had enough of evidence to reject the null hypothesis and moved to conclude that there were relationships between socioeconomic status and the family's choice of a treatment facility for the children in early childhood. The alternative hypothesis was therefore upheld.

Summary

In this chapter, the results from analysis of the data collected from October to November 2015 Nigeria DHS were presented. A sample size of n= 369 and a critical level of significance *P*-value set at 0.05 in chi-square analysis and multinomial logistic regression. I used the two statistical tests to derive the following results: overall point

prevalence of malaria among the children in early childhood was 57.72% for Nsukka rural areas as documented by Nigeria DHS of 2015(DHS program, 2015). (a) in RQ1, there was a statistically significant relationship between age susceptibility among the children in early childhood in the household and their results of malaria rapid tests which indicated the presence of malaria through malaria rapid testing. (b)in RQ2, there was a statistically significant relationship between the family's ownership of land for agricultural use and income level. (c)in RQ3, there was a statistically significant relationship between educational attainment, and the couple's extent of effective communication. (d)in RQ4, there was a statistically significant relationship between and whether children in early childhood slept under a mosquito net; the number of children in a household (e) in RQ5, there was a statistically significant relationship between socioeconomic status and the family's choice of a treatment facility.

In the next and the final chapter 5 of this study, the interpretation of the results was discussed. The limitations, recommendations for future study and implications for positive social change were also discussed.

Chapter 5: Discussion, Recommendations, Conclusion

Discussion

Children in early childhood remains one of the groups most at risk of malaria in developing nations. Despite continued interventions through the sponsorships of various public health organizations such as WHO, UNICEF, there have been challenges in reduction of PoM especially among children in rural areas. The rural area of Nsukka is 1located within the endemic regions of SSA with a about 90% of the children 5 years and under at highest risk (Janko et al., 2018; UNICEF, 2016a). In this study, I focused on how potential family-level factors that may be significant contributors to uncontrolled malaria among children in early childhood in rural areas of Nsukka. I provided recommendations to bridge the communication and knowledge gaps.

Globally, the goal of eliminating malaria has not been met (Azunie, 2017; Louis et al, 2015; Stephan, 2015). I used the potential family-level factors that may predict PoM for analysis such as socioeconomic status, a couple's extent of effective communication, and whether children in early childhood slept under a mosquito net. I also used the family's choice of a treatment facility for to predict the income-level.

In this study, I also focused on the transmission of malaria related to the potential family-level factors that may likely to predict PoM. The transmission patterns related to the potential family-level factors modeled in Figure 15 depicted an interventional model explaining how to close both knowledge and communication gaps with subsequent outcome evaluation. I used 2015 data from the Nigeria DHS survey to analyze the potential factors that may predict PoM. The original dataset was filtered to include

Enugu State and rural community (Nsukka) and heads of household with children in early childhood. I used the IBM-SPSS version 24 to answer the following research questions and hypotheses using chi-square analysis and multinomial logistic regression.

Research Question 1 (RQ1): Is there a relationship between the age group susceptibility among children in early childhood and the prevalence of malaria?

Research Question 2 (RQ2): Is there a relationship between the family's ownership of land for agricultural use and prevalence of malaria among children in early childhood?

Research Question 3 (RQ3): Is there any relationship between the couple's extent of effective communication and prevalence of among children in early childhood?

Research Question 4 (RQ4): Is there a relationship between whether children in early childhood slept under mosquito net and prevalence of malaria?

Research Question 5 (RQ5): Is there a relationship between the family's choice of a treatment facility childhood and the prevalence of malaria?

Findings

The first research question showed a statistically significant relationship between the age groups susceptibility among children in early childhood and their positive results of rapid malaria test. In the second research question, there was also a statistically significant relationship between the family's ownership of land for agricultural use and her income level. The third research question showed a statistically significant relationship between the couple's extent of effective communication and educational attainment. In the fourth research question, there was a statistically significant relationship between whether children in early childhood slept under a mosquito and the

number of children in the household. Finally, the fifth research showed a statistically significant relationship between the family's choice of a treatment facility and her socioeconomic status.

All these statistically significant findings did not differentiate from each other in contribution to PoM negatively or positively. I used cross-sectional design to measure both malaria and the potential family-level factors at the same time without comparison. I described each finding in detail in the next section of this study.

Interpretation of the Findings

Children whose age range were 0–29 months were less likely to be exposed to malaria transmission; because the babies were more highly protected than the toddlers by their mothers. The mothers who engage in proper use of mosquito net, indoor residual spray and having mosquito-proof window and doors could contribute adequately to protection of the children in early childhood in household (Sultana et al., 2017; Thanh et al., 2017; Okoye et al., 2015; Stanisic et al., 2015). The children whose age range were 30–59 months were more likely to have malaria exposure in a family who had toddlers.

There was a likelihood of insufficient knowledge of age as one of the potential family-level factors that may predict PoM by heads of household. Tailoring appropriately cultured language to educate the heads of household is imperative in rural Nsukka to reduce PoM.

For the second research question, I found that the number of families engaged in farming practice were 3656(85%) more than the rest of rural 645(15%) dwellers. The families whose primary occupation was farming face high risk of malaria transmission.

This finding is similar to Muyanga(2014) who noted the increasing risk of malaria transmission among the group of rural smallholder agriculture. Al(2014) and Mayala et al.(2015) demonstrated in their previous studies on exposure of malaria-related transmission to farming practice; and is common among fish pond owners and crop growers. Each family's farming practice drives the environment that favors the breeding ground for mosquitoes (Amek et al., 2018). Fish farming such as the establishment of ponds near homes creates an opportunity to high malaria transmission. The expansion of the agricultural land for cultivation and fish farming encourage sharing of natural environment with the vectors (Alout et al., 2014; Molina Gómez et al., 2017). Generally, most families whose primary occupation is farming are vulnerable to high malaria transmission intensity. However, the protection of children in early childhood in rural areas remains one of the biggest challenges.

The third research question was based on extent of effective communication between couple in household. There were 55.6% that had knowledge of malaria and associated symptoms despite 54.5% without formal education. There was a likelihood that without formal education training, control, prevention, and treatment of malaria may be effectively carried out by the family with children in early childhood through an effective communication between the couple.

Power sharing and delegation in a rural setting between the couple define the relationship to heads of household in decision making; especially in the allocation of anti-malaria drugs to families with children (Anderson, Reynolds & Gugerty, 2017). There are variations in the decision making among families in rural areas indicating that there are

significant differences across households in their perceptions (Doss, 2013; Kebede et al., 2013; Malapit et al., 2014). Generally, education contributes significantly to malaria prevention, control, and treatment in rural areas which reflects women's age and their level of education (Amoran, 2013).

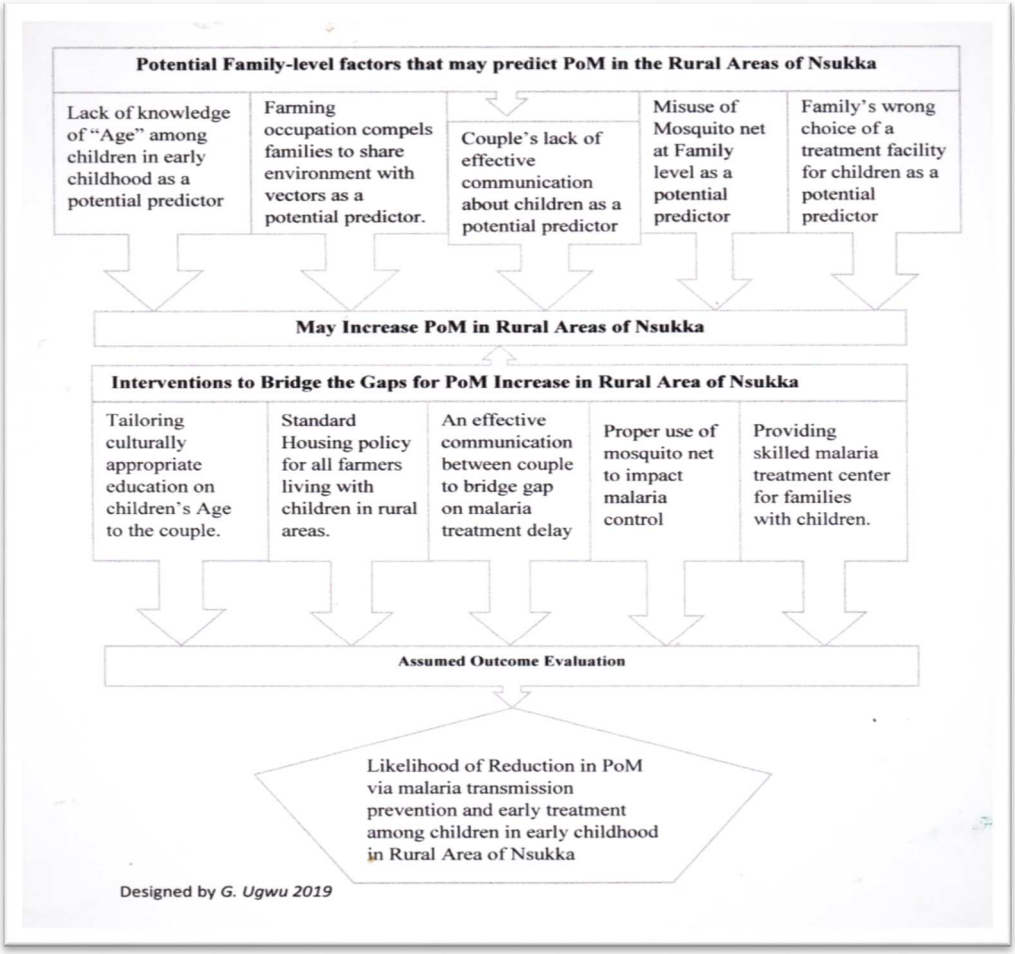
For the fourth research question, I found that 63% of middle class and high-income families were likely to own a mosquito net while only 37% of the low-income families were likely to own a mosquito net. I also found that only 39.40% of the number of children in early childhood in the household who fell under low-income families were likely to sleep under the mosquito net. In this research question, I found that 18.60% virtually had no access to a mosquito net while 15.40% have little or no access to a mosquito net. Finally, I found that 26.60% of the respondents said that they had no mosquito net in their household. The local health officials would have properly distributed mosquito net to the families in rural areas of Nsukka but might not be in compliance with the use of mosquito net (Kesteman, Randrianarivelojosia, & Rogier, 2017; Musoke et al., 2015; Tobin-West & Kanu, 2016). This finding agreed with previous studies as in Girum et al. (2017), and Tusting et al. (2016) who were able to demonstrate how poverty can negatively impact the prevention and control of malaria in endemic regions especially in rural areas. Improving the socio-economic wellbeing of the rural Nsukka can positively impact the control, prevention and treatment of malaria (Bizimana, Kienberger, Hagenlocher, & Twarabamenye, 2016; Sundararajan, Kalkonde, Gokhale, Greenough, & Bang, 2013).

In the fifth research question, I found that 58.9% family in rural areas of Nsukka chose to patronize chemist/patent medicine vendors (PMV). I also found that 13.7% of families who had the means of transportation sought for treatment from government health facilities. Some 9.6% of rural families sought for treatment of their children from community pharmacy stores while 4.1% of them sought for treatment of their children from a traditional practitioner. Other 2.7% of the rural families sought for treatment of their children through self-medication while only 1.4% were able to seek for treatment of their children from a government hospital.

The 57.3% low-income families with children may face high risk malaria exposure; while 4.9% high-income families are likely to have less risk within the rural Nsukka. Each family's socioeconomic status reflected on her treatment-seeking behaviors for the children in early childhood. The high-income families sought treatment from standard government health facilities. Microeconomic and macroeconomic level of the family and government respectively shaped the overall health of the rural families (Guerra, de Sousa, Ndong-Mabale, Berzosa, & Arez, 2018; Udeh, Onwujekwe, Adewole, & Onoka, 2016). The treatment-seeking behaviors of the high-income families from the government facility were to avoid fake drugs as well as receiving services from highly skilled health staff (Karunamoorthi, 2014). It has not been evaluated to ascertain whether the chemist/PMV meet the quality treatment of malaria in rural areas. The chemist/PMV facility is likely the primary source of the health services to the underserved rural population where the vulnerable groups are common.

A higher percentage of the rural families who sought treatment for their children in early childhood from chemist/PMV were arguably associated with their low socioeconomic status. Low-income families sought for treatment of malaria from the Chemist/PMV due to their proximity and relatively low-cost anti-malaria drugs in the rural area of Nsukka. This low cost of treatment of malaria has attracted many low-income families to the chemist/PMV in rural areas (Lassi et al., 2016; Orimadegun & Ilesanmi, 2015).

Figure 15. The Model that Explained the Family-level Factors 'Gaps Closure and Outcome Evaluation on reduction of PoM.



Study Results in Relation to the Socioeconomic Model (SEM)

I used the SEM to provide readers with an understanding of how a theoretical framework guided the epidemiological principles in this study. Family influences accurately connected these principles for control, prevention and treatment of malaria in rural areas of Nsukka for this study. I also used the SEM to explain how it can be applied as a guide to various levels of health promotional activities in our society today.

However, in this study I only picked one level out of five levels as a guide-the interpersonal level. From this level, I applied it to this study by analyzing how the couple can influence each other to impact the control, prevention, and treatment of malaria in rural of Nsukka. Researchers have demonstrated the synergistic combination of SEM and behavior change communication in many health promotional settings (Afoakwah et al., 2018; Koenker et al., 2014). Caesar, Peters-Lawrence, Mitchell, & Powell-Wiley (2017) suggested that effective communication and relationship could create a positive impact within the household in rural areas towards meeting the demand on control, prevention, and treatment of the children in early childhood.

In this study, I only focused on the interpersonal level of influence. I used interpersonal level of influence to explain how family influences positively or negatively impact the rural malaria control among children in early childhood. The potential family-level factors I selected for this study were influential and showed statistically significant. These were income level, education, ownership of land for agricultural use, the number of children in early childhood who slept under the mosquito net, effective communication between the couple and the family's choice of a treatment facility (DHS program, 2015). Many researchers have used SEM second level to explained how the income level shaped families in search of affordable treatment facility (Kassam, Collins, Liow, & Rasool, 2015; Oluwasogo, Henry, Abdulrasheed, Olawumi, & Olabisi, 2016). The heads of the household usually the husbands always influence the treatment of their children by giving the order before initiating treatment (Dhawan et al., 2014; Kamya et al., 2015). High-

income families who sought for treatment facility in the city showed that there was a likelihood of no element of trust in the available treatment center in rural areas.

Communication and the relationship

Behavior change communication (BCC) in SEM explained the relationship to the heads of household in this study. Good relationship breeds effective communication and vice versa (Betterhealth, n.d.). There might be an element of sharing positive feelings between the couple in a healthy relationship. The one's partner with one another creates an opportunity for action towards the attitudes that exist (Ceasar et al., 2017). Communication and fulfillment of one's partner's need are imminent. The relationship and communication are better health channels (Betterhealth, n. d.). Effective communication between the couple may serve as a new tool in mitigating PoM among children in rural areas where zero-level of education is a tradition.

In African culture, heads of household mostly men must be consulted by the wives before any treatment could be initiated on children (Chukwuocha, Okpanma, Chukwuocha, & Nwakwuo, 2015; Ncogo et al., 2017). A healthy relationship between the couple creates an avenue to effective communication. Heads of the family who were tailored culturally related health education improved drastically on rural malaria prevalence (Azunie, 2017&Fokam, et al.,2016). Defensiveness and isolation among the couple should be avoided to meet the children's demands on control, prevention and treatment of malaria in rural areas (Svedberg, Nygren, Staland-Nyman, & Nyholm, 2016).

Informing the policy for a change based on the findings was the application of the SEM on this study. I used the policy level of the SEM for this study and suggested that it would be necessary to provide an accurate headcount on the children in each family before distribution of mosquito net. In this study I used SEM as a guide to prioritize families with children in early childhood by using all types of preventive strategies of malaria in rural areas. Researchers also apply SEM in all policy related prevention, treatment and control of malaria include, housing policy in rural areas; and could help in maintaining the housing standards to all rural dwellers (Awuah et al., 2018). The researchers also apply SEM to provide possible study potential for rural household's members to engage in proper use of available malaria preventive tools to reduce morbidly and mortality within their families (Azunie, 2017).

Limitations of this Study

In this study, I used of secondary data to analyze uncontrolled malaria in the rural area of Nsukka but was not enough to induce the eradication of malaria. Limitations associated with secondary data was unavoidable in this study. It was inherent with secondary data from DHS that it was not required to answer a specific research question or hypothesis and so some variables had to be re-categorized to address the problems in this study as in research question one (RQ1). Cheng & Phillips (2014) noted that when some variables failed to be categorized and before analysis, the error is likely to be introduced. DHS data used for this study was secondary data that made it difficult to ensure the quality of the statistical analysis. There were some missing data reported in the DHS files which could affect the validity of the results at some points. The data I used

was three years plus old and might not serve as a representative of the current problem in Nsukka, Eastern Nigeria. The results of this study were limited to rural Nsukka communities and therefore cannot be generalized to urban areas in Enugu state or other states in Nigeria. In this study I also used secondary data for analysis and was not guaranteed to solve the problems associated with uncontrolled malaria among children in early childhood in families. Therefore, the secondary data I used for this study had never been evaluated.

Recommendations

In this study, I used a quantitative cross-sectional design to examine the relationship between family-level factors that may predict PoM. The local health official or stakeholders should engage each family with children in early childhood in deeper sensitization on malaria transmission. One family at a time will create more impact than educating combined families. This approach is likely to discourage family related cultural barriers which can be effective on malaria prevention, control, and treatment.

Families with children who practice farming should be prioritized when distributing mosquito nets. Those who live in thatched houses with children should be provided with mosquito nets according to the number of children in the household. Annual head counts on children born to each family should be maintained to meet the demands of mosquito net distribution.

The families who maintain the culture of waiting for the husband to come home before initiating treatment for their children who have a malaria-related fever should be

discouraged. Their husbands should be educated by tailoring culturally appropriate language on the dangers posed by the delay in malaria treatment among children.

The families should be discouraged from seeking for treatment at local chemist/patent medicine vendors (PMV) facility. The families with children should be directed to government-sponsored mobile health clinic to meet the children demands for malaria treatment. Caesar et al. (2017) suggested that there must be adequate communication, awareness, relationship, and empowerment through education to reduced negative impacts of family factors of rural malaria. Some families living in rural areas despite sensitization failed to comply with the use of mosquito net by misusing the net or not even using it for its purpose. Moon et al. (2016) elaborated on the factors affecting the use of mosquito nets which were due to lack of instructions on the proper use of it or knowledge of its use. A policy on the misuse of mosquito net should be established to discourage its misuse among families with children.

The WHO, UNICEF, and other philanthropic organizations should have their representatives working with the local health officials to ensure proper distribution of mosquito nets to rural families who have children.

Further studies should be focused on Family Perceptions of rural malaria control and belief in Nsukka, Eastern Nigeria. The descriptive studies and specified local data collection on malaria control would inform policy on pragmatic efforts to target the vulnerable rural families with children. Family-based perceptions of malaria control and beliefs have proven to be effective in reducing malaria burdens of morbidity and mortality (Mensah-Brown et al., 2017; Onyeneho, Idemili-Aronu, Igwe, & Iremeka,

2015). Therefore, focusing on family factors could establish an understanding of the control, prevention, and treatment of children in the rural to reduce overall burdens of malaria in Nsukka, Eastern Nigeria.

Implications for Positive Social Change

The implications for positive social change were divided into three levels: Individual, Organizational and Societal Levels.

Individual level

Findings from this study, I suggested that age group susceptibility to malaria transmission among children in early childhood implicated heads of a household's lack the knowledge of age involvement. Tailoring culturally appropriate education on the age of children is imperative to all heads of households that care for the children in rural areas. Empowering the heads of households on first aid for malaria treatment in rural among children in early can reduce delays on treatment by receiving education on dosages of antimalaria drugs. Educating individual heads of household to delegate power to their wives to avoid treatment delays and end seeking behavior for the poorly skilled malaria treatment facility. This approach would ameliorate complications among children in early childhood in malaria treatment. The knowledge of malaria symptoms through formal education can reduce the malaria burdens of mortality and morbidity among children.

Organizational level

The WHO, UNICEF, and other philanthropic organizations that sponsor the distribution of mosquito net should ensure adequate supply to the families with children. Every batch of delivery must be evaluated to check disparities in distribution.

Societal level

The families living in rural areas must have standard housing, and the government should provide those who could not afford. The results associated with ownership of land for agricultural practice and income level. Policy on a housing plan for all families living in rural areas of Nsukka. The policy against misuse of mosquito net should be promulgated. Headcount on all children in the families will help to meet the demands for mosquito nets. There is a need for sustainability of standard housing plan through program initiative such as Family in Children (FIC). FIC will address malaria transmission through poor housing among children of low-income families.

Conclusion

Socioeconomic status, microeconomic level, and effective communication form the primary driving force behind these potential family-level factors that may predict PoM in rural Nsukka. Significant number of families in rural area are classified as low-level status under socioeconomic spectrum while their demands and purchasing power are determined by microeconomic level. Effective communication between couples without formal education may create positive impact in reducing PoM in rural area of Nsukka. Awareness of these family-level factors may create a better understanding in designing of interventional methods to mitigate uncontrolled malaria in rural area of Nsukka. The family-level factors may inform a new policy of women empowerment to

make malaria treatment decision among children in the absence of their husbands during emergency.

Given the nature of the design method used for this study, the statistically significant results were not differentiated from each other; to ascertain which family-level factor contributed more to PoM. The statistically significant results that may encourage PoM should be addressed through appropriate intervention. Recommendation for further study was on family perceptions of rural malaria control and belief in Nsukka.

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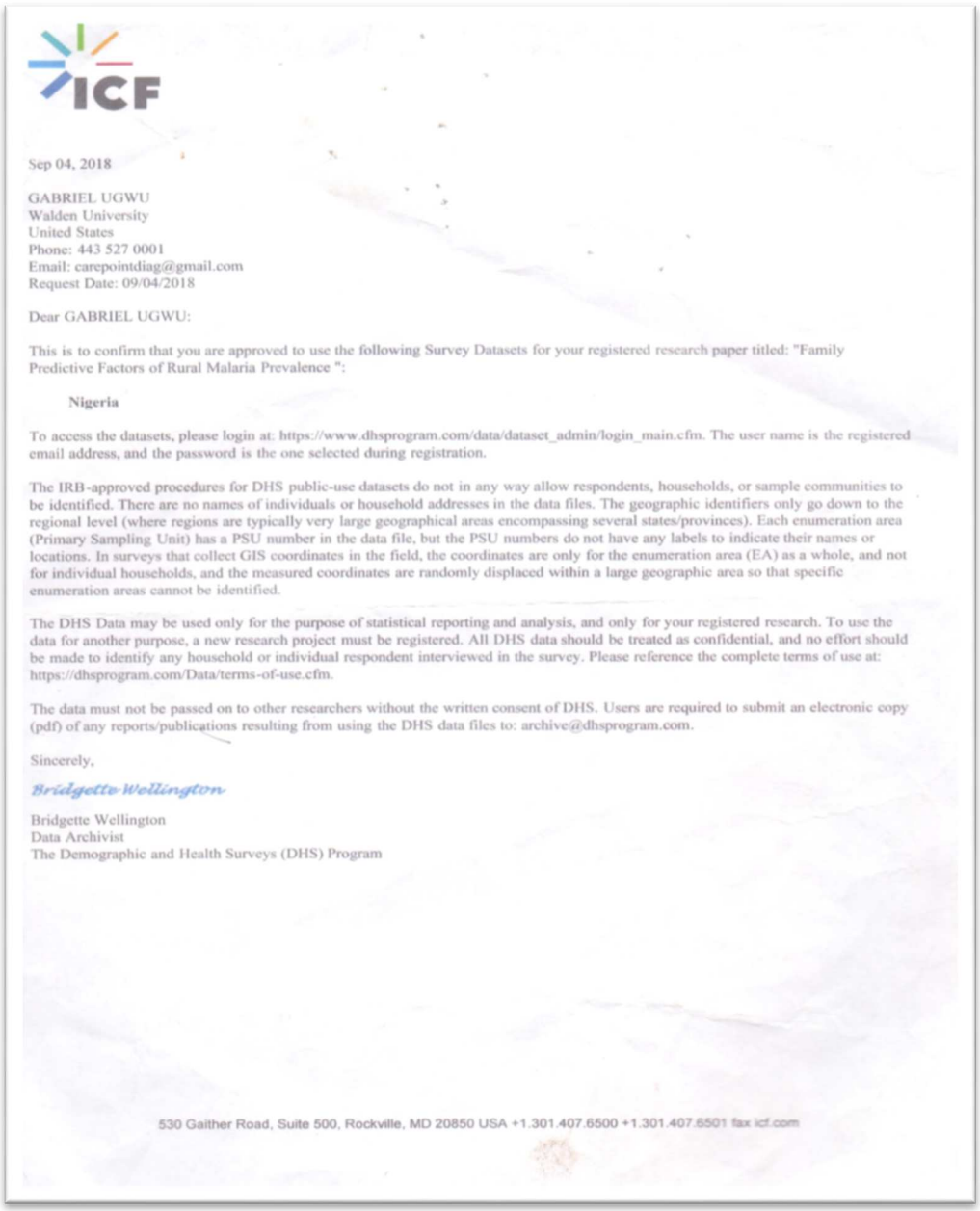
Appendix A



Sep 04, 2018

GABRIEL UGWU
Walden University
United States
Phone: 443 527 0001
Email: carepointdiag@gmail.com
Request Date: 09/04/2018

Dear GABRIEL UGWU:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Family Predictive Factors of Rural Malaria Prevalence ":

Nigeria

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. Users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: archive@dhsprogram.com.

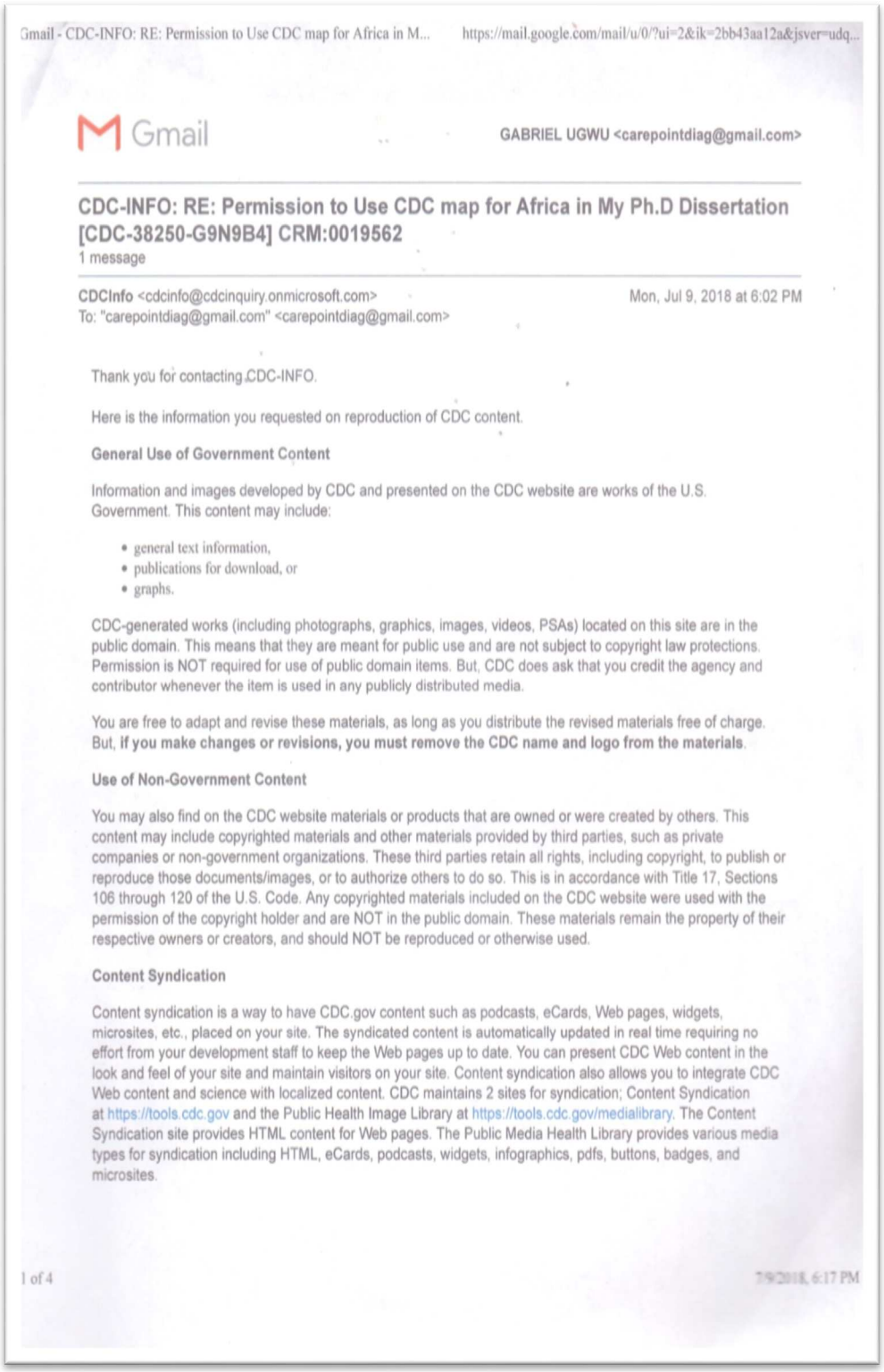
Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

530 Gaither Road, Suite 500, Rockville, MD 20850 USA +1.301.407.6500 +1.301.407.6501 fax icf.com

Appendix B



Gmail - CDC-INFO: RE: Permission to Use CDC map for Africa in M... https://mail.google.com/mail/u/0/?ui=2&ik=2bb43aa12a&jsver=udq...

Gmail GABRIEL UGWU <carepointdiag@gmail.com>

CDC-INFO: RE: Permission to Use CDC map for Africa in My Ph.D Dissertation [CDC-38250-G9N9B4] CRM:0019562

1 message

CDCInfo <cdcinfo@cdcinquiry.onmicrosoft.com> Mon, Jul 9, 2018 at 6:02 PM
To: "carepointdiag@gmail.com" <carepointdiag@gmail.com>

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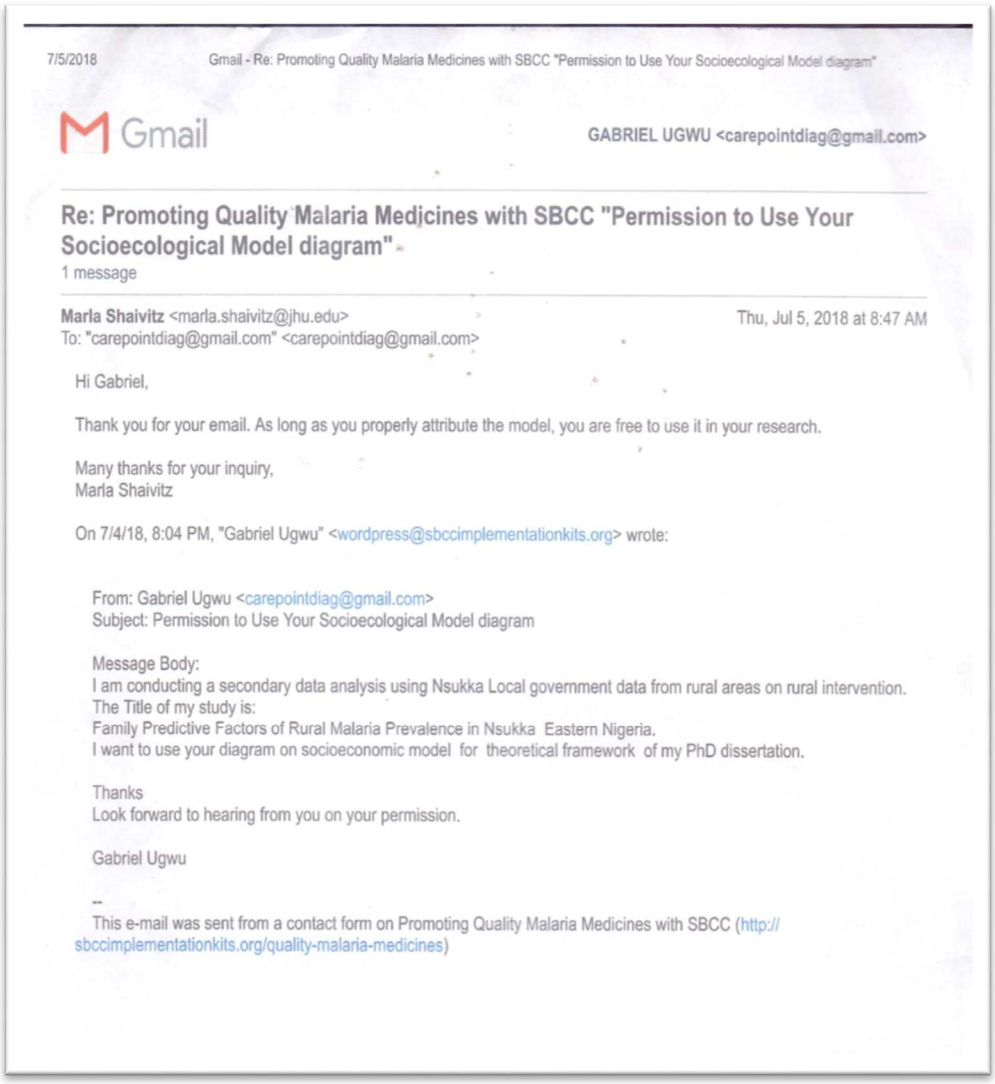
1 of 4 7/9/2018, 6:17 PM

Appendix C



7/5/2018 Gmail - Re: Promoting Quality Malaria Medicines with SBCC "Permission to Use Your Socioecological Model diagram"

Gmail GABRIEL UGWU <carepointdiag@gmail.com>

Re: Promoting Quality Malaria Medicines with SBCC "Permission to Use Your Socioecological Model diagram"

1 message

Marla Shaivitz <marla.shaivitz@jhu.edu> Thu, Jul 5, 2018 at 8:47 AM
To: "carepointdiag@gmail.com" <carepointdiag@gmail.com>

Hi Gabriel,

Thank you for your email. As long as you properly attribute the model, you are free to use it in your research.

Many thanks for your inquiry,
Marla Shaivitz

On 7/4/18, 8:04 PM, "Gabriel Ugwu" <wordpress@sbccimplementationkits.org> wrote:

From: Gabriel Ugwu <carepointdiag@gmail.com>
Subject: Permission to Use Your Socioecological Model diagram

Message Body:
I am conducting a secondary data analysis using Nsukka Local government data from rural areas on rural intervention.
The Title of my study is:
Family Predictive Factors of Rural Malaria Prevalence in Nsukka Eastern Nigeria.
I want to use your diagram on socioeconomic model for theoretical framework of my PhD dissertation.

Thanks
Look forward to hearing from you on your permission.

Gabriel Ugwu

--
This e-mail was sent from a contact form on Promoting Quality Malaria Medicines with SBCC (http://sbccimplementationkits.org/quality-malaria-medicines)