DECOMPOSITION OF CHANGES IN MALARIA PREVALENCE AMONG UNDER-FIVE CHILDREN IN NIGERIA

BY

OWOEYE, DEBORAH OLAMIPOSI

B.Sc. STATISTICS (ADO-EKITI)

MATRIC NUMBER: 189745

A DISSERTATION SUBMITTED TO

THE DEPARTMENT OF EPIDEMIOLOGY AND MEDICAL STATISTICS,

FACULTY OF PUBLIC HEALTH, COLLEGE OF MEDICINE,

UNIVERSITY OF IBADAN

IN PARTIAL FULFILMENT OF

THE REQUIREMENT FOR THE AWARD OF

MASTERS OF SCIENCE DEGREE IN MEDICAL STATISTICS

DECEMBER, 2016

CERTIFICATION

We certify that this project work was carried out under our supervision by Owoeye, Deborah Olamiposi of the Department of Epidemiology and Medical Statistics, Faculty of Public Health, College of Medicine, University of Ibadan.

.....11/01/2017.....

Supervisor

Dr Oyindamola B. Yusuf

B.Sc. (Ibadan); M.Sc. (Ibadan); Ph.D (Ibadan).

Department of Epidemiology and Medical Statistics,

Faculty of Public Health,

University of Ibadan

.....11/01/17.....

Co-Supervisor

Dr. J.O. Akinyemi

B.Tech (Akure), M.Sc. (Ibadan), Ph.D (Ibadan)

Department of Epidemiology and Medical Statistics,

Faculty of Public Health,

University of Ibadan

DEDICATION

To the Almighty God for His faithfulness.

To my family for their love and absolute support.

ACKNOWLEDGEMENT

First and foremost, my profound gratitude goes to my good God for the completion of this work, though it was tough, but He helped me all the way.

My sincere appreciation goes to my supervisor, Dr. (Mrs.) Oyindamola B. Yusuf for her support in the completion of the work. I also appreciate Dr. Joshua O. Akinyemi for his effort in making this work a success.

I am grateful to all my lecturers in the Department of Epidemiology and Medical Statistics, College of Medicine, University of Ibadan, for their words of encouragement at all times.

My gratitude goes to my parents and siblings including my nieces and nephews for their love and support during the course of this programme. You are simply the best.

My heartfelt thanks go to my fiancé for his kindness and support.

I say a big thank you to all my course mates for making the programme a fantastic one.

To all my friends who have contributed to this study one way or another, thanks.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

CDC	Centre for Disease Control
EAs	Enumeration Areas
IPTp	Intermittent Preventive Treatment in pregnancy
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
LR	Logistic regression
OBD	Oaxaca Blinder decomposition
PMI	President's Malaria Initiative
RBM	Roll Black Malaria
UNICEF	United Nations children's Education Fund
WHO	World Health Organization

ABSTRACT

Malaria among under-five children remains a public health problem in sub-Saharan Africa. Insecticide-treated mosquito net (ITN) used for protection against mosquito bites have proven to be a practical, highly effective, and cost-effective intervention against malaria. Despite the fact that ITN have been made accessible to the population, malaria still continues to be the major cause of child mortality and morbidity in Nigeria. Although, several studies have assessed the utilization of ITN, its impact on the prevalence of malaria over time is yet to be documented in Nigeria. Therefore, this study was conducted to decompose changes in malaria prevalence among under-five children between 2003 and 2013.

The data for this study were extracted from the children recode file of the 2003 and 2013 Nigeria Demographic Health Survey (NDHS) datasets. The outcome variable was the occurrence of malaria in which occurrence of fever was used as a proxy, while explanatory variables include child's age, child's sex, place of residence, maternal education, wealth index, ownership of ITN and utilization of ITN. Malaria prevalence and its determinants in 2003 and 2013 were summarized using frequency and percentages. Percentage change in both outcome and explanatory variables between 2003 and 2013 was estimated. Logistic regression was used to explore factors associated with malaria among children under five. A multivariate decomposition technique was used to partition changes in malaria prevalence into two components- contribution of changes in determinants and changes in the effect of determinants.

A total of 5204 and 28634 records of children under-five were available in 2003 and 2013 respectively for analysis. Malaria prevalence decline by 59% between 2003 and 2013. Ownership of ITN increased by 383% and the utilization of ITN increased by 221% between the two periods. Child's age, maternal education, wealth index were found to be associated with malaria, ownership of ITN (OR = 1.19; 95% CI = 1.1002, 1.2795), utilization of ITN (OR = 0.99; 95% CI = 0.9193, 1.0862). Oaxaca blinder decomposition analysis showed a difference of 0.1879 ($p < 0.001$) in the prevalence of malaria between the two years. Changes in determinants contributed 4.7% and changes in the effect of determinants contributed 95.3% in the decline of malaria prevalence. Ownership of ITN and its utilization contributed 92% and 13.3% to the observed decline of malaria.

There was a decline in the prevalence of malaria among children under five in Nigeria in the last ten years. Ownership of ITN and its utilization were the most contributing factors to the decline in the prevalence of malaria. Mother's level of education should be enhanced, more efforts should be made in promoting ITN and its utilization should therefore continue.

Keywords: Decomposition, Malaria, Oaxaca blinder.

Word count: 425.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Decomposition techniques are useful for identifying and explaining the separate contributions of group differences in measurable characteristics, which are based on regression analysis of the relationships between the outcome variable of interest and its correlates. Decomposition methods include, rate decomposition, the Oaxaca-Blinder means-coefficient decomposition, which allows coefficients to vary by sub-group, and quantile regression decomposition, which allows effects to vary across the distribution.

When faced with difference in mean of outcomes between two groups, researchers frequently examine how much of the difference can be explained by differences in observable characteristics. A common approach to distinguish between explained and unexplained components was developed by (Oaxaca, 1973), with the original "Oaxaca–Blinder" (O–B) decomposition based on separate linear regressions for the two groups.

The Oaxaca-Blinder decomposition method is a statistical technique that is used to compare the effects of different contributing characteristics. It's a very popular descriptive tool that permits the decomposition of the difference in an outcome variable between two groups into a part that is explained by differences in the observed characteristics of these groups and a part that is due to differences in the estimated coefficients. The Oaxaca Blinder decomposition explains the contribution of each factor to the difference in the outcome, thus identifying which factors contribute most to generating difference between the two groups (O'Donnell et al., 2008).

The goal of Oaxaca Blinder decomposition is to partition that part that is due to group differences in the mean values of the independent variable within the groups and group differences in the effects of the independent variable. Oaxaca Blinder method was initially limited to continuous dependent variables, but it has been extended to the case of binary dependent variables such as education, experience, marital status (Fairlie, 2005; Bauer et al., 2008).

The Oaxaca-Blinder multivariate decomposition approach is the most familiar and widely used method for linear models (Blinder, 1973; Oaxaca, 1973). Multivariate decomposition is used to partition the difference in mean responses between groups or over time into components that reflect the difference in the mean levels of model predictors and difference in the effects of those predictors across groups or over time. Multivariate decomposition provides more detail by assessing the relative contribution of specific covariates to the outcome. The essence of a multivariate decomposition is to know the contribution of each covariate to the components of the difference. Multivariate decomposition approach is applicable to many demographic outcomes, which is especially useful for models that are nonlinear in parameters such as binary response like the presence and absence of a disease, event count, and hazard rate models (Fairlie, 2005).

Malaria is a mosquito-borne infectious disease of humans caused by parasitic protozoans (a group of single-celled microorganisms) belonging to the plasmodium type (WHO, 2014). Malaria symptoms include fever, fatigue, vomiting and headache. In severe cases it can cause yellow skin, seizures, coma or death (Caraballo, 2014). WHO recommends a multi-prolonged strategy to prevent, control and eliminate malaria. Key interventions include: the use of insecticide-treated mosquito nets (ITN), indoor residual spraying (IRS), diagnostic testing, intermittent preventive treatment in pregnancy (IPTp) and treatment of confirmed cases with effective anti-malaria medicines (WHO, 2007).

An insecticide-treated net (ITN) is a net (usually a bed net), designed to block mosquitoes physically, that has been treated with safe, residual insecticide for the purpose of killing and repelling mosquitoes, which carry malaria. Intermittent preventive treatment of malaria in pregnancy (IPTp) is a full therapeutic course of antimalarial medicine given to pregnant women at routine prenatal visits, regardless of whether the recipient is infected with malaria. IPTp reduces maternal malaria episodes, maternal and fetal anemia, placental parasitaemia, low birth weight, and neonatal mortality.

Indoor residual spraying (IRS), is one of the primary vector control interventions for reducing and interrupting malaria transmission, it is a highly effective method of malaria control recommended by the World Health Organization. IRS, involves the coordinated, timely spraying of the interior walls of homes with insecticides in order to kill the adult vector mosquitoes that land and rest on

these surfaces. The primary effects of IRS towards curtailing malaria transmission are: i) to reduce the life span of vector mosquitoes so that they can no longer transmit malaria parasites from one person to another, and ii) to reduce the density of the vector mosquitoes. In some situations, IRS can lead to the elimination of locally important malaria vectors. Some insecticides also repel mosquitoes and by so doing reduce the number of mosquitoes entering the sprayed room, and thus human-vector contact.

1.2 PROBLEM STATEMENT

Malaria is a fully preventable disease; however, about 3.4 billion people are at risk of the disease globally with 1.2 billion people at high risk (WHO, 2013). Malaria was accountable for the death of about 482,000 under-five children even though an estimated 136 million Insecticide Treated Nets (ITNs) were distributed to endemic countries in 2012 (WHO, 2013). Almost 70% of pregnant women suffer from malaria, which contributes to maternal anemia, low birth weight, still births, abortions and other pregnancy-related complications (Federal Ministry of Health, Abuja, 2005).

Significant resources have been invested in malaria control programs in recent years, with clear aims of reducing malaria transmission. Documenting the effect of these interventions require measurement of intervention scale-up as well as changes in malaria-associated outcomes.

The World Health Assembly and the Roll Black Malaria partnership in 2005 set the goal of reducing the number of malaria cases and deaths recorded in 2000 by 75% or more by the end of 2015 (WHO, 2010). There has been a noticeable increase in international finding for malaria control in the past decade. This finding has led to tremendous progress in increasing access to insecticide treated nets (ITN), indoor residual spraying (IRS) and intermittent preventive treatment in pregnancy (IPTp). Myths and misconceptions about malaria prevention is still prevalent (Adebayo, 2015). There is a high awareness of ITN, which did not influence the usage in preventing malaria (Edelu, 2010). There was a discrepancy between net possession and net use with the rate of use lower than possession (Aderibigbe et al., 2014).

1.3 JUSTIFICATION OF THE STUDY

Malaria has proven to be the most disease amongst the health problems confronting countries in the sub-Saharan Africa, therefore affecting their development with a high proportion of its wealth being drained by it (WHO, 2008). The groups most at risk are children under-five years of age and pregnant women. Pregnant women are vulnerable because their natural immunity is reduced; thus, they are four times more likely to suffer from complications of malaria than non-pregnant women. Malaria is a cause of pregnancy loss, low birth weight, neonatal mortality and stillbirth. Individuals with sickle cell and other low immune groups are also at higher risk (WHO, 2010).

The transmission of malaria has been extensively investigated and has informed control and treatment programs worldwide. The changes in malaria prevalence can be attributed to three major control interventions which are: insecticide treated nets (ITN), indoor residual spraying (IRS) and intermittent preventive treatment in pregnancy (IPTp). Despite the fact that ITN have been made accessible to the population, malaria still continues to be the major cause of child mortality and morbidity in Nigeria.

When dealing with health data, there is a challenge of estimating the contribution of each factor in the outcome variable of interests. In response to this challenge, OBD fit for estimating the contribution of each factor in the outcome variable of interests. Although, several studies have assessed the utilization of ITN, its impact on the prevalence of malaria over time is yet to be documented in Nigeria. Therefore, this study will decompose changes in malaria prevalence among under-five children between 2003 and 2013.

1.4 OBJECTIVES

1.4.1 Main Objective

To decompose changes in malaria prevalence among under-five children between 2003 and 2013 in Nigeria.

1.4.2 Specific Objectives

1. To examine changes in malaria prevalence and some of its determinants in Nigeria between 2003 and 2013.
2. To examine the association between malaria in under-five children and some selected household and maternal factors in Nigeria.
3. To estimate contribution of each determinant to changes in malaria among children under-five between 2003 and 2013 in Nigeria.

CHAPTER TWO

LITERATURE REVIEW

2.1 MALARIA

Malaria is one of the world's most common and serious tropical diseases, with nearly half the world's population at risk of being infected with malaria. Although preventable and treatable, malaria causes significant morbidity and mortality, with the greatest numbers of cases and deaths in resource-poor regions and among young children (WHO, 2015). Strategies and efforts to address malaria have evolved over time (CDC, 2008). More recently, in the late 1990s, malaria began to receive renewed attention, particularly after the 1998 creation of the Roll Back Malaria Partnership (RBM).

In 2000, all nations agreed to targets malaria globally as part of Millennium Development Goal 6 (combat HIV/AIDS, malaria, and other diseases). Since then, expanded efforts by the U.S. government (USG), other donor governments, multilateral institutions, and affected countries have helped to increase access to malaria prevention and treatment and reduce cases and deaths (WHO, 2015) and there has been increasing intervention of the possibility of finally eradicating the disease (Tanner, 2015).

According to World Health Organization, malaria is the most causes of 30 percent to 50 percent of all outpatient call to hospital and health services and also causes up to 50 percent hospital admission in sub-Saharan Africa (WHO, 2012). Malaria is a prime etiological factor that slowed down the economic growth in the continent of Africa as a result of lost productivity or income associated with illness or death and other damages associated with the disease. Malaria is a social and economic problem in the country and is the major cause of morbidity and mortality (WHO, 2012). Malaria has been a fatal disease associated with high morbidity and mortality that greatly crushed the socioeconomic position of endemic nation state (Azizi, 2013).

More than three billion people in nearly 100 countries are at risk from malaria. Sub-Saharan Africa is the highest region with malaria in the world, and parts of Asia and Latin America also face significant malaria epidemics. Many challenges continue to complicate malaria control efforts in countries with ongoing malaria transmission, including poverty, poor sanitation, weak health

CHAPTER TWO

LITERATURE REVIEW

2.1 MALARIA

Malaria is one of the world's most common and serious tropical diseases, with nearly half the world's population at risk of being infected with malaria. Although preventable and treatable, malaria causes significant morbidity and mortality, with the greatest numbers of cases and deaths in resource-poor regions and among young children (WHO, 2015). Strategies and efforts to address malaria have evolved over time (CDC, 2008). More recently, in the late 1990s, malaria began to receive renewed attention, particularly after the 1998 creation of the Roll Back Malaria Partnership (RBM).

In 2000, all nations agreed to targets malaria globally as part of Millennium Development Goal 6 (combat HIV/AIDS, malaria, and other diseases). Since then, expanded efforts by the U.S. government (USG), other donor governments, multilateral institutions, and affected countries have helped to increase access to malaria prevention and treatment and reduce cases and deaths (WHO, 2015) and there has been increasing intervention of the possibility of finally eradicating the disease (Tanner, 2015).

According to World Health Organization, malaria is the most causes of 30 percent to 50 percent of all outpatient call to hospital and health services and also causes up to 50 percent hospital admission in sub-Saharan Africa (WHO, 2012). Malaria is a prime etiological factor that slowed down the economic growth in the continent of Africa as a result of lost productivity or income associated with illness or death and other damages associated with the disease. Malaria is a social and economic problem in the country and is the major cause of morbidity and mortality (WHO, 2012). Malaria has been a fatal disease associated with high morbidity and mortality that greatly crushed the socioeconomic position of endemic nation state (Azizi, 2013).

More than three billion people in nearly 100 countries are at risk from malaria. Sub-Saharan Africa is the highest region with malaria in the world, and parts of Asia and Latin America also face significant malaria epidemics. Many challenges continue to complicate malaria control efforts in countries with ongoing malaria transmission, including poverty, poor sanitation, weak health

systems, limited disease surveillance capabilities, natural disasters, armed conflict, migration, climate change, and the presence of counterfeit and/or sub-standard antimalarial drugs (WHO, 2015). The groups most at risk are children under-five years of age and pregnant women. Pregnant women are vulnerable because their natural immunity is reduced; thus, they are four times more likely to suffer from complications of malaria than non-pregnant women.

2.2 OVERVIEW OF MALARIA IN NIGERIA

Malaria in Nigeria is endemic and constitutes a major public health problem despite the curable nature of the disease. Nigeria bears up to 25 percent of the malarial disease burden in Africa, hence contributing significantly to the one million lives lost per year in the region, which mostly consists of children and pregnant women. Malaria-related deaths account for up to 11 percent of maternal mortality. Also, they contribute up to 25 percent of infant mortality and 30 percent of under-5 mortality, resulting in about 300,000 childhood deaths annually.

The disease overburdens the already-weakened health system: nearly 110 million clinical cases of malaria are diagnosed each year, and malaria contributes up to 60 percent of outpatient visits and 30 percent of admissions. Malaria also exerts a huge social and economic burden on families, communities, and the country at large, causing an annual loss of about 132 billion Naira in payments for treatment and prevention as well as hours not worked (Jimoh et al., 2007). At least 50% of the population has at least one episode of malaria annually resulting in high productivity losses while children that are aged less than five years have 2 to 4 attacks annually (FMoH, 2005).

Malaria in Nigeria remains most important health problem in public health. It negatively impacts the social and economic development of communities in Nigeria and it is responsible for school absenteeism and low productivity at workplaces and on farms. A study in Enugu Nigeria averred that the situation of maternal mortality in Nigeria in general remains a major concern as statistics available reveals that the country maternal deaths rank second in the world after India (Okeibunor et al., 2010). The knowledge about malaria infection is high and so also is the level of participation in its control (Bamidele et al., 2012). A study in Nigeria revealed that malaria prevalent causes suffering to human society and influences burden on human population (Olusegun et al., 2012).

2.3 MALARIA CONTROL INTERVENTIONS

Malaria control efforts involve a combination of prevention and treatment strategies and tools, such as insecticide-treated bed nets (ITN); indoor residual spraying (IRS) with insecticides; diagnosis and treatment with antimalarial drugs, particularly ACTs; (WHO, 2011) and intermittent preventive treatment in pregnancy (IPTp, a drug treatment for pregnant women that prevents complications from malaria for a woman and her unborn child). Although access to prevention and treatment services has grown over time, gaps remain. Over the past decade, the number of ACT treatments procured by the public and private sectors has increased more than thirty-fold. Similarly, access to and use of ITNs and IRS has increased significantly but remains incomplete, and coverage of IPTp has been increasing but remains limited (WHO, 2015).

2.3.1 Insecticide Treated Nets (ITNs)

Insecticide-treated mosquito net (ITN) used for protection against mosquito bites have proven to be a practical, highly effective, and cost-effective intervention against malaria (WHO, 2015). The use of ITNs is currently considered the most cost-effective method of malaria prevention in highly endemic areas. Scaling up ITN coverage and use by young children and pregnant women has been made a consensus target of the Millennium Development Goals (MDGs), the Roll Back Malaria Partnership (RBM), and the US President's Malaria Initiative (PMI). Studies showed that in 2010, there were enough insecticide-treated nets (ITNs), primarily LLINs, procured on the African continent to cover 73% of the population at-risk, but there is a challenge of fair distribution (WHO, 2011; Katz et al., 2011).

The use of ITNs or LLINs is the main method of malaria prevention employed in Nigeria. A study from Nigeria showed that a community designed and implemented ITN distribution and educational programme was more successful in increasing coverage (by an additional 7-9%) than routine national ANC distribution (Okeibunor et al 2011). Increasing the number of nets owned per household might not be a critical decider on whether the net will be used or not (Ezire et al., 2015). A review conducted regarding the reported reasons for not using a bed net when one was available (in the general population) and found that reasons such as discomfort and perceived low mosquito density were the most common reasons for non-use (Pulford et al., 2011). There was a

discrepancy between net possession and net use with rate of use lower than possession (Aderibigbe et al., 2014).

2.3.2 Indoor Residual Spraying (IRS)

Spraying houses with insecticides (indoor residual spraying; IRS) to kill mosquitoes is one of the main methods that have been used to control malaria on a large scale. IRS has helped to eliminate malaria from great parts of Asia, Russia, Europe, and Latin America, and successful IRS programmes have also been run in parts of Africa. There has been mounting interest in scaling-up IRS, and DDT in particular, for malaria control in Africa as IRS is a passive and a good intervention (WHO, 2007). In 2012, total of 88 countries, including 40 countries in Africa, implemented Indoor Residual Spraying for malaria control (WHO, 2013).

Indoor Residual Spraying is considered to be one of the most promising technologies for achieving reductions in the global malaria scourge and its burden. Indoor residual spraying (IRS) is another component of efforts to control malaria transmission in Nigeria. Part of the new strategy in the fight against malaria is to increase IRS coverage in Nigeria. In the quest to reduce the malaria burden, Nigeria adopted Integrated Vector Management (IVM) in 2006. The acceptability of indoor residual spraying is related to whether householders perceive it as beneficial (Rodríguez et al., 2006). According to Tanser in his literature stated that the evidence from randomized comparisons of IRS versus no IRS confirms that IRS reduces malaria incidence in unstable malaria settings (Tanser et al., 2010).

2.3.3 Intermittent Preventive Treatment in Pregnancy (IPTp)

Pregnant women who carry the malaria parasite may be at risk for serious problems that harm their own health, compromise the health of the fetus, and increase the likelihood of adverse pregnancy outcomes such as stillbirth, spontaneous abortion, and low birth weight. IPTp-SP is recommended by the World Health Organization (WHO) for all pregnant women at each scheduled antenatal care (ANC) visit until the time of delivery, provided that the doses are given at least one month apart.

As a protective measure, in 2001, the Federal Ministry of Health recommended that pregnant women receive intermittent preventive treatment (IPT) of malaria during pregnancy using two doses of sulphadoxine-pyrimethamine (SP). The 2010 Nigeria Malaria Indicator Survey reported that only 15% of women who had given birth in the two years preceding the survey had received

even one dose of SP during their ANC visits, less than a third of the number who attended ANC with a skilled provider (Udonwa et al., 2010).

Studies revealed that few pregnant women adhere to the recommended two-dose course (Akinleye et al., 2009; Udonwa et al., 2010; Onwujekwe et al., 2012). Low IPTp use puts women at risk of malaria in pregnancy and its adverse outcomes like anemia, spontaneous abortions, prematurity or low birth weight (Okpere et al., 2010). Knowledge of prophylaxis for malaria prevention is associated with SP-IPTp use in south-west Nigeria (Akinyele, 2011). A studies showed that coverage of IPTp has remains far below target in many countries including Nigeria (Onoka et al., 2012).

2.4 FACTORS AFFECTING PREVALENCE OF MALARIA

The analytical framework for the study of malaria prevalence determinants in developing countries has been documented (Adam et al., 2005). There are factors that influence malaria prevalence, some of the factors include: Age, Education, Place of residence and Socioeconomic Factors.

Risk of malaria infection is greatly increased by age, malaria prevalence was observed to decrease as age increased (Adam et al., 2005). Children below age five specifically infant that are one year and below are likely not to have built significant immunity to the harmful form of malaria. Also, pregnant women with limited immunity are much more likely to give birth to a child of low birth weight with higher risk of dying from malaria. According to Agumo and Oyibo (2009), pregnant women of maternal age is at the greatest risk of having malaria infection. Sani (2015) demonstrated that infection rates are higher in women in their first and second pregnancies, with lower rates in later pregnancies.

The zone of residence (rural or urban) is an important determinant for malaria and appropriate use of malaria preventive methods. Urbanization, with its profound changes in the socio-economic and physical landscapes, has contributed to reduced malaria transmission in many malaria-endemic countries, Adaptation of mosquito species to the urban environment—for example, to heavily polluted breeding sites and more modest water volume requirements—has been reported (De Silva

and Marshall, 2012). A study in Nigeria, (Uzochukwu et al., 2008) revealed that mothers in rural areas reported more malaria in children than their counterparts from the urban areas.

Malaria transmission is generally higher in rural than urban Africa, and there are close links between malaria and agriculture, including intense farming, terracing, irrigation and drainage (Basurko et al., 2013). A study revealed that malaria is a disease of the rural people, particularly the rural poor and this implies that rural poverty may be a reason for the higher malaria cases among the rural under-five children compared to their urban counterparts (Fernando et al., 2003). More children from the rural areas had malaria cases than children from the urban areas (Nyarko et al., 2014).

Education is related to illiteracy and lack of access to information. Several studies revealed that educational backgrounds of people affect their habits positively (Sharma et al., 2008; Carlsson et al., 2013). Education influenced malaria prevention and control practices. Lack of proper education increase chance of malaria if communities are not aware of the signs, symptoms and risk factors for malaria, they cannot protect against or treat its symptoms. Level of education is a predictor of the type of help first sought when a child has fever.

Mothers with no formal education or primary only are not likely to visit a health facility first compared to mothers with secondary education (Worrall et al., 2002). A study in Southeast Nigeria showed that higher levels of education were associated with improved knowledge and practices in relation to appropriate prevention and treatment strategies (Dike et al., 2006). Also, a study that was based on participants' clinical history indicate that illiterate pregnant women in Nigeria had the highest prevalence rate of malaria (Adefioye et al., 2007).

Women tend to have lower educational and literacy level than men, this may affect their ability to recognize the signs and symptoms of malaria and their knowledge of available treatment. Prevalence of malaria and parasite density among pregnant women in the area decreased proportionately with the increase in education level (Agomo et al., 2009). It was observed that non- educated pregnant women had the highest prevalence rate, while those with a tertiary level of education had the lowest prevalent rate of malaria (Agomo et al., 2009).

Malaria is a disease of poverty because wealth could protect people from malaria infection (Messina et al., 2011). Malaria prospers most where human societies have prospered least and this suggest that malaria and poverty are closely related (Sach, 2002). Low socio-economic status is associated with the risk of malaria parasitaemia compared to higher status. A study in the socioeconomic development against malaria reported that poorer households are not just more susceptible to disease but are also more vulnerable to the costs of disease, which might worsen the destitution, also, children with low socioeconomic status are more prone to malaria than those with higher socioeconomic status within the same locality (Tusting et al., 2013).

Higher socioeconomic status has been found to be significantly positively associated with ITN use, intermittent preventive treatment in pregnancy (IPTp) and ACT coverage and use (De et al., 2013). According to Kyu who stated that people with higher socioeconomic status are likely to have all these than their low socioeconomic status counterparts: (a) higher levels of education and awareness of malaria prevention. (b) Ability to purchase antimalarial drugs that would reduce malaria infection rate and (c) access to good health care services and living in a good housing conditions (Kyu et al., 2013).

2.5 APPLICATION OF OAXACA BLINDER DECOMPOSITION IN MEDICINE

The Oaxaca Blinder decomposition is a technique that decomposes differences between any two groups, it has been used extensively in explaining wage differentials between males and females, immigrants and natives, blacks and whites workers. The logic behind the Oaxaca decomposition is that it explain the difference in the outcome between two groups into two parts, a part that is explained by the difference in the level of the determinants, such as income or education level, and a part that is explained by the difference in the effect of the determinants on the outcome variable.

Oaxaca Blinder decompositions have been carried out using linear regression models with the property that such models fit exactly at the mean of the sample, the approach has also been used for binary, ordered and count models (Fairlie, 2003; Bauer, 2008). This methodology has been extensively applied in labor economics to analyzed wage differentials (Madden, 2008). It is

gaining popularity in health research (Le Cook, 2009) such as nutrition status, HIV/AIDS status, immunization, child mortality.

Reports in medical literature suggests that OBD is suitable for decomposition of child nutrition status (Uthman, 2009; Cavatorta et al., 2015). In Egypt, Jordan and Yemen, Ahmad et al. (2016) decompose the rural-urban differences in child malnutrition into two components one that is explained by differences in the level of the determinants, and another component that is explained by differences in the effect of the determinant on the child nutritional status. Oaxaca Blinder decomposition was applied to decompose the change in health status in Catalonia from 1994 to 2006 for every sex and age group (Altes, 2011). Epo et al. (2011) applied Oaxaca Blinder decomposition technique to explain poverty and inequality trends in Cameroon.

Oaxaca blinder decomposition was applied to factors contributing to child mortality reductions in 142 low and middle income countries between 1990 and 2010 (Bishai et al., 2014). Poulami Chatterjee (2014) decompose the gender gap in full immunization among children of age one to two years. Poulami Chatterjee used OBD to quantify the amount of discriminating behavior contributing to this gap in immunization between two genders. Sebastian et al. (2015) decomposes socioeconomic inequalities in functional somatic symptoms by social and material conditions in Sweden.

Hosseinpoor et al. (2012) modeled the gender differences in health using OBD technique partitioned the differences in health between women and men into an "explained" component that arises because men and women differ in social and economic characteristics, and an "unexplained" component due to the differential effects of these characteristics. Haddad used OBD technique to explore the sources of the health difference between tribal and non-tribal groups, explaining the part of the health gap due to group differences in the distribution of health determinants and the part due to differences in the effects of these determinants (Haddad et al., 2012).

Powers et al. (2011) decomposed the gender differences in HIV/AIDS prevalence in each country and time period into the part attributable to differences in the distribution of characteristics between men and women and the part due to differences in the effects of these characteristics on HIV prevalence. Gbemisola Oseni (2014) utilizes the Oaxaca-Blinder decomposition method to

decompose gender differentials in agricultural production in Nigeria. Oaxaca-Blinder decomposition were used to determined factors affecting access to safe toilet facilities in Nigerian households and also investigates the factors responsible for rural-urban disparity in accessing safe toilets among Nigerians (Abdu et al., 2015).

Oaxaca Blinder decomposition was applied to investigate determinants of regional income disparity in rural Vietnam (Takahashi, 2007). Dulton in one of his research applied Oaxaca Blinder to study regional disparities in obesity in Canada (Dulton, 2011). Miller and Sarpong (2011) decomposes the racial-ethnic differences in childhood asthma treatment. OBD technique was used to analyze racial disparities in birth outcomes (Lhila, 2012). Adewara et al. (2014) applied Blinder-Oaxaca decomposition to determine the degree of health risk between the rich and the poor in the urban and rural areas in Nigeria. Njau et al. (2014) applied Oaxaca Blinder decomposition to investigate the relationship between maternal education and childhood malaria infection rates in settings with relatively high malaria transmission.

CHAPTER THREE

METHODOLOGY

3.1 STUDY AREA

Nigeria is the seventh most populous in the world and the most populous nation in Africa and the 14th largest in land mass. The territorial boundaries are defined by the republics of Niger and Chad in the north, the Republic of Cameroon on the east, and the Republic of Benin on the west. Nigeria has an area of 923,768square kilometers and lies between latitudes 4°16' and 13°53' north and longitudes 2°40' and 14°41' east. Nigeria is bordered by approximately 850kilometres of the Atlantic Ocean to the south, stretching from Badagry in the west to the Riodel Rey in the east. Nigeria comprises of 36states with a Federal Capital Territory (FCT), these states are grouped into six geopolitical zones: North Central, North East, North West, South East, South-South and South West. It has 774 constitutionally recognized local government areas (LGAs) and an estimates of 374 ethnic groups. The major ethnic groups are Hausa/Fulani, Igbo and Yoruba which account for about 68%, Edo, Ebira Ijaw, Ibibio, Kanuri, Nupe and Tiv account for 27% and other minority ethnic groups made up of 5%.

3.2 STUDY DESIGN

This study was a retrospective analysis of data from 2003 and 2013 National Demographic Health Survey (NDHS).

3.3 STUDY POPULATION

The population for the 2003 and 2013 NDHS constitutes females aged 15-49 years and males aged 15-59 years in Nigeria. Children under-five years of age are the study population.

3.4 SAMPLING FRAME AND TECHNIQUE

The sample for 2003 NDHS was a two-stage stratified sample. The sample frame for this survey was the list of enumeration areas (EAs) developed for the 1991 population Census. Nigeria was divided into 36 states. Each state was subdivided into local government areas (LGAs) and each LGA was divided into localities. Each locality was subdivided into enumeration areas (EAs). The

list of approximately 212,080 EAs, with household and population information (from the 1991census) for each EA, was evaluated as a potential sampling frame for the 2003 NDHS. The EAs are grouped by states, by LGAs within a state, and by localities within an LGA, stratified separately by urban and rural areas.

The sample for the 2013 NDHS was a stratified sample, selected independently in three stages from the sampling frame. The primary sampling unit (PSU), referred to as a cluster for the 2013 NDHS is defined on the basis of Enumeration Areas from the 2006 population census. Stratification was achieved by separating each state into urban and rural areas. In the first stage, 893 localities were selected in each sampling stratum. In the second stage, one EA was randomly selected from most of the selected localities with an equal probability selection, in total, 904 EAs were selected. The resulting list of households served as the sampling frame for the selection of households in the third stage, a fixed number of 45 households were selected in every urban and rural cluster through equal probability systematic sampling based on the household listing.

3.5 DATA SOURCE AND SAMPLE SIZE

The data for this study were extracted from the children recode file of the 2003 and 2013 Nigeria Demographic Health Survey. The sample size for the children under-five was 2504 in 2003, 26834 in 2013 and 33838 for the two years.

3.6 DATA COLLECTION

NDHS 2003 and 2013 surveys make used of three questionnaires, which include: the Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. The model questionnaires reflect relevant issues such as fertility and family planning, domestic violence, child mortality, children's nutritional status, the utilization of maternal and child health services, and knowledge and attitudes towards HIV/AIDS family planning. Information on relevant background characteristics was collected. Data on the age and sex of household members in the Household Questionnaire were used to identify women and men who were eligible for individual interviews. The Women's Questionnaire was used to collect information from all women age 15-49.

3.7 STUDY VARIABLES

The variables in this study are:

3.7.1 Outcome Variable

The outcome variable is this study is malaria but the occurrence of fever was used as a proxy for malaria infection. The occurrence of malaria was defined as occurrence of fever in the last two weeks and was coded as: Yes-1 and No- 0.

3.7.2 Explanatory Variables

The choice of explanatory variables was based on literature on factors influencing occurrence of malaria (Agomo et al, 2013; Zuwaira et al, 2013; Aderibigbe et al, 2014). It consists of Child's age, Sex of child, Place of residence, Mother's education, Wealth index, Insecticide Treated Net (ITN), Children under-five slept under ITN night before survey. The explanatory variables that are categorical are coded in the table below:

CODING OF VARIABLES

S/No	Variables	Coding
1	Child's Age (Months)	0-11 11-23 24-35 36-47 48-59
2	Child Sex	Male Female
3	Place of Residence	Urban Rural
4	Mother's Education	None Primary Secondary/Higher
5	Wealth Index	Poorest Poorer Middle

		Richer Richest
6	Ownership of ITN	Yes No
7	Children under-five slept under ITN last night before survey	Yes No

3.8 DATA MANAGEMENT AND ANALYSIS

Data was extracted from the NDHS 2003 and 2013 dataset, the data was cleaned and the missing values was handled by using complete case analysis (listwise deletion) and weighted using SPSS version 20. The two dataset were merged together in SPSS so as to form a single data and was then transferred to STATA in which descriptive analysis, logistic regression and Oaxaca Blinder decomposition were carried out and R statistical software was used to generate the chart.

Descriptive statistics (frequencies and proportions) was used to summarize malaria prevalence and it factors. Percentage change in both outcome and explanatory variables between 2003 and 2013 was estimated. Logistic regression was used to explore factors associated with malaria among children under five. A multivariate OBD decomposition technique was used to partition changes in malaria prevalence into two components- contribution of changes in determinants and changes in the coefficient of determinants.

$$Percentage\ Change = \frac{2013\ percentage - 2003\ percentage}{2003\ percentage} \times 100$$

$$Percentage\ contribution = \frac{coefficients\ of\ each\ variable}{total\ coefficients} \times 100$$ (Uthman, 2009; Kumar and Singh, 2013).

3.9 LOGISTIC REGRESSION

Logistic regression is a special case of the generalized linear model that is similar to linear regression which is widely used in health research. Logistic regression is a type of regression model where the dependent variable is categorical. It is used to estimate the probability of a binary response (a variable that can take only two values like occurrence or non-occurrence of an event) based on one or more independent variables using a logistic function.

Assumptions of Logistic Regression

The model of logistic regression is based on different assumptions that should not be violated before it can be applied.

1. The response variable must have two possible outcomes (1=healthy; 0=sick)
2. The model should have little or no multicollinearity that is, the explanatory variables should be independent from each other.
3. A large sample size is required.
4. Assumptions of chi-square test must be satisfied.
5. There should be a relationship between the response variable and explanatory variables.

Logistic Regression Model

Logistic regression model can be written just as the simple linear regression model in the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_p X_p \quad \ldots 1$$

Where,

Y is the response variable which is dichotomous

β's are the coefficient of the explanatory variables

X's are the explanatory variables

The logit link function can be used to transform a linear regression to make it fit for probabilities because its output always takes values between zero and one. Therefore, Y can be expressed as

logit (p) where p is the probability of occurrence of an event. In this study, the event of interest is the occurrence of malaria.

The logit transformation is written as the log of odds:

$$odds = \frac{probability\ of\ occurence\ of\ malaria}{probability\ of\ non-occurrence\ of\ malaria} = \frac{p}{1-p} \quad \ldots 2$$

Odds vary on a scale of (0, ∞), which makes the log of odds to vary on a scale of (-∞, ∞). This implies that an additive unit change in the value of an explanatory variable bring about a change in the odds by a constant multiplicative amount.

$$logit\ (p) = \log(odds) = log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_p X_p \quad \ldots 3$$

Taking the exponential of the model, this now become:

$$e^{logit\ (p)} = odds = \left(\frac{p}{1-p}\right) = e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\cdots+\beta_p X_p} \quad \ldots 4$$

Let logit (p) = z, then equation 4 can be re-written as:

$$e^{z} = \left(\frac{p}{1-p}\right) = e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\cdots+\beta_p X_p} \quad \ldots 5$$

The inverse of the logit function is the logistic function, so equation 5 is:

$$p = \frac{e^z}{1+e^z} \quad \ldots 6$$

3.10 OAXACA BLINDER DECOMPOSITION

Oaxaca Blinder decomposition is a statistical technique that allows the decomposition of outcome variables between two groups into a part that is explained by differences in observed characteristics and a part attributable to differences in the estimated coefficients based on a regression model. The Blinder-Oaxaca decomposition technique is especially useful for identifying and explaining the separate contributions of group differences in measurable characteristics, such as education, age, sex, utilization of ITN, residence, and region, to occurrence of malaria in outcomes.

The technique is easy to apply and only requires coefficient estimates from linear regressions for the outcome of interest and sample means of the independent variables used in the regressions. The aim of the Blinder-Oaxaca decomposition is to explain how much of the difference in mean outcomes across two groups is due to group differences in the levels of explanatory variables, and

how much is due to differences in the magnitude of regression coefficients (Oaxaca 1973; Blinder 1973).

Multivariate Oaxaca Blinder decomposition is a statistical technique used to partition the difference in mean responses between groups or over time into components that reflect the difference in the mean levels of model predictors and difference in the effects of those predictors across groups or over time. Multivariate decomposition provides more detail by assessing the relative contribution of specific covariates to these components.

3.10.1 Twofold Decomposition

In Oaxaca blinder decomposition, regression model is been fit for two groups. There are two groups in the model which are year 2003 and 2013. The regression model for the two groups are:

$$Y_{2003} = \alpha + \beta X_{2003} + \varepsilon \quad \ldots \quad 1$$

$$Y_{2013} = \alpha + \beta X_{2013} + \varepsilon \quad \ldots \quad 2$$

Where,

Y_{2003} and Y_{2013} are the occurrence of malaria in year 2003 and 2013 respectively

α is an intercept term or constant

β is the coefficient of the explanatory variables

X_{2003} and X_{2013} are the vector of explanatory variables for year 2003 and 2013 respectively.

ε is a residual term

The 2013 survey is assumed to have a higher mean of Y and the 2003 have a lower mean value of Y than 2013. The change between the mean outcomes of the two groups

$$\bar{Y}_{2013} - \bar{Y}_{2003} = \bar{X}_{2013}\beta_{2013} - \bar{X}_{2003}\beta_{2003} \quad \ldots \quad 3$$

Subtract and then add $X_{2003}\beta_{2013}$ in equation 3

$$\bar{Y}_{2013} - \bar{Y}_{2003} = \bar{X}_{2013}\beta_{2013} - \bar{X}_{2003}\beta_{2013} + \bar{X}_{2003}\beta_{2013} - \bar{X}_{2003}\beta_{2003} \quad \ldots \quad 4$$

$$\bar{Y}_{2013} - \bar{Y}_{2003} = (\bar{X}_{2013} - \bar{X}_{2003})\beta_{2013} + \bar{X}_{2003}(\beta_{2013} - \beta_{2003}) \quad \ldots \quad 5$$

The first term in the right hand side of the equation is the explained part called "Decomposition effect" since it reflects differences in the distribution of X's between the two groups, where the second term is the unexplained part called Coefficient Components "C" that reflects differences in the β's i.e in the way X's affect malaria.

3.10. 2 Threefold Decomposition

In the context of a linear regression, the mean outcome for Group $G \in \{2003,2013\}$ can be expressed as $\bar{Y}_G = \bar{X}_G \hat{\beta}_G$, where $\bar{X}_G$ contains the mean values of explanatory variables and $\hat{\beta}_G$ are the estimated regression coefficients. Hence, $\Delta\bar{Y}$ can be rewritten as the mean difference between equation 1 and 2:

$$\bar{Y}_{2013} - \bar{Y}_{2003} = \bar{X}_{2013}\hat{\beta}_{2013} - \bar{X}_{2003}\hat{\beta}_{2003} \quad \ldots \quad 6$$

This expression can in turn be written as the sum of the following three terms:

$$\Delta\bar{Y} = (\bar{X}_{2013} - \bar{X}_{2003})\hat{\beta}_{2003} + \bar{X}_{2013}(\hat{\beta}_{2013} - \hat{\beta}_{2003}) + (\bar{X}_{2013} - \bar{X}_{2003})(\hat{\beta}_{2013} - \hat{\beta}_{2003}) \ldots 7$$

The first term on the right hand side of equation 7 is the explained part called "Decomposition Effect" or "Endowment term", the second term and the third term are the unexplained part called "Coefficient term" and "interaction term" respectively.

The endowments term represents the contribution of differences in explanatory variables across groups, and the coefficients term is the part that is due to group differences in the coefficients. Finally, the interaction term accounts for the fact that across group differences in explanatory variables and coefficients can occur at the same time.

CHAPTER FOUR

RESULTS

4.1 MALARIA PREVALENCE AND ITN UTILIZATION AMONG CHILDREN UNDER-FIVE

The total record of children under-five available in this study was 5204 in year 2003 and 28634 in year 2013. Figure 1 shows the change in malaria and ITN. Childhood malaria was more prevalent in year 2003 (31.8%) than year 2013 (13.1%). This translates into about 59% decrease in the prevalence of malaria for over a period of ten years. There was a reasonable increase in the ownership of insecticide treated nets (ITN) between the two years (383%). Similarly, utilization of ITN increased by approximately 221% from 7.0% in 2003 to 22.5% in 2013.

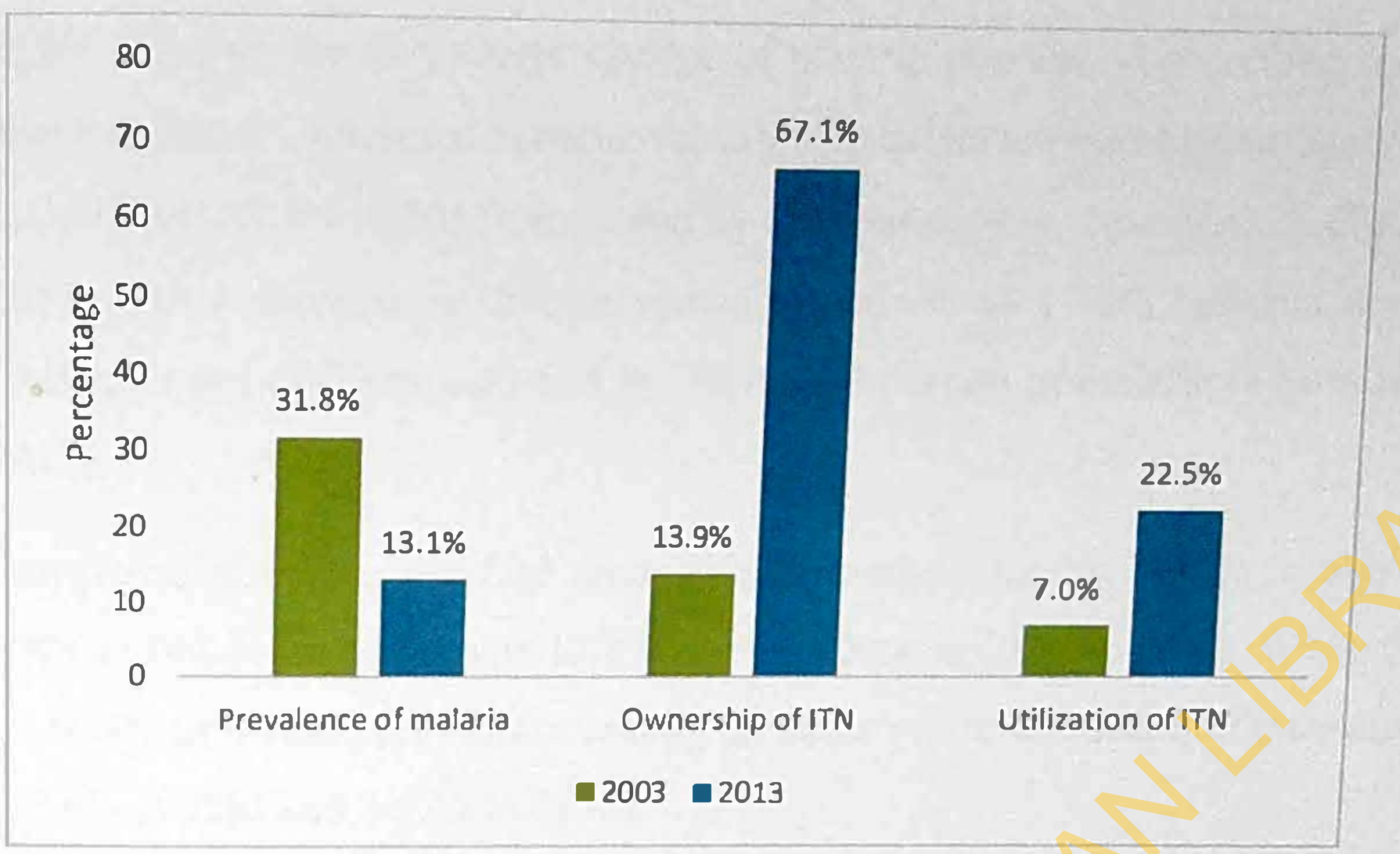

Figure 1: Percentage change in prevalence of malaria and ITN.

4.2 BACKGROUND CHARACTERISTICS OF CHILDREN WITH MALARIA

Table 1 shows the percentage change of malaria prevalence according to selected background characteristics. Childhood malaria was more prevalent among children aged 12-23 months (25.5% in 2003 and 28.4% in 2013), followed by children aged 0-11months (25.6% in 2003 and 21.5% in 2013) with a decrease in the prevalence of malaria by 17.2% between the period of ten years. Children aged 48-59 months had the lowest proportion of malaria (11.6% in 2003 and 13.2% in 2013).

Prevalence of malaria was high among children whose mother had no formal education (53.2% in 2003 and 46.4% in 2013) with 12.8% decrease between the two years. While there was an increase of 36.9% of malaria prevalence among children whose mothers had secondary/higher education (23.6% in 2003 and 32.3% in 2013).

Malaria was most prevalent among children in rural area (68.2% in 2003 and 68.2% in 2013) with no change in malaria between the two years. About one-quarter (25.2% in 2003 and 24.2% in 2013) of children in the poorest wealth quintile had malaria compared to their counterparts in the richest wealth quintile (13.0% in 2003 and 12.2% in 2013) which yielded a 6.2% decrease in malaria prevalence.

Table 1: Percentage change of malaria prevalence according to selected background characteristics

Factors	Malaria in 2003 (%)	Malaria in 2013 (%)	Percentage Change
Child's Age (Months)			
0-11	411 (25.6)	783 (21.2)	-17.2
12-23	409 (25.5)	1049 (28.4)	11.4
24-35	330 (20.6)	748 (20.3)	-1.5
36-47	267 (16.7)	622 (16.9)	1.2
48-59	186 (11.6)	489 (13.2)	13.8
Child's Sex			
Male	818 (51.0)	1902 (51.5)	1.0
Female	785 (49.0)	1789 (48.5)	-1.0
Maternal Education			
No Education	852 (53.2)	1711 (46.4)	-12.8
Primary	373 (23.3)	786 (21.3)	-8.6
Secondary/ Higher	378 (23.6)	1194 (32.3)	36.9
Residence			
Rural	1093 (68.2)	2518 (68.2)	0
Urban	510 (31.8)	1173 (31.8)	0
Wealth Index			
Poorest	404 (25.2)	892 (24.2)	-4.0
Poorer	358 (22.3)	912 (24.7)	10.8
Middle	324 (20.2)	807 (21.9)	8.4
Richer	309 (19.3)	629 (17.0)	-11.9
Richest	208 (13.0)	451 (12.2)	-6.2
Ownership of ITN	243 (15.2)	2593 (70.3)	362.5
Utilization of ITN	114 (7.5)	819 (22.5)	212.5

4.3 LOGISTIC REGRESSION ANALYSIS OF FACTORS INFLUENCING PREVALENCE OF MALARIA IN 2003

A multivariate logistic regression was carried out to explore the factors influencing prevalence of malaria among children under five. Children aged 12-23 months were 39% more likely to have malaria than children aged 0-11 months (OR = 1.39, p < 0.001), while the children in 24-35 months age group were 7.0% at higher risk of having malaria than their counterparts in 0-11 months age group (OR = 1.07 p = 0.445). Children between age 36-47 months were 26% at lower risk of having malaria compared to children between age 0-11 months (OR = 0.74, p = 0.001). Also, children that are between age 48-59 months were 41% (OR = 0.59, p < 0.001) less likely to have malaria compared with children that are 0-11 months old.

Female children were 2.3% at higher risk of having malaria than their male counterparts. Children living in the rural areas were 37% (OR = 1.37, p <0.001) more likely to have malaria than children in the urban areas. Children whose mothers had no formal education were 40% (OR = 1.40, p <0.001) more likely to have malaria than children whose mothers had secondary/higher education, while, children whose mothers had primary education were 14% (OR = 1.14, p = 0.144) at higher risk of having malaria than children whose mothers had secondary/higher education.

Children in the poorest wealth quintile were 17% at higher risk of having malaria than children in the middle wealth quintile (OR =1.17, p = 0.097), while, children in the poorer wealth quintile were 7.0% (OR = 1.07, p =0.493) more likely to have malaria than their counterparts in the middle wealth quintile. Also, children in the richer wealth quintile were 7.0% less likely to have malaria compared to those in the middle wealth quintile (OR = 0.93, p = 0.424), while, children in the richest wealth quintile were 37% (OR = 0.63, p <0.001) at lower risk of having malaria compared with children in the middle wealth quintile.

4.3 LOGISTIC REGRESSION ANALYSIS OF FACTORS INFLUENCING PREVALENCE OF MALARIA IN 2003

A multivariate logistic regression was carried out to explore the factors influencing prevalence of malaria among children under five. Children aged 12-23 months were 39% more likely to have malaria than children aged 0-11 months (OR = 1.39, p < 0.001), while the children in 24-35 months age group were 7.0% at higher risk of having malaria than their counterparts in 0-11 months age group (OR = 1.07 p = 0.445). Children between age 36-47 months were 26% at lower risk of having malaria compared to children between age 0-11 months (OR = 0.74, p = 0.001). Also, children that are between age 48-59 months were 41% (OR = 0.59, p < 0.001) less likely to have malaria compared with children that are 0-11 months old.

Female children were 2.3% at higher risk of having malaria than their male counterparts. Children living in the rural areas were 37% (OR = 1.37, p <0.001) more likely to have malaria than children in the urban areas. Children whose mothers had no formal education were 40% (OR = 1.40, p <0.001) more likely to have malaria than children whose mothers had secondary/higher education, while, children whose mothers had primary education were 14% (OR = 1.14, p = 0.144) at higher risk of having malaria than children whose mothers had secondary/higher education.

Children in the poorest wealth quintile were 17% at higher risk of having malaria than children in the middle wealth quintile (OR =1.17, p = 0.097), while, children in the poorer wealth quintile were 7.0% (OR = 1.07, p =0.493) more likely to have malaria than their counterparts in the middle wealth quintile. Also, children in the richer wealth quintile were 7.0% less likely to have malaria compared to those in the middle wealth quintile (OR = 0.93, p = 0.424), while, children in the richest wealth quintile were 37% (OR = 0.63, p <0.001) at lower risk of having malaria compared with children in the middle wealth quintile.

Table 2: Logistic Regression Analysis of Factors Influencing Prevalence of Malaria in Year 2003.

Factors	OR	95% Conf. Int. Lower	Upper	P-value
Child's Age (Months)				
0-11[c]	1.00			
12-23	1.39	1.1703	1.6523	<0.001*
24-35	1.07	0.8970	1.2807	0.445
36-47	0.74	0.6176	0.8909	0.001*
48-59	0.59	0.4787	0.7160	<0.001*
Child's Sex				
Male[c]	1.00			
Female	1.02	0.9090	1.1522	0.702
Residence				
Urban[c]	1.00			
Rural	1.37	1.2105	1.5556	<0.001*
Maternal Education				
No Education	1.40	1.2099	1.6164	<0.001*
Primary	1.14	0.9576	1.3447	0.144
Secondary/Higher[c]	1.00			
Wealth Index				
Poorest	1.17	0.9727	1.3950	0.097
Poorer	1.07	0.8872	1.2821	0.493
Middle[c]	1.00			
Richer	0.93	0.7666	1.1183	0.424
Richest	0.63	0.5103	0.7678	<0.001*
Ownership of ITN				
No[c]	1.00			
Yes	1.16	0.9817	1.3744	0.081
Utilization of ITN				
No[c]	1.00			
Yes	1.05	0.8314	1.3233	0.687

c=Reference category, *p< 0.05

4.4 LOGISTIC REGRESSION ANALYSIS OF FACTORS INFLUENCING PREVALENCE OF MALARIA IN 2013

Children aged 12-23 months were 53% at higher risk of having malaria than children aged 0-11 months (OR =1.53, p <0.001), while, children aged 24-35 months were 13% more likely to have malaria than children aged 0-11 months (OR = 1.13, p = 0.024). Children aged 36-47 months were 13% (OR = 0.87, p = 0.013) at lower risk of malaria compared to children aged 0-11 months, while, children aged 48-59 months were 30% (OR = 0.70, p <0.001) less likely to have malaria compared to their counterparts aged 0-11 months.

Female children were 6.0% times more likely to have malaria than male children (OR = 1.06, p = 0.116). Children living in the rural areas were 12% (OR = 1.12, p = 0.003) more likely to have malaria than their counterparts living in the urban areas. Children whose mothers had no education were 7.0% at higher risk of having malaria than children whose mothers had secondary/higher education (OR = 1.07, p = 0.089), also, children whose mothers had primary education were 11% (OR = 1.11, p = 0.043) at higher risk of having malaria than children whose mothers had secondary/higher education.

Children in the poorest wealth quintile were 2.0% at higher risk of having malaria than children in the middle wealth quintile (OR = 1.02, p = 0.650), while, children in the poorer wealth quintile were 1.0% (OR = 1.01, p = 0.938) more likely to have malaria than their counterparts in the middle wealth quintile. Also, children in the richer wealth quintile were 19% less likely to have malaria compared to those in the middle wealth quintile (OR = 0.81, p <0.001), while, children in the richest wealth quintile were 35% (OR = 0.65, p <0.001) at lower risk of having malaria compared with children in the middle wealth quintile.

Table 3: Logistic Regression Analysis of Factors Influencing Prevalence of Malaria in year 2013.

Factors	OR	95% Conf. Int. Lower	Upper	P-value
Child's Age (Months)				
0-11[c]	1.00			
12-23	1.53	1.3807	1.6878	<0.001*
24-35	1.13	1.0160	1.2601	0.024*
36-47	0.87	0.7756	0.9705	0.013*
48-59	0.70	0.6195	0.7867	<0.001*
Child's Sex				
Male[c]	1.00			
Female	1.06	0.9863	1.1328	0.116
Residence				
Urban[c]	1.00			
Rural	1.12	1.0375	1.2033	0.003*
Maternal Education				
No Education	1.07	0.9895	1.1592	0.089
Primary	1.11	1.0031	1.2169	0.043*
Secondary/Higher[c]	1.00			
Wealth Index				
Poorest	1.02	0.9240	1.1350	0.650
Poorer	1.01	0.9064	1.1121	0.938
Middle[c]	1.00			
Richer	0.81	0.7246	0.9060	<0.001*
Richest	0.65	0.5737	0.7328	<0.001*
Ownership of ITN				
No[c]	1.00			
Yes	1.19	1.1002	1.2795	<0.001*
Utilization of ITN				
No[c]	1.00			
Yes	0.99	0.9193	1.0862	0.986

c=Reference category, *p< 0.05.

4.5 OVERALL DECOMPOSITION MODEL OF MALARIA PREVALENCE AMONG CHILDREN UNDER-FIVE.

To investigate the contribution of selected factors in explaining the difference in the prevalence of malaria between year 2003 and 2013, Oaxaca Blinder decomposition analysis was used. The change in malaria prevalence was decomposed into three parts; the first part is known as the decomposition effect which is due to differences in the distribution of the determinants between year 2003 and 2013. The second part is the coefficient effect which is the part due to differences in the coefficients of these determinants between the groups, and the third part is the interaction effect which is the interaction between decomposition effect and coefficient effect.

The overall decomposition model showed that prevalence of malaria was 0.3188 ($p < 0.001$) in year 2003 and 0.1309 ($p < 0.001$) in year 2013 with a difference of 0.1879 ($p < 0.001$) .Figure 2 shows the difference of each determinant (decomposition effect) between year 2003 and 2013 which accounted for 4.7% of the observed reduction in malaria ($p < 0.001$) and the change in impact of each determinant (coefficient) of malaria accounted for approximately 95.3% of the decrease in malaria for the period of ten years. While the interaction effect was marginal and insignificant.

Table 4: Overall Decomposition Model Results of Malaria Prevalence among Children Under-Five between 2003 and 2013 in Nigeria.

	Coefficient	Stand. Error	95% Conf. Int.		P-value
			Lower	Upper	
2003 Survey	0.3188	0.006605	0.3058	0.3317	<0.001*
2013 Survey	0.1309	0.002022	0.1269	0.1348	<0.001*
Difference	**0.1878**	**0.006908**	0.1743	0. 2014	**<0.001***
Determinants	0.0098	0.002318	-0.0143	-0.0052	<0.001*
Coefficients	0.1991	0.013055	0.1735	0 .2247	<0.001*
Interaction	-0.0014	0.011311	-0.0236	0.0206	0.896

*p< 0.05.

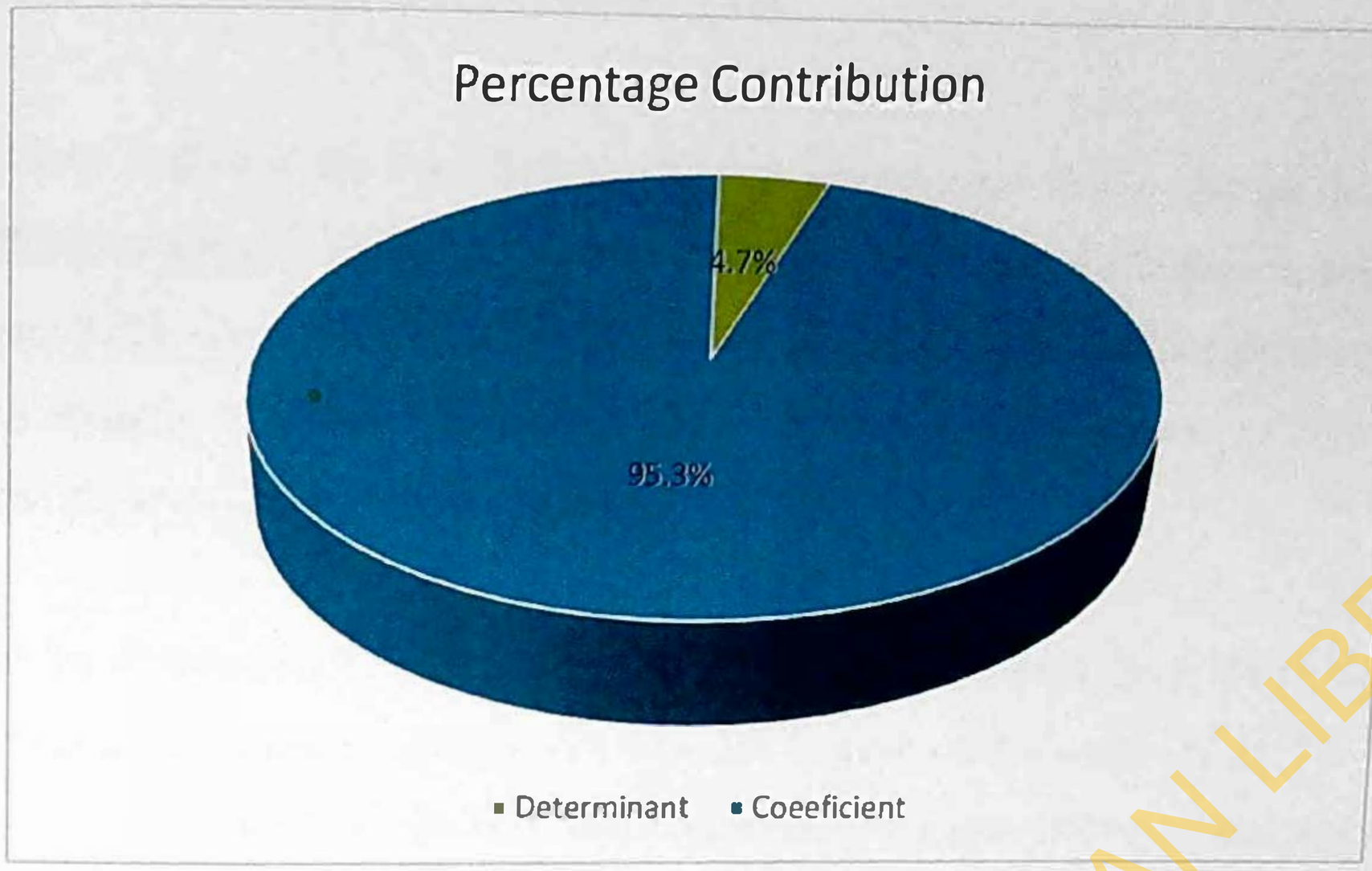

Figure 2: Percentage contribution of determinants and coefficients to the decline in malaria prevalence.

4.6 CONTRIBUTION OF EACH DETERMINANTS TO MALARIA PREVALENCE AMONG CHILDREN UNDER-FIVE.

Table 5 shows the contribution of each determinant to the change in malaria over time. The Positive percentages show a positive contribution to the difference in malaria between year 2003 and 2013. Ownership of ITN was the largest factor explaining the difference in malaria prevalence of about 92% between the two years ($p < 0.001$). Also, utilization of ITN accounted for 13.3% of the observed reduction in malaria ($p = 0.045$).

In the observed reduction in malaria, child's age accounted for 9.7% ($p < 0.001$) to the change in malaria prevalence. Child's sex has the lowest contribution of 0.1%. Residence contributed approximately 4% to the observed reduction in the prevalence of malaria between the two years ($p = 0.013$). Maternal primary education contributed 5.9% to the difference in malaria ($p = 0.004$), while, maternal secondary/higher education contributed -14.0% ($p < 0.001$) to the observed difference in malaria between the two years.

Wealth index accounted for -10.7% of the difference in malaria with children in the poorer wealth quintile contributing 1.2%, while, children in the middle wealth quintile contributed 0.7%, children in the richer wealth quintile contributed -4.3% and children in the richest wealth quintile contributed -8.3% ($p = 0.043$) to the observed reduction in the prevalence of malaria between the two years.

4.6 CONTRIBUTION OF EACH DETERMINANTS TO MALARIA PREVALENCE AMONG CHILDREN UNDER-FIVE.

Table 5 shows the contribution of each determinant to the change in malaria over time. The Positive percentages show a positive contribution to the difference in malaria between year 2003 and 2013. Ownership of ITN was the largest factor explaining the difference in malaria prevalence of about 92% between the two years ($p < 0.001$). Also, utilization of ITN accounted for 13.3% of the observed reduction in malaria ($p = 0.045$).

In the observed reduction in malaria, child's age accounted for 9.7% ($p < 0.001$) to the change in malaria prevalence. Child's sex has the lowest contribution of 0.1%. Residence contributed approximately 4% to the observed reduction in the prevalence of malaria between the two years ($p = 0.013$). Maternal primary education contributed 5.9% to the difference in malaria ($p = 0.004$), while, maternal secondary/higher education contributed -14.0% ($p < 0.001$) to the observed difference in malaria between the two years.

Wealth index accounted for -10.7% of the difference in malaria with children in the poorer wealth quintile contributing 1.2%, while, children in the middle wealth quintile contributed 0.7%, children in the richer wealth quintile contributed -4.3% and children in the richest wealth quintile contributed -8.3% ($p = 0.043$) to the observed reduction in the prevalence of malaria between the two years.

Table 5: Contribution of each determinants of malaria prevalence among children under-five between 2003 and 2013 in Nigeria.

Factors	Coefficient	Stand. Error	95% Conf. Int.		P-value	%
			Lower	Upper		Contribution
Child's Age	0.00114	0.00029	0.0005	0.0017	<0.001*	9.7
Child's Sex						
Male[c]						
Female	0.00001	0.0001	-0.0001	0.0001	0.789	0.1
Residence						
Urban[c]						
Rural	0.0005	0.00019	0.0001	0.0008	0.013*	4.0
Maternal Education						
None[c]						
Primary	0.0007	0.00024	0.0002	0.0012	0.004*	5.9
Secondary/Higher	-0.0016	0.00040	-0.0024	-0.0008	<0.001*	-14.0
Wealth Index						
Poorest[c]						
Poorer	0.00014	0.00012	-0.0001	0.0004	0.218	1.2
Middle	0.00008	0.00011	-0.0001	0 .0003	0.457	0.7
Richer	-0.0005	0.00031	-0.0011	0.0001	0.099	-4.3
Richest	-0.0001	0.00048	-0.0019	-0.0001	0.043*	-8.3
Ownership of ITN						
No[c]						
Yes	0.0107	0.00242	-0.0155	-0.0059	<0.001*	91.7
Utilization of ITN						
No[c]						
Yes	0.0016	0.000775	0.00003	0.0031	0.045*	13.3
Total	0.01168					100

c=Reference category, *p< 0.05.

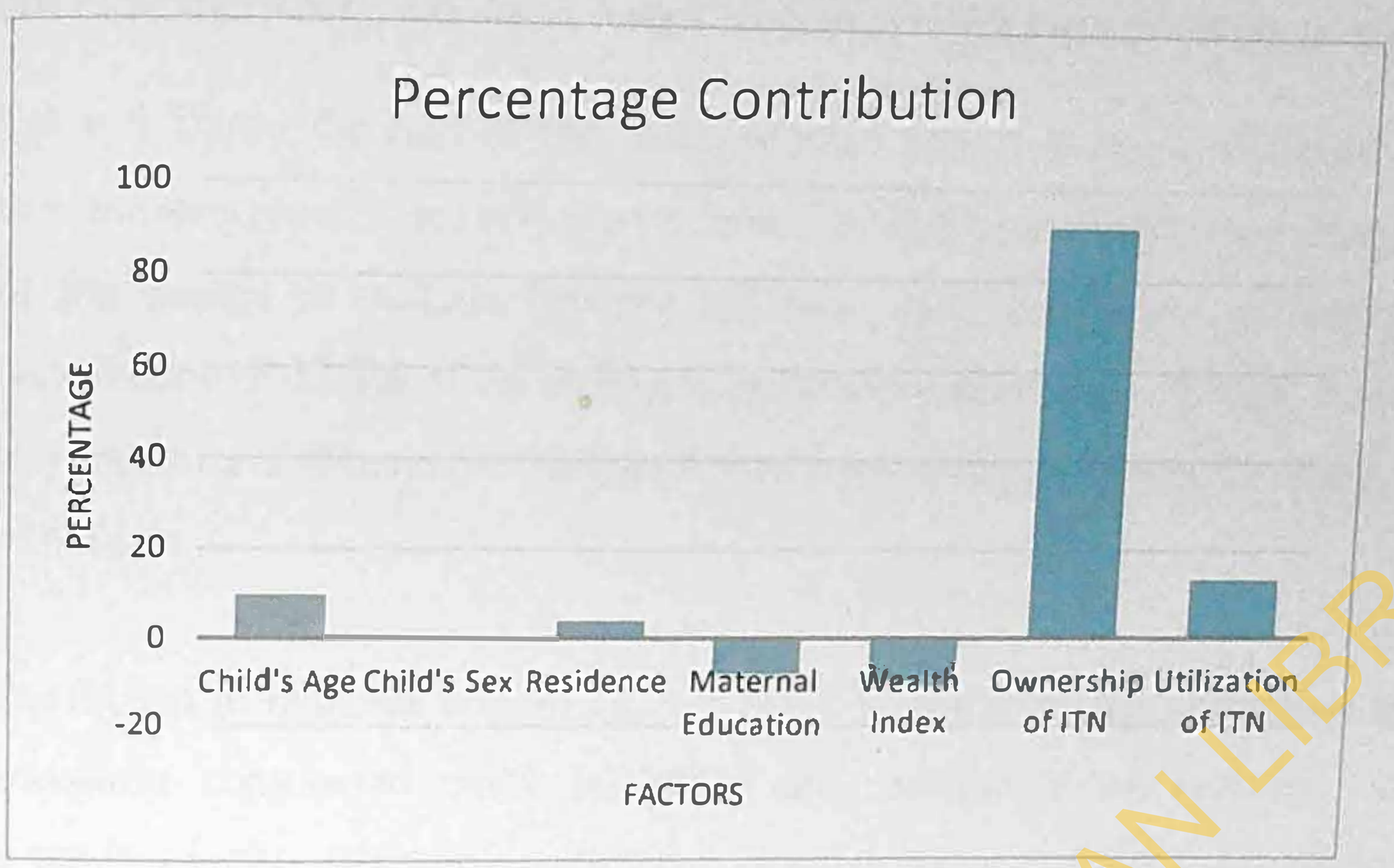

Figure 3: Percentage contribution of each determinant to malaria prevalence.

4.7 CONTRIBUTION OF DIFFERENCES IN THE EFFECT OF THE DETERMINANTS OF MALARIA AMONG CHILDREN UNDER- FIVE.

Table 6 shows the part of the decomposition that is due to differences in the effect of each determinants (coefficient effect) over time. The Change in coefficients effects accounted for 95.9% of the change in malaria between the two years. Coefficient of residence had the highest contribution of 15.7% of the change in malaria prevalence ($p = 0.002$). Coefficient of child's age accounted for 5.8% and coefficient of child's sex accounted for 0.9% of the change in prevalence of malaria.

Coefficient of maternal education contributed 15.5% with children whose mothers had primary education contributed 5.4% ($p=0.001$) and coefficient of children whose mothers had secondary/higher education contributed about 10% ($p < 0.001$). Coefficient of wealth index accounted for approximately 10% of the difference in malaria in which the richer category contributed about half (5.2%) of this contribution ($p =0.009$) and the richest contributing approximately 4% to the change in the prevalence of malaria. Coefficient of ownership of ITN contributed 1.4% to the change in malaria prevalence, also, the coefficient of utilization of ITN contributed 1.7% to the change in the prevalence of malaria between the two years.

Table 6: Contribution of Differences in the Effect of the Determinants of Malaria among Children under- Five between 2003 and 2013 in Nigeria.

Factors	Coefficients	Stand. Error	95% Conf. Int.		P-value	%
			Lower	Upper		Contribution
Child's Age	-0.0115	0.0081	-0.0273	0.0044	0.158	-5.8
Child's Sex						
Male[c]						
Female	0.00182	0.0059	-0.0097	0.0134	0.758	0.9
Residence						
Urban[c]						
Rural	0.03118	0.0099	0.0116	0.0507	0.002*	15.7
Maternal Education						
None[c]						
Primary	-0.0107	0.0032	-0.0169	-0.0045	0.001*	-5.4
Secondary/Higher	-0.0202	0.0058	-0.0315	-0.0089	<0.001*	-10.1
Wealth Index						
Poorest[c]						
Poorer	0.00021	0.0040	-0.0076	0.0081	0.959	0.1
Middle	0.00184	0.0038	-0.0056	0.0092	0.626	0.9
Richer	0.01029	0.0039	0.0025	0.0180	0.009*	5.2
Richest	0.00786	0.0042	-0.0004	0.0162	0.063	3.9
Ownership of ITN						
No[c]						
Yes	-0.00271	0.0140	-0.0302	0.0248	0.847	-1.4
Utilization of ITN						
No[c]						
Yes	-0.0035	0.0063	-0.0158	0.0089	0.582	-1.7
Constant	0.19449	0.0222	0.1510	0.2379	<0.001*	97.7
Total	0.19912					100

c=Reference category. *p <0.05

CHAPTER FIVE

DISCUSSION

5.1 CHANGES IN MALARIA PREVALENCE AND ITS DETERMINANTS

Our findings revealed that malaria prevalence has declined in the last ten years. This decline is not surprising, going by the huge resources and interventions put forward by the RBM, NMEP (national malaria eradication programme). Several studies have documented reduction in the prevalence of malaria in African countries (WHO, 2009; Chizema et al., 2010; Mmbando et al., 2010). In a study in Senegal, there was a decrease of 32% of malaria between 1996 and 2010 (Brasseur et al., 2011). Also, in Malawi, the proportion of malaria cases decreased by 50% from 2001 to 2005 (Roca-Feltrer, 2012). A study reported that malaria reduced by almost 85% in two communities in Tanzania (Meyrowitsch et al., 2011).

Though this study revealed a decline in the prevalence of malaria, but malaria is still high in Nigeria. This agree with studies in Nigeria which reported similar prevalence of malaria (Salako et al., 2008). A study in the northern part of Nigeria revealed a prevalence of 56.9% of malaria among under-five children in 2008 (Ikeh and Teclaire, 2008). Also, a study in North-western Nigeria documented a prevalence of 11.7% among under five children in a general hospital (Umaru and Uyaiabasi, 2015).

In this study, malaria prevalence was similar for both males and females which is in line with the findings of other studies (Peterson et al., 2009; Baragatti et al., 2009; Danielle et al., 2016). However, this contradict a study in North-western Nigeria reported that males had a higher prevalence of malaria (Umaru and Uyaiabasi, 2015).

The findings also revealed that place of residence was associated with malaria, whereby, the prevalence of malaria was higher in rural areas than the urban areas. This is consistent with study conducted by Liu et al. (2000). Also, a study in south east Nigeria (Uzochukwu 2008) documented that mothers living in the urban areas were more aware of malaria prevention than mothers in the rural areas which results in high prevalence of malaria in rural areas than urban.

In this study, children whose mother had no formal education had a higher prevalence of the disease which may be associated to the fact that children were more likely to have received prompt and effective treatment if their mothers had at least a secondary education. A study documented that mothers that are educated may be open to advances in public health and medicine, more aware of malaria symptoms and related health risks (Cleland and Van, 1998). Also, studies have shown that there is a correlation between maternal education and children health (Desai and Alva, 1998) as mothers who are educated tend to be more knowledgeable about health problems and how to deal with them. Likewise, another study reported that the more educated a mother is, the less likely for the child to have malaria and this may be due to the fact that an educated mother will understand information on malaria better and are more likely to implement the preventive measures they have been taught (Chitunhu and Musenge, 2012).

Wealth index was associated with the prevalence of malaria in this study; malaria was higher among the children from households in the lowest wealth quintile. This is in line with what other studies have reported pertaining to wealth index and malaria morbidity (Sachs and Malaney 2002). Several studies have documented that malaria is a disease of the poor and inadequate health care facilities as well as poor economic status will increase vulnerability of the population to malaria (Snow et al., 2003; Akazili et al., 2008; Chitunhu et al., 2012). Health status has been linked to economic status of an individual (Stratton et al., 2008).

The proportion of households possessing mosquito net(s) and the proportion of children less than five years of age who slept under a net are two of the key RBM bed net ownership indicators used to investigate the strength and weaknesses of monitoring malaria control (RBM, 2005). Utilization of ITN is one of the most effective interventions of malaria (Lengeler, 2000).

Ownership of ITN has increased in several countries. (Dagne et al., 2008; Kolaczinski et al., 2010).This study revealed that a large proportion of respondents and households owned ITN. This concurs with the findings from Uganda (Pullan et al., 2010) that also had high proportion of ownership of ITN and is in line with studies by Okebe et al. (2014) and Danielle et al., (2016). However, ITN coverage in this study fell short of the global target of 80% set in a 2005 World Health Assembly resolution (WHO, 2005) and by the RBM.

This study showed that despite high ownership of ITN in Nigeria, its utilization remain low and this is not associated with prevalence of malaria in the logistic regression analysis. The lack of

association could be due to an inconsistent or inappropriate use of ITN or maybe before a child slept under the ITN, the child has been exposed to mosquito bites. A study in Kenya reported high possession of ITN with low usage (Atieli et al., 2011) and a study in South west Nigeria also reported that ownership of ITN was high but proportion of sleeping under it was low (Aderibigbe et al., 2014). Another studies also documented that ownership of ITN does not imply its utilization (Hassan et al., 2008; Fetenne et al., 2009). This study contradict the results found in several studies which reported that there was evidence of an association between utilization of ITN and malaria prevalence (Wotodjo et al., 2015).

5.2 DECOMPOSITION OF PREVALENCE OF MALARIA

In this study, Oaxaca blinder decomposition analysis was used to explain the changes in the prevalence of malaria in 2003 to 2013. This methods allows explaining the proportion of the changes attributable to the changes in determinants, and also the part attributed to changes in the effect of the determinants between the groups (Uthman, 2009; Kumar, 2013).

The results of the decomposition shows that there is a decline in the prevalence of malaria that is the prevalence of malaria is significantly lower among children under five in 2013 than in 2003 in Nigeria. This was similar to several studies which reported decline in the prevalence of malaria (Mmbando et al., 2010; Brasseur et al., 2011). The results also showed that the changes in the prevalence of malaria is mainly due to changes in the effect of the determinants.

The analysis revealed that the key factors that determined the prevalence of malaria are the ownership of ITN and the utilization of ITN. This was in agreement with some studies which stated that there was evidence of an association between utilization of ITN and malaria prevalence (Wotodjo et al., 2015). Undoubtedly, these variables have remained important factors to consider in implementing policies to reduce prevalence of malaria in developing countries like Nigeria.

association could be due to an inconsistent or inappropriate use of ITN or maybe before a child slept under the ITN, the child has been exposed to mosquito bites. A study in Kenya reported high possession of ITN with low usage (Atieli et al., 2011) and a study in South west Nigeria also reported that ownership of ITN was high but proportion of sleeping under it was low (Aderibigbe et al., 2014). Another studies also documented that ownership of ITN does not imply its utilization (Hassan et al., 2008; Fetenne et al., 2009). This study contradict the results found in several studies which reported that there was evidence of an association between utilization of ITN and malaria prevalence (Wotodjo et al., 2015).

5.2 DECOMPOSITION OF PREVALENCE OF MALARIA

In this study, Oaxaca blinder decomposition analysis was used to explain the changes in the prevalence of malaria in 2003 to 2013. This methods allows explaining the proportion of the changes attributable to the changes in determinants, and also the part attributed to changes in the effect of the determinants between the groups (Uthman, 2009; Kumar, 2013).

The results of the decomposition shows that there is a decline in the prevalence of malaria that is the prevalence of malaria is significantly lower among children under five in 2013 than in 2003 in Nigeria. This was similar to several studies which reported decline in the prevalence of malaria (Mmbando et al., 2010; Brasseur et al., 2011). The results also showed that the changes in the prevalence of malaria is mainly due to changes in the effect of the determinants.

The analysis revealed that the key factors that determined the prevalence of malaria are the ownership of ITN and the utilization of ITN. This was in agreement with some studies which stated that there was evidence of an association between utilization of ITN and malaria prevalence (Wotodjo et al., 2015). Undoubtedly, these variables have remained important factors to consider in implementing policies to reduce prevalence of malaria in developing countries like Nigeria.

5.3 LIMITATIONS

In this study, there was a limitation of the choice of reference category in Oaxaca blinder decomposition analysis where results pertaining to categorical variables in the model was sensitive to which category is selected as the omitted or base category, this affect the ratio of the determinant to the component of the differences (the determinant has a lower contribution to the coefficients).

5.4 CONCLUSION

This study decomposed prevalence of malaria in Nigeria. The results of this study revealed a decline in the prevalence of malaria. Ownership of ITN and its utilization were the most contributing factors to the observed decline in the prevalence of malaria among children under five in Nigeria.

5.5 RECOMMENDATIONS

Health policy makers should make rural areas as targets for malaria intervention and control programmes. Mother's level of education should be enhance. More efforts should be made in promoting ITN and its utilization should therefore continue. Oaxaca blinder decomposition should be applied when researchers want to know the contribution of each factor to an outcome variable.

REFERENCES

AbdulMusa, Adewara, S.O. and Oloni, E., 2015. Determinants of access to safe toilet facilities and its rural-urban disparity in Nigeria. *Ilorin Journal of Economic Policy*, 1(1).

Adebayo, A.M., Akinyemi, O.O., Cadmus, E.O., 2015. Knowledge of malaria prevention among pregnant women and female caregivers of under-five children in rural southwest Nigeria. *Peer J.*

Aderibigbe, S.A., Olatona, F.A., Sogunro, O. et al., 2014. Ownership and utilization of long lasting insecticide treated nets following free distribution campaign in South West Nigeria: A systematic review. *Journal of Tropical Medicine*, 819563.

Agomo, C.O., Oyibo, W.A., Anorlu, R.I.,et al., 2009. Prevalence of Malaria in Pregnant Women in Lagos South west Nigeria. *Kor Journal Parasitol.* doi:10.3347/kjp.2009.47.2.179., 47:179–83.

Akazili, J., Aikins, M. and Binka, F.N., 2008. Malaria treatment in Northern Ghana: what is the treatment cost per case to households? *Africa Journal Health Science* (14):70–79.

Akinleye, S.O., Ajayi, I.O., 2011. Knowledge of malaria and preventive measures among pregnant women attending antenatal clinics in a rural local government area in Southwestern Nigeria. *World HealthPopulation*; 12.

Akinleye, S.O., Falade, C.O. and Ajayi, I.O., 2009. Knowledge and utilization of intermittent preventive treatment for malaria among pregnant women attending antenatal clinics in primary health care centers in rural southwest, Nigeria: a cross-sectional study. *BMC Pregnancy Childbirth*; 9(28).

Atieli, H.E., Zhou, G., Afrane Y. et al., 2011. Insecticide-treated net (ITN) ownership, usage and malaria transmission in the highlands of western Kenya. *Parasites & Vectors*; 4 (113).

Azizi, M. H. and Bahadori, M., 2013. Brief historical perspectives of malaria in Iran; 16(2), 131 135.

Basurko, C., Demattei, C., Han-Sze R.et al., 2013. Deforestation, agriculture and farm jobs: a good recipe for Plasmodium vivax in French Guiana, *Malaria Journal*: 12(90).

Bauer, T.K. and Sinning, M., 2008. An extension of the Blinder-Oaxaca decomposition to nonlinear models. Advances in Statistical Analysis; 92,197–206.

Bishai, D.M., Cohen R., Alfonso Y.N., 2016. Factors contributing to child mortality reductions in 142 low and middle-income countries between 1990 and 2010. *PLoS ONE* 11(1).

Brasseur, P., Badiane, M., Cisse, M. et al., 2011. Changing patterns of malaria during 1996–2010 in an area of moderate transmission in southern Senegal. *Malar J*, 10:203.

Caraballo, H. 2014. "Emergency department management of mosquito-borne illness: malaria, dengue, and west Nile virus". *Emergency Medicine Practice*, 16 (5).

Cavatorta, E., Shankar, B. and Flores-Martinez, A., 2015. Explaining Cross-State Disparities in Child Nutrition in Rural India. *World Development*; 76, 216-237.

CDC- The History of Malaria, an Ancient Disease. http://www.cdc.gov/malaria/about/history.

Chitunhu, S., Musenge, E., 2012. Direct and indirect determinants of childhood malaria morbidity in Malawi: a survey cross-sectional analysis based on malaria indicator survey data for 2012 *Malaria Journal* 2015 14:265 DOI: 10.1186/s12936-015-0777-1.

Chizema, K.E., Miller, J.M., Steketee, R.W. et al., 2010. Scaling up malaria control in Zambia: progress and impact 2005-2008. *Am J Trop Med Hyg.* 2010, 83: 480-488. 10.4269/ajtmh.2010.10-0035.

Cleland, J.G. and Van- Ginneken, J.K., 1998. Maternal education and child survival in developing countries: the search for pathways of influence. *SocSci Med*; 27:1357–68.

Cunningham, C.: Health of indigenous peoples. BMJ. 2010, 340: c1840.

Dagne, G. and Deressa, W., 2008. Knowledge and utilization of insecticide treated mosquito nets among freely supplied households in Wonago Woreda, Southern Ethiopia. *Ethiopia Journal Heal Dev.*; 2(1):34-41.

Das, M.B., Hall, G., Kapoor, S. et al., 2012. India: the scheduled tribes. Indigenous Peoples, Poverty and Development. Edited by: Hall GH, Patrinos HA., Cambridge University Press.

De Silva, P.M. and Marshall, J.M., 2012. Factors contributing to urban malaria transmission in sub-Sahara.

De, A.M., Lois, V.R., Tiendrebeogo, J. et al., 2013. Moving towards universal. doi: 10.1186/1478 75475-6.

Denise, P.M., Marielle K.B., Eric, K. et al. 2013. Increase in malaria prevalence and age of at risk population in different areas of Gabon. *Malaria Journal*, 12:3.

Desai, S., Alva, S., 1998. Maternal education and child health: is there a strong causal relationship? *Demography*; 35(1).

Drissa, S., Yentema O., Arijit N. et al., 2014. What lies behind gender inequalities in HIV/AIDS in sub-Saharan African countries: evidence from Kenya, Lesotho and Tanzania. *Health Policy Plan*. 2014) 29 (7): 938-949.

Dutton, D.J. and McLaren L., 2011. Explained and unexplained regional variation in Canadian obesity prevalence. *Obesity*; 19:1460–1468.

Edelu, B.O., Ikefuna, A.N., Emodi, J.I. et al. 2010. Awareness and use of insecticide-treated bed nets among children attending outpatient clinic at UNTH, Enugu-the need for an effective mobilization process. *Afr Health Sci*. 10(2): 117-119.

Ezire, O., Adebayo, S.B., Idogho O. et al., 2015. Determinants of use of insecticide-treated nets among pregnant women in Nigeria. *International J Women Health. 26; 7:655-661.*

Fernando, D., Wickremasinghe, R., Mendis, K.N., et al., 2003. Cognitive performance at school entry of children living in malaria-endemic areas of SriLanka. *Transactions of the Royal Society of Tropical Medicine and Hygiene*; 97(2):161–165.

Fettene, M., Balkew, M., Gimblet, C., 2009. Utilization, retention and bio-efficacy studies of Permanent in selected villages in Buie and Fentalie districts of Ethiopia. *Malar J*. 2009; (1):114.

FMOH, 2005. Federal Ministry of Health. National Antimalarial Treatment Policy. National malaria and Vector Control Division, Abuja, Nigeria.

Hassan, S.E., Malik, E.M., Okoued, S.I., et al., 2008. Retention and efficacy of long-lasting insecticide-treated nets distributed in eastern Sudan: a two-step community-based study. *Malar J.*; 7(1):85.

Hosseinpoor, A.R., Stewart, W.J., Amin, A., et al., 2012. Social Determinants of Self-Reported Health in Women and Men: Understanding the Role of Gender in Population Health. *PLoS ONE* 7(4).

Ikeh, E.I., Teclaire, N.N., 2008. Prevalence of malaria parasitaemia and associated factors in febrile under 5 children seen in PHC centers in Jos, North Central Nigeria. *Niger Postgrd Med J* 2008, 15:65-69.

Jimoh, A., Sofola, O., Petu A., et al., 2007. Quantifying the Economic Burden of Malaria. *International Journal of Health Planning and Management*, 2013, Jan; 28(1): 102–21.

Jombo, G.T., Mbaawuaga, E.M., Ayegba, A.S., et al., 2010. How far we rolled back malaria on the African continent nine years down? The burden of malaria among pregnant women in a semi-urban community of northern Nigeria. *J Med Sci.* 1:235–41.

Jurges, H. and Berlin, D.I., 2010. Discussion papers 68. Berlin: German Institute for Economic Research; True health vs response styles: exploring cross-country differences in self-reported health.

Katz, I.K., Low-Beer, R.D., Atun, R., 2011. Scaling up towards international targets for AIDS, tuberculosis, and malaria: contribution of global fund-supported programs in 2011–2015. *PLoS One*. 6: 1-7.

Le Cook, B., McGuire, T.G., Zuvekas, S.H., 2009. Measuring trends in racial/ethnic health care disparities. *Med Care Res Rev*; 66:23–48.

Lengeler, C., 2000. Insecticide-treated bednets and curtains for preventing malaria. *Cochrane Database Syst Rev.*;2.

Lhila, A., Long, S., 2012. What is driving the black-white difference in low birthweight in the US? *Health Econ*; 21:301–315.

Liu, J., Bousema, T., Zelman, B., et al., 2000. Is housing quality associated with malaria incidence among young children and mosquito vector numbers? Evidence from Korogwe, Tanzania. *PLoS ONE*; 9:e87358.

Madden D., 2008. HEDG working paper 08/08. York: University of York; Gender differences in mental well-being: a decomposition analysis. *Malaria Journal*. 2013; 12: 133.

Malaney, P., Sielman, A., and Sachs, J. 2004. The malaria gap. *The American Journal of Tropical Medicine and Hygiene*; 71(2): 141–146.

Messina J.P., Taylor S.M., Meshnick S.R et al., 2011: Population, behavioural and environmental drivers of malaria prevalence in the Democratic Republic of Congo. *Malaria Journal*. 10: 161.

Meyrowitsch, D.W., Erling, M.P., Michael A. et al., 2011. Is the current decline in malaria burden in sub-Saharan Africa due to a decrease in vector population? *Malaria Journal* 2011 10:188.

Miller, G.E. and Sarpong, E.M., 2011. Trends in the Pharmaceutical Treatment of Children's Asthma, 1997 to 2008. Research Findings No. 31. *Agency for Healthcare Research and Quality*, Rockville, MD.

Millicent, L.U. and Gabriel N., 2015. Prevalence of Malaria in Patients Attending the General Hospital Makarfi Kaduna – State, North Western Nigeria. *American Journal of Infectious Diseases and Microbiology*; 3(1):1-5.

Mmbando, B.P., Vestergaard, L.S., Kitua, A.Y. et al., 2010. A progressive declining in the burden of malaria in north-eastern Tanzania. *Malar J.* 2010, 9: 216-10.1186/1475-2875 9-216.

Njau, J.D., Stephenson, R., Menon, M.P. et al., 2014. Investigating the important correlates of maternal education and childhood malaria infections. *Am J Trop Med Hyg*;91(3):509 19.

Nyarko, S.H., Cobblah, A., 2014. "Sociodemographic Determinants of Malaria among Under-Five Children in Ghana," *Malaria Research and Treatment*, vol. 2014, Article ID 304361, 6 pages, 2014.

O'Donnell, O., Van Doorslaer, E., Wagstaff, A., 2008. A guide to techniques and their implementation. Washington, DC: The World Bank; analyzing health equity using household survey data.

Okebe, J., Mwesigwa, J., Kama, E.L., et al., 2014. A comparative case control study of the determinants of clinical malaria in the Gambia. *Malar J.*; 13:306.

Okeibunor, J.C., Orji, B.C., Brieger, W., 2011. Preventing malaria in pregnancy through community directed interventions: evidence from Akwa Ibom state, Nigeria. *Malar J*; 10:227-10.1186/1475-2875-10-227.

Okeibunor, J. C., Onyeneho, N. G., and Okonofua, F. E., 2010. Policy and programs for reducing maternal mortality in Enugu.

Okpere, E.E., Enabudoso, E.J., Osemwenkha, A.P., 2010. Malaria in pregnancy. *Niger Med J*;51:109-13.

Olusegun, O. L., Thomas, R., and Micheal, I. M. (2012). Curbing maternal and child mortality The Nigerian experience; doi:10.5897/IJNM11.030. 4: 33–39.

Onoka, A.C., Hansom, K., Onwujekwe OE., 2012. Low coverage of IPTp in Nigeria: demand side influence.

Onwujekwe, O., Soremekun, R., Uzochukwu, B., et al., 2012. Patterns of case management and chemoprevention for malaria-in-pregnancy by public and private sector health providers in Enugu state, Nigeria. *BMC Res Notes*. 10.1186/1756-0500-5-211./ 5: 211.

Oaxaca, R.L., Blinder, 1973. Male-Female Wage Differentials in Urban Labor Markets. *International Economic Review:* vol. 14, issue 3, pages 693-709.

Pulford, J., Hetzel, M.W., Bryant, M., et al., 2011. Reported reasons for not using a mosquito net when one is available: a review of the published literature. *Malar J.*, 10: 10 10.1186/1475-2875-10-10.

Pullan, R.L., Bikirwa, H., Staedke, S.G., et al., 2010. Plasmodium infection and its risk factors in eastern Uganda. *Malar J.*; 9(1):2.

RBM: The Global Strategic Plan Roll Back Malaria 2005-2015. Geneva, Switzerland: Roll Back Malaria Partnership Secretariat; 2005.

Roca-Feltrer, A., Kwizombe, C.J., Sanjoaquin, M.A., 2012. Lack of decline in childhood malaria, Malawi, 2001–2010. Emerg Infect Dis 2012, 18:272.

Rodríguez, A.D., Penilla, R.P., Rodríguez, M.H., et al., 2006. Acceptability and perceived side effects of insecticide indoor residual spraying under different resistance management strategies. *SaludPublica Mex*;48:317-324.

Sachs, J., Malaney, P., 2002. The economic and social burden of malaria. Nature 415:680–685.

Salako, L.A., Brieger, W.R., Afolabi, B.M., et al., 2008. Treatment of childhood fevers and other illnesses in three rural Nigerian communities. *J Trop Paed*; 47:230-238.

Samuel, H.N. and Anastasia, C., 2014. Sociodemographic Determinants of Malaria among Under Five Children in Ghana. *Malaria Research and Treatment*, Article ID 304361, 6 .

Simangaliso, C., and Eustasius, M., Direct and indirect determinants of childhood malaria morbidity in Malawi: a survey cross-sectional analysis based on malaria indicator survey data for 2012. *Malaria Journal*, 201514:265.

Snow, R.W., Craig, M.H., Newton, C., et al., 2003. The public health burden of Plasmodium falciparum malaria in Africa. Working Paper 11. Disease Control Priorities Project, Fogarty International Center, National Institutes of Health, Bethesda.

Somi, M.F., Butler, J.R., Vahid F., et al., 2007. Is there evidence for dual causation between malaria and socioeconomic status? Findings from rural Tanzania. *The American Journal of Tropical Medicine and Hygiene;* 77(6):1020–1027.

Stratton, L., O'Neill, M.S., Kruk, M.E. et al., 2008. The persistent problem of malaria: Addressing the fundamental causes of a global killer. *SocSci Med*; 67:854–862.

Tanner, M. and Savigny, D., 2015. Malaria Eradication Back on the Table. Bulletin of WHO; 86(2); World Malaria Report 2015.

Tusting, L.S., Willey, B., Lucas H., et al., 2013. Socioeconomic development as an intervention against malaria: a systematic review and meta-analysis,' *Lancet*.

Udonwa, N., Gyuse, A., Etokidem, A., Malaria, 2010. Knowlegde and prevention practices among school adolescents in a coastal community in Calabar, Nigeria. *Afr J Primary Health Care Fam Med.*; 2: 103 106.

Umaru, M.L. and Uyaiabasi, G.N. "Prevalence of Malaria in Patients Attending the General Hospital Makarfi, Makarfi Kaduna – State, North Western Nigeria." *American Journal of Infectious Diseases and Microbiology*, vol. 3, no. 1 (2015): 1-5.

Uthman O.A., 2009. Decomposing socio-economic inequality in childhood malnutrition in Nigeria. *Maternal andChild Nutrition*; 5(4):358-367.

Uzochukwu, B.S., Onwujekwe, E.O., Onoka, C.A., et al., 2008 "Rural-urban differences in maternal responses to childhood fever in South East Nigeria." *PLoS ONE*; 3(3).

WHO: Malaria_resolution_2005.

WHO: World Malaria Report, 2010. Geneva, Switzerland: World Health Organization; .

WHO: World malaria report 2011. Geneva: World Health Organization.

World Health Organization: WHO World Malaria Report. 2012, Geneva, Switzerland.

WHO. March 2014. Retrieved 28 August 2014.

WHO, World Malaria Report 2015, CDC, Malaria, webpage, www.cdc.gov/malaria/;8(2).

Worrall, E.S., Basu, X.X., Hanson, K., 2003. The relationship between socio-economic status and malaria: a review of the literature, in Proceedings of the Conference on Ensuring That Malaria Control Interventions Reach the Poor, London, UK.

Wotodjo, A., Diagne, N., Gaudart, J., et al., 2015. Malaria risk factors in Dielmo, a Senegalese malaria-endemic village, between October and November of 2013: a case-control study. *Am J Trop Med Hyg;* 92:565-8.

APPENDIX

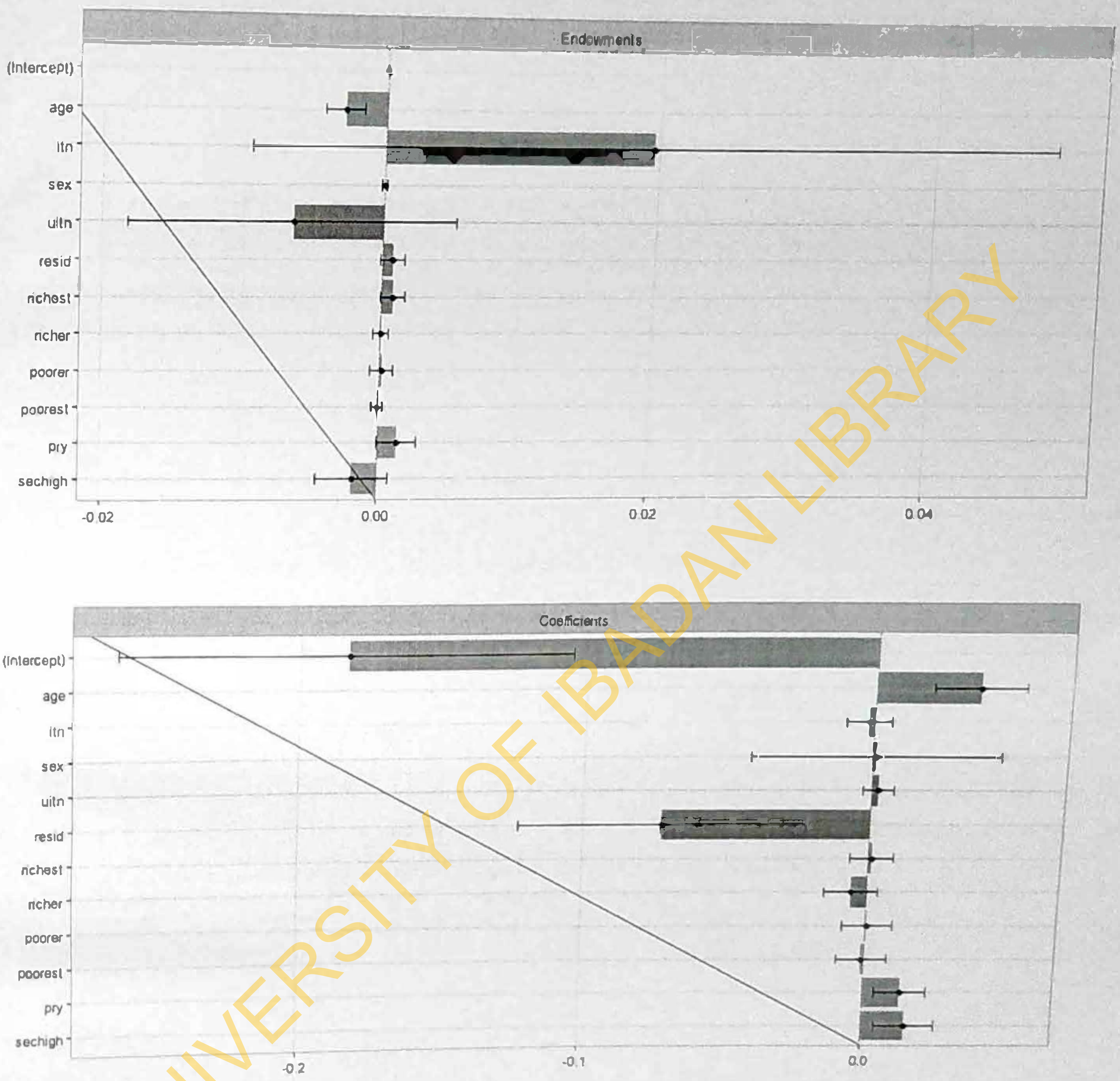

Figure 4: Determinants and coefficients components of a threefold Oaxaca blinder decomposition.