DECOMPOSITION OF CHANGES IN UNDER-FIVE MORTALITY IN NIGERIA GEO-POLITICAL REGIONS

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ABSTRACT

Background: Despite global decline in childhood mortality, public literature still indicates that child health outcomes are generally poor in Sub-Saharan Africa. India and Nigeria account for more than a third of all under-five mortality. The progress in lowering child mortality has been paralleled by progress in various determinants of health such as poverty reduction, improved health technologies, and quality education. There are gaps in evidence that capture if the decline in child mortality has been due to increase in absolute levels of factors or due to changes in impact of existing levels of health determinant. This study applies Oaxaca-Blinder decomposition to changes in childhood mortality levels in Nigeria to identify the relative contributions of the two components.

Methods: Data on 31482 and 6029 under-five children in the birth history from NDHS 2013 and 2003 respectively were analyzed. The study adopted two methodologies. The first method involves the estimation of under-five mortality rate by using the life-table technique. The second method uses the Oaxaca-Blinder decomposition method to decompose changes in under-five mortality between 2003 and 2013 to determine how much of change can be attributed to impact of determinants of under-five mortality rate and how much is attributable to improved levels of the determinants. The Oaxaca-Blinder decomposition method which is a technique used to study mean outcome differences between two groups and to compare the effects of different contributing characteristics was applied.

Result: The under-five mortality rate decline from 191.2 per thousand live births to 118 per thousand live births in Nigeria. Across the region, the South South (51.4%) recorded the highest decline in under-five mortality between 2003 and 2013 and the South East (23.2%) experienced the least. There had been slight changes in the level of key determinants of under-five mortality between 2003 and 2013. Only the use of insecticides treated bed net shows a drastic improvement (14.4% in 2003 and 67.3% in 2013). Overall effect of change in factor level over time indicate that the demographic variable that contributes most to under-five mortality is birth interval less than 24months (-0.00019), followed by behavioural and health related factor skilled delivery (-0.000032). Environmental factor-improved toilet facility (-0.00094) and the socio-economic factor is mothers with primary education (-0.000037).

Conclusion: The slight change experienced in under-five mortality rate in Nigeria had been due to improvement in birth interval and maternal age at birth.

Keywords: Under-five mortality changes, Geo-political regions, Decomposition, Nigeria

Word count: 400

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To my husband-my father, my guardian, I say thank you for your affectionate love and support.

To my parents, and siblings- thanks for your love and care in all ways.

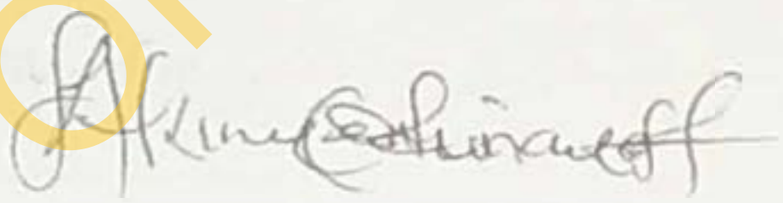
Thank you all and God bless.

DEDICATION

To child survival in Nigeria

CERTIFICATION

I certify that this work titled "Decomposition of Changes in Under-Five Mortality in Nigeria geo-political regions" was carried out by Adelakun, Funmilayo Aminat in the Department of Epidemiology and Medical Statistics, Faculty of Public Health, University of Ibadan under my supervision.



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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Infant and child mortality data are important not only for demographic assessment but also for design and evaluation of health programmes and policies. Childhood mortality measures are sensitive indicators of population health and well being because they reflect a combined effect of individual, household, community and environmental factors (Mosley and Chen, 1984).

Infant mortality is the risk of dying during the first year of life, measured as infant mortality rate and denoted by ${}_0q_1$, child mortality is defined as the risk of dying between ages twelve and fifty-nine months which is denoted by ${}_4q_1$, while under-five mortality rate (U5MR) is defined as the risk of dying between birth and the fifth birthday and it is denoted by ${}_5q_0$.

There have been considerable gains in child survival in the world over the past ten years and recent report have it that infant mortality rate has decreased from an estimated rate of 100 deaths per 1000 live births in 1999 to 34 deaths per 1000 live births in 2013. Some countries like North Africa, Eastern Europe, South-east Asia, and Latin America have reduced under-five mortality by half between 1990 and 2010. Childhood mortality has been declining in most developing countries from the mid-1980s and throughout the 1990s. However, this decline has recently slowed, stopped, or reversed itself in some countries of sub-Saharan Africa (Rutstein, S.O 2000).

Despite global decline in childhood mortality, public health literature indicates that the highest rates of child mortality are still in sub-Saharan Africa and they are ranked as the top worst performers in reduction of child mortality with an under-five mortality rate of 92 deaths per 1000 live birth (Child Mortality Report, 2013). Few countries like Ethiopia, Malawi, and Namibia are making progress and majority experiencing no change like Democratic Republic of the Congo while some like Chad had sadly

experienced an increase from 201 death per 1000 in 1999 to 209 death per 1000 in 2009 (Rutherford, et al. 2010).

It is unacceptable that every day about 17,000 children still die before their fifth birthday, mostly from preventable causes and treatable diseases, even though the knowledge and technologies for lifesaving interventions are available (UNICEF, 2014). Infant and child mortality are 100 and 201 deaths per 1000 live births respectively (NDHS, 2003) while 69 and 128 deaths per 1000 live births respectively (NDHS, 2013). Although, it has shown decline in child mortality in Nigeria, the figures are still very high compared with most developed nations.

About half of under-five deaths occur in only five countries: India, Nigeria, Pakistan, Democratic Republic of the Congo and China. India and Nigeria account for more than a third of all under-five deaths with 21% and 13% deaths respectively. The effect of neighbourhood context on child survival has also been recognised in a number of countries in sub-Saharan Africa (Omariba, et al. 2007). It is a known fact that there are regional differential in childhood mortality levels in Nigeria and there is substantial geographic variation in the patterns of under-five mortality in the country where South-west Nigeria has 89 deaths per 1000 live births and the North-east having 222 deaths per 1000 live births (Adedini, 2013). A number of reasons have been given for this enormous regional disparity. Antai (2011) study on inequality in under-five mortality in Nigeria also found that under-five death is highest among Hausa/Fulani/Kanuri tribes in the Northern Nigeria because of poor access to good quality health care as well as shortage of skilled birth attendants.

Nigeria like many other nations in sub-Saharan Africa is not on track to achieve the Millennium Development Goal 4 which is to reduce under-five mortality by two-thirds between 1990 and 2015.

This research assesses how much of the progress in child health has been due to increased levels of known determinants of child health and how much had been due to changes in the impact of the determinants. Using Oaxaca-Blinder decomposition method, the magnitude of the observed improvement was decomposed using the dataset of Nigeria Demographic and Health Survey of 2003 and 2013. The Oaxaca-Blinder decomposition

allows for an analysis which simultaneously considers several possible drivers of the change observed over time.

1.2 Statement of the Problem

Children in sub-Saharan Africa countries are more than 15 times more likely to die before the age of five than children in developed countries (World Health Organization, Report). Among 20 sub-Saharan African countries that have conducted Demographic and Health Surveys since 2005, 18 countries showed improvements in infant survival. The Millennium Development Goal for child mortality calls for a reduction of two-thirds over 25 years period 1990-2015, which implies an annual rate of decline of 4.4% and only 12 of the 20 countries have rates of decline that exceed this rate. About one-third of all countries in Africa have a decline of 30% in under-five mortality, while a number of countries sadly show a considerable increase (Becher, 2010). Empirical evidence from past studies also shows that regional disparities exist in child mortality and there has been minimal improvement in child health especially in Northern Nigeria (Adedini, 2013). Many research papers have been committed to measuring progress which is not correlated with the absolute level of under-five mortality burden. Instead, countries and geographical regions with similar wealth and under-five mortality levels had being showing wide differences in child health progress over the years since they have different policies. The progress in child survival with the associated factors in the regions had not been previously investigated and there are gaps in evidence on the effect of the key determinants of decline in under-five mortality.

1.3 Justification of the Study

Progress in child survival urgently requires greater attention in order to reduce preventable child deaths. Death during infancy and early childhood period are tragedies for individuals and families. There are evidence based factors that shows the relative contributions of the identified factors to the decline in under-five mortality which include; Socio-economic status (maternal education), Behavioural and Health Related Factors (Antenatal care utilization, skilled delivery, tetanus toxoide injection during pregnancy, child immunization, use of insecticide treated net), Environmental factors (source of drinking water, toilet facility, urban residence) and Bio-demographic factors (Twin birth,

child sex, birth interval, maternal age) as identified by Akinyemi et al.(2013). The progress in lowering child mortality has been paralleled by progress in various determinants of health such as poverty reduction, improved health technologies, and quality education. However, there are two possible explanations (Bishai, et al. 2014) for the decline in child mortality:

- The increased impact of existing levels of health determinants
- The improvements in the absolute levels of health determinants.

Hence, this study applies Oaxaca-Blinder decomposition to changes in childhood mortality levels in Nigeria to identify the relative contribution of the two factors mentioned.

1.4 Objectives

1.4.1 Main Objectives

To assess the contribution of changes in the levels of determinants to the changes in the childhood levels

1.4.2 Specific Objectives

1. To determine changes in under-five mortality between 2003 and 2013 across geo-political regions in Nigeria
2. To determine changes in the levels of key determinants of childhood mortality between 2003 and 2013
3. To determine the effect of change in factor levels of key determinants of childhood mortality
4. To determine effect of change in factors' impact over time

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of Mortality

The study of mortality provides information about the population's state of health, which serves as a measure of living standards in a country. It gives an indication of the social differences that exist within the society and it also provides information on the population's future growth potential. A rapid fall in mortality can result in accelerated growth in the situation of high fertility, unless the declines in mortality are matched by similar declines in fertility. Knowledge about a country's mortality situation is therefore relevant for effective development and planning (Boachie-Yiadom, 2013).

2.2 Global Overview of Mortality

Global estimate of under-five mortality rate is about 90 deaths perl 000 live birth in 1990 and 46 deaths per 1000 live birth in 2013, which had shown a drastic reduction in the global world under-five deaths. Bishai, et al. (2014) carried out a study on factors contributing to mortality reduction in 142 low and middle income countries between 1990 and 2010 and found that factor levels account for more progress in mortality reduction. Subramanian, et al. (2006) also gave evidence that socio-economic effect of mortality is substantial among Indians which had resulted into poor health outcomes among them. About 10 million children under the age of five die annually and half of these deaths occur in just six countries while 42 countries account for 90% of these deaths. Sub-Saharan Africa recorded about 179 deaths per 1000 live birth in 1990 and up to about 92 deaths per 1000 live birth in 2013. About 41% of the global under-five deaths occur in the sub-Saharan Africa and 34% occur in the South Asia. (Black et al, 2003).

Globally, the major killers of children under the age of five are pneumonia, diarrheal diseases, acute respiratory infection, and malaria.

2.2.1 Pneumonia

Pneumonia accounts for 15% of all deaths of children under the age of five. Pneumonia can be prevented by immunization, adequate nutrition and by addressing environmental factors. Pneumonia caused by bacteria can be treated with antibiotics, but only one third

of children with pneumonia receive the antibiotics they need. It has kill an estimated 922 000 children in 2015. Preventing pneumonia in children is an essential component of a strategy to reduce child mortality. Immunization against Hib, pneumococcus, measles and whooping cough (pertussis) is the most effective way to prevent pneumonia.

2.2.2 Diarrheal

Dehydration caused by severe diarrhoea is a major cause or mortality among young children. The World Health Organization (WHO) has estimated that diarrhoea is responsible for more than 3 million deaths of under-five children annually. Death from dehydration is preventable by oral rehydration therapy or increased fluid intake.

2.2.3 Acute Respiratory Infection

Acute Respiratory Infection (ARI) is among the leading cause of mortality throughout the world. WHO estimate that acute respiratory infection accounts for more than 4millon deaths among children under-five. Diagnosis and treatment with antibiotics can prevent deaths caused by acute respiratory infection.

2.2.4 Malaria

Malaria is endemic throughout Nigeria. The Malaria Action Programme for States, MAPS, says that malaria is responsible for the death of more than 300,000 children under age five in Nigeria annually. Fever is a malaria symptom. Malaria and other illnesses that cause fever have contributed to high level of malnutrition and mortality in children (NDHS 2013).

2.3 Overview of Under-five Mortality in Africa

There is a huge variation in infant and child mortality from one country to another in the African continent because various countries are at different stages of economic development.

In a study by (Lutambi et al, 2010), it shows that there arc differences in under-five mortality rate among geo-political regions in Nigeria. In Africa, under-five mortality rates vary significantly from one sub-region to the other. The rates arc as high as 163.2 and 197.6 deaths per 1000 live births in Guinea and Niger republic respectively; and as low as 28.3 deaths per 1000 live birth in Egypt (Macro International Inc, 2011). Lykens et al, (2009) observed that an infant born in a less developed nation is over 13 times more

likely to die before reaching fifth birthday compared to his/her counterparts in the developed world.

Sub-Saharan Africa has the highest risk of death in the first month of life and is among the regions showing the least progress. In 2011, about 72% of all under-five deaths occur within the first year of life. (WHO Report, 2014). As a result, infant and under-five mortality is seen as a major public health issue of concern in Africa as in other developing nation.

2.4 Factors Contributing to Changes in Under-Five Mortality in Nigeria

Most of the factors identified from various studies on childhood mortality in developing countries have followed the Mosley and Chen (1984) framework, which is based on the idea that the factors that affect childhood mortality work through a set of "proximate determinants." The socioeconomic variables act through proximate determinants such as maternal factor, environmental health factors; nutrient deficiency; injury; and household behaviours. Gandotra et al. (1990) latter categorized the underlying factors behind the immediate causes of child deaths into five broad groups: demographic factors; socio-economic factors; environmental factors; sanitation and hygienic factors and medical factors. Mosley and Chen (1984) conceptual framework was used to assess the determinants of child mortality under the broad factors: socio-economic, demographic, biological and environmental factors.

2.4.1 Socio-economic factors

Numerous studies have shown a close association between child mortality and socio-economic status (for example, Preston, 1975 and 1985; Hobcraft et al., 1984; Hill, 1985; World Bank, 2000). Socio-economic status includes residence, region, mother's education, wealth quintile, and work status (Amouzou). Deaths of children are closely related to maternal health. One million children die each year because the mother is died, and the risk of death of children less than five years doubles if the mother dies in childbirth. More than 25,000 children die every day and every minute a woman dies in child birth. Specifically, mother's level of education has been found to be closely associated with improved child survival in Nigeria (Caldwell, 1979). A study on maternal education and child survival in the developing countries by Cleland et al, (1988) also established the importance of maternal education in successful childrearing. (Kravdal,

2004; Uthman et al, 2008), also noted that equitable care work to the advantage of children born to the educated mothers.

A study by Antai, (2011) attributed ethnic differentials to the risk of under-five mortality to disparities in maternal level of education among various ethnic groups in Nigeria. In some parts of sub-Saharan Africa, under-five mortality was seen to be higher among mothers from households with high level of wealth quintile. Early weaning of infants are common in household of high level of wealth quintile and this resulted in infections on infants because their immunity is lower than infants' well breastfed. Studies have shown inconsistency in wealth quintile influencing infant mortality. (Fotso, 2007; Brockerhoff et al, 2000). There is also incontinency in work status of the mother; some studies had reported higher infant mortality among non-working mothers. Uddin et al,(2006) found that working mothers are able to provide basic need for their children. Foster et al. (2011), found in his studies in urban areas in parts of sub-Saharan Africa that working and non-working mothers established no difference in their influence on child mortality. Damodar el al, (2015) also observed that household wealth, birth interval, region and maternal education level are significantly associated with childhood mortality.

2.4.2 Behavioural and Health related factors

The use and knowledge of healthcare services are important behavioural determinants of childhood mortality. Childhood deaths caused by diarrhoea, respiratory diseases and measles can be prevented or cured by use of antibiotics, oral rehydration therapy, and immunization. Health behavioural factors that have been found to be associated with child survival are breastfeeding, immunization, insecticide treated net usage, contraception, and medical treatment of illnesses. These factors are directly related to provision and utilisation of healthcare services. Routine immunisation against vaccine preventable diseases is a key child survival intervention which has received enormous funding in recent years (Akinyemi et al. 2013).

2.4.3 Environmental factors

Environment-related factor that has been found to exhibit pronounced variations in child survival is region and ethnicity. Environmental health risks fall into two broad categories. The first category is the traditional hazards, which is related to poverty and lack of development, such as lack of improved water source, inadequate sanitation and waste

disposal, indoor air pollution, and some vector-borne diseases. The second category is the modern hazards such as urban air pollution and exposure to agro-industrial chemicals and wastes that are caused by development that lacks environmental safeguards. World Bank,(2000). Access to water, sanitation and cooking fuel is a large element of decent and safe housing. It has large direct and indirect impacts on children's health. Many of the pervasive diseases are water-related which account for about 4% of all death. Another environment-related factor that has been found to show pronounced variations in child survival is region (geographical location of residence).The regional differences found in previous studies are due to differences in climate, and household environmental factors such as the cooking fuel used in the household (Kandala et al. 2007). Antai (2011) established that under-five mortality rates were significantly higher in some political regions (especially in the Northern region) compared to the others.

2.4.4 Demographic factors

Demographic factors are strongly associated with the survival chances of young children. Some of these factors include: sex of the child, multiplicity of births, and mother's age at birth, previous birth interval, and size of child at birth. Mortality is higher among children from multiple births (twins, triplets, etc.). Whitworth et al, (2002) study in India found that higher level of maternal education has the benefit of weakening the effect of short birth interval because increased female independence and access to resources tend to remove the competition for resources that often characterize short birth interval. Uthman et al. (2008) also found that multiple birth children in Nigeria were twice as likely to die in infancy. There is a U-shaped relationship between childhood mortality and mother's age at birth. (Akinyemi et al. 2013).

2.5 Oaxaca- Blinder Decomposition Method

The Oaxaca Blinder method is a statistical technique used to compare the effects of different contributing characteristics .The technique is used to study mean outcome differences between groups or to study group differences in an outcome variable. There are two groups A and B, an outcome variable Y, and set of predictors. Oaxaca method is based on two regression models fitted separately for the two population groups.

$$Y_{2003} = \beta X_{2003} + \varepsilon_{2003}$$

$$Y_{2013} = \beta X_{2013} + \varepsilon_{2013}$$

Y is the outcome variable, β is the coefficient including the intercept, X is the explanatory variable, and ε is the error term.

At each value of X, the outcome variable Y is assumed better. The 2013 survey is assumed to have a higher mean of X and the 2003 have a lower mean value of Y than 2013.

The change between the mean outcomes of the two groups

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

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

The first part of the right hand of the above equations is the observable difference in the variables in the two groups (the explained component).

The second part is differences in the variable coefficients in the two groups (the unexplained component).

2.6 Knowledge Gap

In spite of improvement in child health outcome, under-five mortality rates remain unacceptably high in Sub- Saharan African countries (Mesiko and Mojeku, 2012). There are evidence based factors that contribute to decline in under-five mortality which are Regions, Socio-economic status, Behavioural and Health Related Factors, Environmental and Bio-demographic factors (Akinyemi et al, 2013).

However, there are gaps in evidence that capture if the decline in child mortality has been due to increase in absolute levels of factors or due to change in impact of existing levels of health determinant.

Therefore, the Oaxaca Blinder decomposition method had decomposed the under-five mortality to show the relative contribution of various factors that has contributed to decline in under-five mortality.

CHAPTER THREE

METHODOLOGY

3.1 Study Setting

The study is based on a nationally representative sample data for Nigeria. Nigeria lies between latitudes 4°16' and 13°53' north and longitudes 2°40' and 14°41' east in the West African sub-region. It shares borders with Niger in the north, Chad in the northeast, Cameroon in the east, and Benin in the west. To the south, Nigeria is bothered by approximately 850 kilometres of Atlantic Ocean, stretching from Badagry in the west to the Rio del Rey in the east (National Population Commission, 2009). The country is the most populous in Africa and the sixth largest in the world after China, India, USA, Indonesia and Brazil. Nigeria is made up of 36 states, a Federal Capital Territory and grouped into six geo-political regions namely: North West, North East, North Central, South East, South West and South South. Each state is subdivided into local government areas (LGAs) and each LGA is also divided to localities.

3.2 Study Design

This study draws on 2003 and 2013 Nigeria Demographic and Health Survey (NDHS) data. The two surveys adopted similar methodology. The primary sampling unit (PSU) which was regarded as a cluster for both surveys was defined on the basis of Enumeration Areas (EAs). The 2003 NDHS adopted the Enumeration Areas designed for 1991 population census while the 2013 NDHS adopted the Enumeration Areas designed for 2006 population census. The 2003 NDHS was selected using a stratified two-stage cluster design while the 2013 NDHS was selected using a stratified three-stage cluster design. In the 2003 NDHS, a total of 365 clusters were selected; 165 in urban and 200 in rural areas while in the 2013 NDHS, a total of cluster 904 clusters were selected; 372 in urban and 532 in rural areas. A representative sample of 40,680 households was selected for the survey, with a minimum target of 943 completed interviews per state.

3.3 Data Source

The data for this study were extracted from the children recode file of the Nigeria Demographic and Health Survey for 2003 and 2013.

3.4 Study Variables

Dependent/ Outcome Variable: Under-five mortality

Independent/ Explanatory Variable: Various determinants of Child Health

Table 3.4.1 Definition of Explanatory Variables

S/NO	Variable	Definition
1	Birth Interval	Number of months between preceding birth and the birth of current child
2	Maternal Age at Birth	Age of mother at birth of the child
3	Maternal Education	Highest education attainment of the mother
4	Antenatal care	If mother received antenatal care during pregnancy
5	Tetanus toxoide injection in pregnancy	If mother took tetanus toxoide injection during pregnancy
6	Skilled Delivery	The birth attendant who took delivery of the child
7	Childhood Vaccination	If the child had vaccination during childhood
8	Possession of Bed net	If the household possess bed net for sleeping
9	Toilet Facility	Household type of toilet facility
10	Water source	Household source of drinking water

Table 3.4.2 Coding of Variables

S/NO	Variables	Coding
1	Birth Interval	First Birth <=24months >24months
2	Maternal Age at Birth	<20years 20-35years >35years
3	Maternal Education	No Education Primary Secondary/Higher
4	Antenatal care	Yes No
5	Tetanus toxoide injection in pregnancy	Yes No
6	Skilled Delivery	Yes No
7	Childhood Vaccination	Yes No
8	Possession of Bed net	Yes No
9	Toilet Facility	Improved Not Improved
10	Water source	Improved Not Improved

3.5 Direct Method of Estimation

A direct method of estimation can be used in a survey dataset that has a complete fertility history. The direct estimation method gives us more information and allows us to estimate the standard errors for mortality rates.

Using the direct method of estimation, under-five mortality rates was derived from 2003 and 2013 NDHS dataset. This method involves taking the data from the complete fertility history and generating a life table. The Demography and Health Survey uses a century month code (CMC) for its date variables. A CMC is the number of the month since start of the century. The variables used for the direct estimation are

V008: Date of interview (CMC)

B3: Date of birth (CMC)

B7: Age at death (months)

B5: Whether the child is still alive

The age at interview variable is generated for children alive and death using Stata statistical package with the command

gen page = (v008-b3) / 12

The timeyears and surviving time (years) is generated for each child in the survey with the command

gen timeyears=

replace timeyears=page

replace timeyears=b7 / 12 if b5==0

gen dead=(b5==0).

The under-five mortality is computed using a life table produced by using the command ltable. A fixed half-yearly interval width was specified

ltable timeyears dead by v007, int (0.5) gr

The first row is the first six months of life of the child while the second row complete the first year of life of the child and it goes on like that for a complete five years. Out of all the children, some will die while some will be censored or lost (that is) those born within the first six month of life of the interview where not fully exposed to the risk of death. The life table assumes that the first number in the lost column where exposed for just three months instead of six month. The total number of children exposed during the first six months is calculated by subtracting half of those that were lost from the total number of children.

Therefore, the survival rate for the first six months is computed by subtracting the number of deaths from total number of children, divided by total number of children exposed. The survival rate for each of the subsequent half year is also computed in this same way and the cumulative survival column is generated.

The under-five mortality rate is the complement of the cumulative survival function at the end of the complete five years. (O'Donnell et al, 2008a)

3.6 Oaxaca Blinder Decomposition

The Oaxaca Blinder method is a statistical technique used to compare the effects of different contributing characteristics. Oaxaca decomposition analysis has been used to decompose the differences by quantifying the contribution attributable to different factors, the main idea is to explain the distribution of the outcome variable (risk of under-five mortality) by a set of factors that vary systematically with socioeconomic, demographic, environmental, behavioural and health related factors. For example, variations in health may be explained by variations in education, income, and quality of care at health facilities. Even if policy makers had managed to eliminate inequalities in some of these dimensions, inequalities may remain in others. The decomposition methods reveal how far inequalities in health can be explained by inequalities in education rather than inequalities in quality of healthcare. The decomposition is based on regression analysis of the relationships between the health variable of interest and its correlates. The analyses are purely descriptive which reveal the associations that characterize the health inequality (O'Donnell et al, 2008b). This study uses the extension of the Oaxaca's technique that is appropriate for binary models to decompose the differences in child survival into contribution attributable to different factors (Oaxaca, R. 1973). This research

decomposed the progress made in child survival in Nigeria geopolitical region between 2003 and 2013.

Models and Assumptions

There were two groups; A and B which is the 2003 and 2013 NDHS dataset, the outcome variable Y is the risk of under-five mortality and set of predictors.

The technique divides the gap between the mean outcome of under-five mortality into two components; the explained component arises because of differences in the groups' characteristics, that is the gap specific to any one of the X's is attributable to the differences in X's and an unexplained component which is attributed to the different effects of these characteristics in either group, that is the differences in B's. The decomposition shows how much of overall gap or gap specific to anyone of X's is attributable to the differences in the X's (explained component) rather than the differences in B's (unexplained component).

3.6 Data Analysis

Normalized sample weights provided in the DHS data were used for all analyses in order to adjust for non-response and enable generalization of findings to the general population. Weight was computed by dividing the sample weight (V005) by 1000000.

Under-five mortality were compared for 2003 and 2013 NDHS data across the geopolitical regions in Nigeria. Descriptive analysis (frequencies and proportions) of key determinants of childhood mortality was obtained. Oaxaca Blinder decomposition method was used to determine the effect of change in factor levels of key determinants of childhood mortality and also to determine the effect of change in factors' impact over time.

CHAPTER FOUR

RESULTS

4.1 Differentials in Under-Five Mortality Rate in Nigeria between 2003 and 2013

Table 4.1 shows that under-five mortality rate for year 2003 was 191.2 per thousand live births and under-five mortality rate for year 2013 was 118 per thousand live births.

It shows that there was just about 38.3% change in under-five mortality between 2003 and 2013.

TABLE 4.1 **Life table of mortality among under-five children in Nigeria in the years 2003 and 2013**

Year	Interval		Beg. Total	Death	Lost	Survival	Std Error	95% Conf. Int.	
								Lower	Upper
2003									
	0	1	6029	425	616	0.9257	0.0035	0.9186	0.9322
	1	1	4988	134	635	0.8992	0.0041	0.8909	0.9068
	1	2	4219	114	584	0.8731	0.0046	0.8637	0.8818
	2	2	3521	61	431	0.8569	0.0050	0.8469	0.8664
	2	3	3029	69	535	0.8355	0.0055	0.8245	0.8459
	3	3	2425	0	445	0.8355	0.0055	0.8245	0.8459
	3	4	1980	31	588	0.8202	0.0060	0.8080	0.8316
	4	4	1361	0	456	0.8202	0.0060	0.8080	0.8316
	4	5	905	9	513	0.8088	0.0070	0.7945	0.8221
	5	5	383	0	383	0.8088	0.0070	0.7945	0.8221
2013									
	0	1	31482	1629	2989	0.9457	0.0013	0.9431	0.9482
	1	1	26864	398	3246	0.9308	0.0015	0.9278	0.9336
	1	2	23220	356	3319	0.9154	0.0017	0.9121	0.9186
	2	2	19545	149	2515	0.9079	0.0018	0.9044	0.9113
	2	3	16881	251	2931	0.8932	0.0020	0.8892	0.8969
	3	3	13699	0	2453	0.8932	0.0020	0.8892	0.8969
	3	4	11246	90	3194	0.8848	0.0021	0.8806	0.8889
	4	4	7962	0	2475	0.8848	0.0021	0.8806	0.8889
	4	5	5487	13	2868	0.8820	0.0023	0.8775	0.8864
	5	5	2606	0	2606	0.8820	0.0023	0.8775	0.8864

4.2 Life Table of Mortality among under-five children in North Central Nigeria in the years 2003 and 2013

The under-five mortality rate in 2003 in North Central region is 154 per thousand live births while it is 89.3 per thousand live births in 2013.

TABLE 4.2 Life Table of Mortality among Under-Five Children in North Central Nigeria in the years 2003 and 2013

Year	Interval		Beg. Total	Death	Lost	Survival	Std Error	95% Conf. Int.	
								Lower	Upper
2003									
	0	1	1015	67	89	0.9310	0.0081	0.9131	0.9453
	1	1	859	21	117	0.9065	0.0095	0.8860	0.9235
	1	2	721	14	108	0.8875	0.0106	0.8649	0.9066
	2	2	599	7	73	0.8765	0.0112	0.8525	0.8968
	2	3	519	6	81	0.8655	0.0120	0.8401	0.8871
	3	3	432	0	95	0.8655	0.0120	0.8401	0.8871
	3	4	337	4	94	0.8535	0.0132	0.8255	0.8774
	4	4	239	0	77	0.8535	0.0132	0.8255	0.8774
	4	5	162	1	98	0.8460	0.0151	0.8137	0.8731
	5	5	63	0	63	0.8460	0.0151	0.8137	0.8731
2013									
	0	1	4614	219	447	0.9501	0.0033	0.9433	0.9562
	1	1	3948	35	451	0.9412	0.0036	0.9337	0.9478
	1	2	3462	31	496	0.9321	0.0039	0.9240	0.9394
	2	2	2935	11	368	0.9284	0.0040	0.9200	0.9359
	2	3	2556	22	459	0.9196	0.0044	0.9105	0.9278
	3	3	2075	0	383	0.9196	0.0044	0.9105	0.9278
	3	4	1692	7	486	0.9152	0.0047	0.9054	0.9239
	4	4	1199	0	364	0.9152	0.0047	0.9054	0.9239
	4	5	835	3	429	0.9107	0.0053	0.8997	0.9206
	5	5	403	0	403	0.9107	0.0053	0.8997	0.9206

4.3 Life Table of Mortality among under-five children in North East Nigeria in the years 2003 and 2013

The under-five mortality rate in 2003 in North East region is 230.4 per thousand live births while it is 134.9 per thousand live births in 2013.

TABLE 4.3 Life Table of Mortality among Under-five Children in North East Nigeria in the years 2003 and 2013

Year	Interval		Beg. Total	Death	Lost	Survival	Std Error	95% Conf. Int.	
								Lower	Upper
2003									
	0	1	1487	116	143	0.9181	0.0073	0.9025	0.9312
	1	1	1228	36	152	0.8894	0.0085	0.8715	0.9049
	1	2	1040	40	126	0.8529	0.0099	0.8323	0.8712
	2	2	874	24	110	0.8280	0.0108	0.8055	0.8481
	2	3	740	17	136	0.8070	0.0117	0.7829	0.8288
	3	3	587	0	97	0.8070	0.0117	0.7829	0.8288
	3	4	490	12	136	0.7841	0.0131	0.7570	0.8085
	4	4	342	0	122	0.7841	0.0131	0.7570	0.8085
	4	5	220	3	114	0.7696	0.0153	0.7380	0.7980
	5	5	103	0	103	0.7696	0.0153	0.7380	0.7980
2013									
	0	1	6517	344	635	0.9445	0.0029	0.9385	0.9499
	1	1	5538	90	625	0.9282	0.0033	0.9214	0.9345
	1	2	4823	89	626	0.9099	0.0038	0.9022	0.9171
	2	2	4108	39	558	0.9007	0.0040	0.8925	0.9083
	2	3	3511	64	613	0.8827	0.0045	0.8735	0.8912
	3	3	2834	0	488	0.8827	0.0045	0.8735	0.8912
	3	4	2346	31	636	0.8692	0.0051	0.8589	0.8788
	4	4	1679	0	509	0.8692	0.0051	0.8589	0.8788
	4	5	1170	4	614	0.8651	0.0054	0.8541	0.8754
	5	5	552	0	552	0.8651	0.0054	0.8541	0.8754

4.4 Life Table of Mortality among under-five children in North West Nigeria in the years 2003 and 2013

The under-five mortality rate in 2003 in North West region is 228.3 per thousand live births while it is 153.1 per thousand live births in 2013.

TABLE 4.4 Life Table of Mortality among Under-five Children in North West Nigeria in the years 2003 and 2013

Year	Interval		Beg. Total	Death	Lost	Survival	Std Error	95% Conf. Int.	
								Lower	Upper
2003									
	0	1	1821	135	196	0.9216	0.0065	0.9079	0.9334
	1	1	1490	45	180	0.8920	0.0076	0.8761	0.9060
	1	2	1265	39	199	0.8622	0.0087	0.8440	0.8784
	2	2	1027	22	112	0.8426	0.0095	0.8230	0.8603
	2	3	893	35	178	0.8060	0.0109	0.7835	0.8263
	3	3	680	0	97	0.8060	0.0109	0.7835	0.8263
	3	4	583	13	193	0.7844	0.0121	0.7595	0.8071
	4	4	377	0	120	0.7844	0.0121	0.7595	0.8071
	4	5	257	3	145	0.7717	0.0140	0.7428	0.7977
	5	5	109	0	109	0.7717	0.0140	0.7428	0.7977
2013									
	0	1	9906	569	892	0.9399	0.0024	0.9349	0.9445
	1	1	8445	179	1037	0.9186	0.0029	0.9128	0.9240
	1	2	7229	154	1142	0.8974	0.0033	0.8908	0.9036
	2	2	5933	71	638	0.8860	0.0035	0.8790	0.8927
	2	3	5224	130	896	0.8619	0.0040	0.8539	0.8695
	3	3	4198	0	702	0.8619	0.0040	0.8539	0.8695
	3	4	3496	37	1078	0.8511	0.0043	0.8425	0.8594
	4	4	2381	0	717	0.8511	0.0043	0.8425	0.8594
	4	5	1664	6	937	0.8469	0.0046	0.8375	0.8557
	5	5	721	0	721	0.8469	0.0046	0.8375	0.8557

4.5 Life Table of Mortality among under-five children in South East Nigeria in the years 2003 and 2013

The under-five mortality rate in 2003 in South East region is 145.5 per thousand live births while it is 111.7 per thousand live births in 2013.

TABLE 4.5 Life Table of Mortality among Under-five Children in South East Nigeria in the years 2003 and 2013

Year	Interval		Beg. Total	Death	Lost	Survival	Std Error	95% Conf. Int.	
								Lower	Upper
2003									
	0	1	524	37	50	0.9259	0.0117	0.8991	0.9457
	1	1	437	10	55	0.9032	0.0134	0.8732	0.9264
	1	2	372	4	50	0.8928	0.0143	0.8612	0.9176
	2	2	318	3	41	0.8838	0.0150	0.8506	0.9100
	2	3	274	2	51	0.8767	0.0157	0.8421	0.9042
	3	3	221	0	46	0.8767	0.0157	0.8421	0.9042
	3	4	175	1	56	0.8707	0.0167	0.8339	0.8999
	4	4	118	0	43	0.8707	0.0167	0.8339	0.8999
	4	5	75	1	43	0.8545	0.0230	0.8025	0.8936
	5	5	31	0	31	0.8545	0.0230	0.8025	0.8936
2013									
	0	1	2816	162	269	0.9396	0.0046	0.9299	0.9480
	1	1	2385	45	310	0.9206	0.0053	0.9096	0.9304
	1	2	2030	31	296	0.9055	0.0059	0.8933	0.9163
	2	2	1703	11	261	0.8991	0.0061	0.8864	0.9105
	2	3	1431	11	249	0.8916	0.0065	0.8781	0.9036
	3	3	1171	0	239	0.8916	0.0065	0.8781	0.9036
	3	4	932	3	243	0.8883	0.0067	0.8743	0.9008
	4	4	686	0	223	0.8883	0.0067	0.8743	0.9008
	4	5	463	0	224	0.8883	0.0067	0.8743	0.9008
	5	5	239	0	239	0.8883	0.0067	0.8743	0.9008

4.6 Life Table of Mortality among under-five children in South South Nigeria in the years 2003 and 2013

The under-five mortality rate in 2003 in South South region is 166.5 per thousand live births while it is 81 per thousand live births in 2013.

TABLE 4.6 Life Table of Mortality among Under-five Children in South South Nigeria in the years 2003 and 2013

Year	Interval		Beg. Total	Death	Lost	Survival	Std Error	95% Conf. Int.	
								Lower	Upper
2003									
	0	1	560	41	58	0.9228	0.0116	0.8966	0.9426
	1	1	461	14	57	0.8929	0.0137	0.8627	0.9168
	1	2	390	13	47	0.8612	0.0158	0.8270	0.8892
	2	2	330	2	45	0.8556	0.0162	0.8206	0.8843
	2	3	283	5	49	0.8391	0.0175	0.8014	0.8702
	3	3	229	0	56	0.8391	0.0175	0.8014	0.8702
	3	4	173	1	45	0.8335	0.0182	0.7942	0.8659
	4	4	127	0	41	0.8335	0.0182	0.7942	0.8659
	4	5	86	0	52	0.8335	0.0182	0.7942	0.8659
	5	5	34	0	34	0.8335	0.0182	0.7942	0.8659
2013									
	0	1	3747	154	365	0.9568	0.0034	0.9496	0.9630
	1	1	3228	32	397	0.9467	0.0038	0.9387	0.9537
	1	2	2799	34	408	0.9343	0.0043	0.9253	0.9422
	2	2	2357	9	327	0.9305	0.0045	0.9211	0.9387
	2	3	2021	15	335	0.9229	0.0048	0.9128	0.9319
	3	3	1671	0	318	0.9229	0.0048	0.9128	0.9319
	3	4	1353	5	378	0.9190	0.0051	0.9083	0.9285
	4	4	970	0	310	0.9190	0.0051	0.9083	0.9285
	4	5	660	0	322	0.9190	0.0051	0.9083	0.9285
	5	5	338	0	338	0.9190	0.0051	0.9083	0.9285

4.7 Life Table of Mortality among under-five children in South West Nigeria in the years 2003 and 2013

The under-five mortality rate in 2003 in South West region is 107.4 per thousand live births while it is 73 per thousand live births in 2013.

TABLE 4.7 Life Table of Mortality among Under-five Children in South West Nigeria in the years 2003 and 2013

Year	Interval		Beg. Total	Death	Lost	Survival	Std Error	95% Conf. Int.	
								Lower	Upper
2003									
	0	1	622	29	80	0.9502	0.0090	0.9291	0.9651
	1	1	513	8	74	0.9342	0.0105	0.9102	0.9519
	1	2	431	4	54	0.9250	0.0114	0.8992	0.9443
	2	2	373	3	50	0.9170	0.0122	0.8896	0.9378
	2	3	320	4	40	0.9048	0.0134	0.8747	0.9279
	3	3	276	0	54	0.9048	0.0134	0.8747	0.9279
	3	4	222	0	64	0.9048	0.0134	0.8747	0.9279
	4	4	158	0	53	0.9048	0.0134	0.8747	0.9279
	4	5	105	1	61	0.8926	0.0179	0.8516	0.9228
	5	5	43	0	43	0.8926	0.0179	0.8516	0.9228
2013									
	0	1	3882	181	381	0.9510	0.0036	0.9435	0.9575
	1	1	3320	17	426	0.9458	0.0038	0.9379	0.9527
	1	2	2877	17	351	0.9398	0.0040	0.9315	0.9472
	2	2	2509	8	363	0.9366	0.0041	0.9279	0.9442
	2	3	2138	9	379	0.9323	0.0044	0.9232	0.9403
	3	3	1750	0	323	0.9323	0.0044	0.9232	0.9403
	3	4	1427	7	373	0.9270	0.0048	0.9170	0.9358
	4	4	1047	0	352	0.9270	0.0048	0.9170	0.9358
	4	5	695	0	342	0.9270	0.0048	0.9170	0.9358
	5	5	353	0	353	0.9270	0.0048	0.9170	0.9358

4.8 Under-Five Mortality Rates (per thousand) in the Six Geopolitical Regions in Nigeria in 2003 and 2013.

Table 4.8 shows that the South South region shows the highest decrease in under-five mortality between 2003 and 2013. Under-five mortality rate decreased by 42% in the North Central region, followed by 41.4% in North East. North West decreased by 32.9% and South West by 32.0% while South East experienced the lowest decrease of 23.2%.

Table 4.8 Under-Five Mortality Rates (per thousand) in the Six Geo-political Regions in Nigeria in 2003 and 2013.

Regions	2003 (per thousand live birth)	2013 (per thousand live birth)	Percentage change in U5M
North Central	154	89.3	-42.0
North East	230.4	134.9	-41.4
North West	228.3	153.1	-32.9
South East	145.5	111.7	-23.2
South South	166.5	81	-51.4
South West	107.4	73	-32.0

4.9 Frequencies and percentage change in selected determinants of under-five mortality in Nigeria (2003 and 2013 NDHS)

The total number of under-five children in 2003 NDHS is 6029 and 31482 in 2013 NDHS dataset. Table 4.16 shows the background characteristics of the children. Over half of birth occurred at least 24months after the previous birth. The proportion of births with preceding birth interval less than 24months reduced by 0.9% between 2003 and 2013. Approximately half (50.3% in 2003, 46.9% in 2013) of mothers had no education which translates to about 7% reduction in mothers with no education and about 29.2% increase in mothers who had secondary or higher education. There was a reduction (2.4%) antenatal care between 2003 and 2013. Almost half (45.0%) of mothers did not take tetanus toxoide injection in pregnancy in 2003 but there was about 10.7% increase in 2013. In both surveys, high proportions (62.3% in 2003 and 61.3% in 2013) of deliveries were not assisted by skilled personnel (doctors, nurses and midwives) and for a period of 10years, there was just about 2.7% increase in skilled delivery assistance. A large percentage (85.6%) of children did not possessed insecticide treated net in 2003 but a drastic reduction (61.8%) change occurred, about 67.3% household now have access to insecticide treated net in 2013. Household access to improved toilet facility reduced from 71.2% in 2003 to 48.2% in 2013 which implies a reduction of 32.3% for a period of 10years. Access to improved source of water increased from 27.5% in 2003 to an average of 57.9% in 2013.

TABLE 4.9 Frequencies and percentage change in selected determinants of Under-five mortality in Nigeria (2003 and 2013 NDHS).

Factors	2003 Frequency	2003 Percentages (%)	2013 Frequency	2013 Percentages (%)	Percentage change
Birth Interval					
First Birth	1206	20.0	6181	19.6	-2
<=24months	1288	21.4	6668	21.2	-0.9
>24months	3535	58.6	22168	59.1	0.9
Maternal Age at Birth					
<20years	385	6.4	1531	4.9	-23.4
20-35years	4557	75.6	23916	76.0	0.5
>35years	1087	18.0	6035	19.2	6.0
Maternal Education					
No Education	3033	50.3	14762	46.9	-6.8
Primary	1473	24.4	6432	20.4	-16.4
Secondary/Higher	1523	25.3	10288	32.7	29.2
Antenatal care					
Yes	1264	33.6	6602	32.8	-2.4
No	2498	66.4	16029	67.2	1.2
Tetanus toxoide injection in pregnancy					
Yes	2029	55.0	12168	60.9	10.7
No	1663	45.0	7811	39.1	-13.1
Skilled Delivery					
Yes	2247	37.7	12030	38.7	2.7
No	3710	62.3	19027	61.3	-1.6
Childhood Vaccination					
Yes	2923	69.2	15110	71.3	3.0
No	1299	30.8	6071	28.7	-6.8
Possession of Bed net					
Yes	869	14.4	21189	67.3	367.4
No	5159	85.6	10280	32.7	-61.8
Toilet Facility					
Improved	4291	71.2	15170	48.2	-32.3
Not Improved	1738	28.8	16312	51.8	79.9
Water source					
Improved	1660	27.5	18225	57.9	110.5
Not Improved	4369	72.5	13257	42.1	-41.9

4.10 Estimates of Impact of under-five mortality factors in 2003 and 2013

From table 4.10, there is an increase (118%) in birth interval less than 24months and 35.2% are greater than 24months. There is also an increase (79.1%) of those that received tetanus toxoide injection in pregnancy. Skilled delivery increases by 75.5% and toilet facility improved by 68.8%. Antenatal care reduces by 72.7%. Maternal age at birth of those between 20-35years reduces by 252.4% and those greater than 35years reduces by724%. Mothers with primary education reduces by 105.5% and those with secondary/higher reduces by 393.5%. Improved water source reduces by 205.9% .The use of insecticide treated bed net increased by 92.3%.

Table 4.10 **Estimates of Impact of under-five mortality factors in 2003 and 2013.**

VARIABLES	Regression Coefficients for U5MR		Change 2003-2013	Percentage Change (%)
	2003	2013		
Birth interval				
≤24months	-0.3584	0.0644	0.4227	118
>24months	-0.6606	-0.4280	0.2326	35.2
TT injection	-0.6321	-0.1320	0.5000	79.1
Skilled delivery	-0.2191	-0.5371	-0.3180	75.5
Toilet facility	-0.2869	-0.0894	0.1975	68.8
Maternal age at birth				
20-35years	0.1761	-0.2685	-0.4446	-252.4
>35years	0.8042	0.2220	-0.5822	-72.4
Maternal education				
Primary	0.5146	-0.028	0.5429	-105.5
Sec/higher	0.1306	-0.3834	0.5140	-393.5
Water source	-0.0176	-0.0539	-0.0363	-205.9
Antenatal care	0.0099	0.0027	-0.007	-72.7
ITN usage	-0.0466	-0.0036	0.0430	92.3

4.11 Oaxaca Blinder Decomposition of Under-five Mortality in Nigeria

For the decomposition part as shown in table 4.11, the first panel report the mean value of mortality for each 2003 and 2013 and it shows the difference between them. The mean of log of mortality was 0.8321 and 0.058 in 2003 and 2013 respectively which yielded a difference of 0.026.

In the second panel of the decomposition output, the change in mortality rate is divided into three parts. It shows component attributable to the gaps in endowments, coefficient and interaction. The first term (endowment) reflects the mean change in 2013 mortality rate if they had the same characteristics as those in 2003. The second term (coefficient) quantifies the change in 2013 mortality when applying the 2003 coefficients to the 2013 characteristics. The change in coefficients accounts for the great bulk of the change in under-five mortality.

The third term (interaction) measures the simultaneous effect of the differences in the endowment (explained part) and coefficient.

Table 4.11 Oaxaca Blinder Decomposition of Under-five Mortality in Nigeria

Dead	Coefficient	Standard Error	Z	P > |z|	95% Confidence Interval
2003 Survey	0.8321	0.00602	13.83	0.000	0.0714, 0.0950
2013 Survey	0.0577	0.00171	33.63	0.000	0.0543, 0.0610
Difference	**0.0256**	**0.00625**	**4.08**	**0.000**	**0.0133, 0.0378**
Endowments	0.0049	0.00278	1.77	0.077	-0.0005, 0.0103
Coefficients	0.0204	0.01168	1.75	0.081	-0.0025, 0.0433
Interaction	0.0002	0.01049	0.02	0.982	-0.0203, 0.0208
EXPLAINED					
Birth Interval					
<=24months	-0.00019	0.00033	-0.59	0.553	-0.0008, 0.0004
>24months	0.00196	0.00053	3.69	0.000	0.0009, 0.0030
TT injection	0.00039	0.00034	1.17	0.241	-0.00026, 0.0011
Skilled Delivery	-0.00003	0.00006	-0.53	0.596	-0.0001, 0.0001
Toilet Facility	-0.00094	0.00069	-1.36	0.172	-0.0023, 0.0004
Maternal age at Birth					
20-35years	0.00106	0.00057	1.88	0.060	-0.0000, 0.0022
>35years	0.00017	0.00016	1.11	0.269	-0.0001, 0.0002
Maternal Education					
Primary	-0.00004	0.00012	-0.32	0.746	-0.0003, 0.0002
Secondary/Higher	0.00154	0.00046	3.37	0.001	0.0006, 0.0024
Water Source	0.00087	0.0011	0.77	0.443	-0.0014, 0.0031
Antenatal care	0.00000	0.00003	0.02	0.980	-0.0001, 0.0001
ITN Usage	0.00009	0.00185	0.05	0.957	-0.0035, 0.0037
COEFFICIENTS					
Birth Interval					
<=24months	-0.00496	0.00391	-1.27	0.204	-0.01261, 0.00270
>24months	-0.01126	0.01243	-0.91	0.365	-0.03562, 0.01310
TT injection	-0.02304	0.01220	-1.89	0.059	-0.4695, 0.00088
Skilled Delivery	-0.00509	0.00714	-0.71	0.475	-0.01908, 0.00890
Toilet Facility	-0.00729	0.00715	-1.02	0.308	-0.02130, 0.00672
Maternal age at Birth					
20-35years	0.02409	0.01669	1.44	0.149	-0.00861, 0.05680
>35years	0.00918	0.00640	1.43	0.151	-0.00336, 0.02173
Maternal Education					
Primary	0.00830	0.0041	2.02	0.043	0.00025, 0.01636
Secondary/Higher	0.01355	0.00746	1.82	0.069	-0.00107, 0.02816
Water Source	0.00161	0.00887	0.18	0.856	-0.01578, 0.01899
Antenatal care	0.00017	0.00540	0.03	0.974	-0.01041, 0.01075
ITN Usage	-0.00211	0.01215	-0.17	0.862	-0.02593, 0.02170
	0.01726	0.02495	0.69	0.489	-0.03164, 0.06617
Cons					
UNEXPLAINED					
Birth Interval					
<=24months	-0.00074	0.04881	-0.02	0.988	-0.09641, 0.09493
>24months	-0.00062	0.04100	-0.02	0.988	-0.08097, 0.07973
TT injection	-0.00087	0.05721	-0.02	0.988	-0.11299, 0.11126
Skilled Delivery	0.00006	0.00374	0.02	0.988	-0.00727, 0.00739
Toilet Facility	0.00120	0.07915	0.02	0.988	-0.15393, 0.15634

Dead	Coefficient	Standard Error	Z	P > |z|	95% Confidence Interval
Maternal age at Birth					
20-35years	0.00102	0.06762	0.02	0.988	-0.13150, 0.13355
>35years	-0.00027	0.01752	-0.02	0.988	-0.03460, 0.03407
Maternal Education					
Primary	-0.00041	0.02739	-0.02	0.988	-0.05409, 0.05326
Secondary/Higher	0.00120	0.07906	0.02	0.988	-0.15375, 0.15615
Water Source	0.00034	0.02179	0.02	0.987	-0.04237, 0.04305
Antenatal care	-0.00000	0.00008	-0.01	0.989	-0.00015, 0.00015
ITN Usage	-0.00069	0.04887	-0.01	0.989	-0.09647, 0.09509

CHAPTER FIVE

DISCUSSION

5.1 Changes in Under-Five mortality rates across Geo-Political regions in Nigeria

The first objective of this study was to determine the changes in under-five mortality across geo-political regions in Nigeria. The direct method was used to estimate under-five mortality in each geo-political region in Nigeria. The study shows that the South-South region experienced the highest reduction in under-five mortality rate between years 2003 and 2013 while the South East region (23.2%) had the lowest change.

5.2 Changes in Key Determinants of Under-Five Mortality

The second objective addressed the changes in some selected determinants of childhood mortality. Considering the behavioural and health related factor, there was slight increase in uptake of tetanus toxoide injection, skilled delivery assistance, and childhood vaccination while mothers that received antenatal care decline from 33.6% in 2003 to 32.8% in 2013. The use of insecticide treated bed net had a drastic increment from 14.4% in 2003 to 67.3% in 2013.

The demographic factors showed that there was a slight increase in maternal age at birth for mothers in age-group 20-35years and in those greater than 35years in 2003 and 2013. There is a reduction (6.4% in 2003) in mothers whose age at birth is less than 20years and (4.9% in 2013).

The socio economic factor that has been found to be an important determinant in under-five mortality is education of the mother. So many studies (Caldwell, 1979; Cleland et.al, (1988); Kravdal, 2004) have dealt on the topic and maternal education has been found to play a protective role in child's mortality. In this study, the proportion of women with secondary/higher school education increases by 29.2% between 2003 and 2013 where there had been reduction in the percentages of mothers that had primary or no education.

As studies have identified improved toilet facility has a factor that reduce under-five mortality, this study has also identified that access to improved toilet facility was better in

2003 than in 2013, there was a reduction of 32.3% in household that had an improved toilet facility.

Maternal age at birth also plays a protective role in reducing under-five mortality. Children of older and more than 35years has higher risk of dying compared to children of mother aged 20-35years as found by Damodar et al, (2015).

5.3 Effect of Change in Key Determinants of Under-Five Mortality

This analysis has decomposed improvements in under-five mortality to determine how much of recent improvements are attributed to change in factor level and the effect of the impact over time. This study shows that effect of changes in birth interval, tetanus toxoide injection in pregnancy, skilled delivery, improved toilet facility, and usage of insecticide treated bed net all shows improvement in factor level between 2003 and 2013.

The effect of improved level of determinants of behavioural and health related factors is linked to the slight reduction experienced in under-five mortality in Nigeria.

5.4 Strengths of the Study

The direct method of estimation makes it possible to capture all under-five deaths in the birth history. The NDHS surveys are nationally representative and it allows for generalization of results across the country.

5.5 Limitations of the Study

The cross-sectional design of this study does not give the overall information about mortality. The direct method of estimation technique used in this study assumes a fixed half-yearly interval and there might be a slight over-reporting of under-five deaths.

5.6 Recommendations

As a result of this study the impact of effect on skilled delivery, improved toilet facility and maternal education has been low. It is recommended that policy makers in Nigeria should carry out intense effort to reduce under-five mortality by improving on maternal health care services on skilled delivery. Maternal education should also be improved especially in the northern region.

5.7 Conclusion

The South East region has the lowest reduction in mortality rate between 2003 and 2013.

The northern region experienced the largest mortality rate in 2003 and 2013.

The use of insecticides treated bed net showed the highest improvement between 2003 and 2013.

The effect of change in demographic variable that contributes most to under-five mortality is birth interval less than 24months. The behavioural and health related factor that contribute most is skilled delivery and the environmental factor that contribute most to under-five mortality rate is improved toilet facility while the socio-economic factor that contribute most is maternal education.

REFERENCES

Adedini, S.A., Odimegwu, C.O., Ononokpono, D.N., Ibisomi,L, Elwange, B.C., and Imasiku, E. (2012). Regional inequalities in under-five mortality in Nigeria: A multilevel analysis. Paper presented at the annual meeting of the population association of America, held in San Francisco, US, May 3-5, 2012.

Akinyemi, J.O.,Bamgboye, E.A., Ayeni,O., (2013) New trends in under-five mortality determinants and their effects on child survival in Nigeria: A review of childhood mortality data from 1990-2008. *African population studies*, 27(1): 25-42

Amouzou, A., and Hill, K. (2004). Child mortality and socioeconomic status in sub-Saharan. *Africa populaion studies* 19(1):1-12

Antai, D. (2011).Regional inequalities in under-five mortality in Nigeria: A population-based analysis of individual and community level determinants. *Population Health Metrics*. 9(6), 1-27

Becher, H (2010). Analysis of Mortality Clustering at member HDSSs within the INDEPTH Network – an important public health issue. *Global Health action supplement* 1, 3-7.

Bishai, D., Cohen, R., Alfonso, Y. N., Adam, T, Kuruvilla, S.,and Schweitzer, J. (2014). Factors contributing to child mortality reductions in 142 low and middle income countries between 1990 and 2010. *Partnership for maternal, newborn and child health*. Alliance for health policy and system research. World Bank and World Health Organization.

Boachie, Y. (2013). Modelling the determinant of under-five mortality using logit regression. Kwame Nkrumah University of Science And Technology. An unpublished thesis.

Black, Robert E, Morris S. S and Bryce Jennifer. (2003) Where and why are 10 million children dying every year? The Lancet 361, 2226-2234.

Brockerhoff, M. and P. Hewett. (2000). Inequality of child mortality among ethnic groups in sub-Saharan Africa. *Bulletin of the World Health Organization*. 78(1):30-41.

Caldwell, J. C., (1979). Education as a factor in mortality decline: An examination of Nigerian data. P*opulation studies 33(3)* 395-413

Child Mortality Report, (2013). Levels and Trends in child mortality. The World bank 1818 H.Street NW, Washington, DC.29-38.

Damodar S, Saritha N, Lucky S, Gulati B.K and Pandey A, (2015). Levels,trends and predictors of infant and child mortality among Scheduled tribes in India. *Indian Journal Med Res;* 141:709-719.

Foster, Vivien, and Pushak, Nataliya. (2011). Nigeria's Infrastructure: A continental perspective. Africa infrastructure country diagnostic. Washington DC, USA: The World Bank

Gandotra, M. M. and Das,N.P. (1990).Contraceptive choice, shift and use continuation: A prospective study. *Journal of Family Welfare*, 36(3)54-69.

Hill, K., (1985). The pace of mortality decline since 1950 in Da Vanzo, Habicht, quantitative studies of mortality decline in the developing world. Working Papers Number 683

Hobcraft, J. N., McDonald, J. W., and Rustein, S. O. (1984). Socioeconomic factors in infant and child mortality: A cross sectional comparison. *Population studies* 38 (2):193-223

Kandala, N. B., Ji, C., Stallard, N., Stranges, S., and Cappucio, F. P. (2007). Spatial analysis of risk factors for childhood mortality in Nigeria. *American Journal of Tropical Medicine and Hygiene* 77(4) 770-779.

Kravdal, Oystein. (2004). Child mortality in India: The community-level effect of education. *Population studies* 58(2): 177-192.

Lutambi, M A, Alexander, M, Jensen, C, Mahutanga, C, and Nathan. R (2010) Under five mortality. Spatial-temporal clusters in Ifikana HDSS in South- eastern Tanzania. *Global Health Action Supplement.*

Lykens, Kristine, Karan P S, and Elewichi Ndukwe. (2009). Social, economic, and political factors in progress towards improving child survival in developing nations. Journal of health care for the poor and underserved, 20(4) 137-148

Macro International Inc.,(2011). MEASURE DHS STAT compilier Retrieved February 25, 2011.

Mesike,C.G, Mojekwu,J.N. (2012). Environmental determinants of child mortality in Nigeria. *Journal of Sustainable Development.*5(1) 65-75

Mosley, W.H, and Chen, L. C., (1984). An analytical framework for the study of child survival in developing countries. *Population and Development Review.* (10) 25-45

Nigeria Demographic and Health Survey (NDHS), 2003: National Population Commission, Federal Republic of Nigeria, ORC Macro, Calverton, Mary land, USA

Nigeria Demographic and Health Survey (NDHS), 2013: National Population Commission, Federal Republic of Nigeria, ORC Macro, Calverton, Mary land, USA

NPC, 2009. National Population Census 2009 Report.

Oaxaca, R (1973). Male- female wage differentials in urban labor markets. International Economic Review 14: 693-709.

O'Donnell O, Van Doorslaer E, Wagstaff A, Lindelow M (2008a). Analyzing health equity using household survey data: A guide to techniques and their implementation. The World bank 1818 H.Street NW, Washington, DC.29-38.

O'Donnell O, Van Doorslaer E, Wagstaff A, Lindelow M (2008b). Analyzing health equity using household survey data: A guide to techniques and their implementation. The World bank 1818 H.Street NW, Washington, DC.147-157.

Preston, S.A (1975). The changing relation between mortality and level of economic development.population studies. 29(2): 2231-2248.

Preston: S.A. (1985). Mortality and development revisited in Da Vanzo, Habicht. Quantitative studies of mortality decline in the developing world. World bank staff working papers number 683, Population and development series Number 8. The World Bank, Washington,D.C.

Rutherford, M. E., Mulholland, K., and Hill, P. C. (2010). How access to health care relates to under-five mortality in sub-Saharan Africa: systematic review. *Tropical Med. International Health.* 15(5):508-519.

Rutstein, S.O., (2000) Factors associated with trends in infant and child mortality in developing countries during the 1990s. *Bulletin of World Health Organization.* 78(10): 1256-1270

Uddin,M., Hossain, M., & Ullah M.O., (2009). Child Mortality in a Developing Country: A statistical analysis. *Journal of Applied Quantitative Method.* 4(3): 25-37

Uthman, O.A. (2008). Environmental factors, neighbourhood deprivation, and under-five mortality in Nigeria: An exploratory spatial data analysis. *Journal of pediatrics and neonatology,* 9(1) 1-10

Uthman, O. A., Uthman, M. B., and Yahaya, I. 2008. A population-based study of effect of multiple birth on infant mortality in Nigeria. *BMC Pregnancy Childbirth* 8: 41. doi: 10.1186/1471- 2393-8-41

UNICEF, (2014). United Nations Inter-agency group for child mortality estimation. United Nations Children fund. 3 UN Plaza, New York.

World Bank, (2000), WHO, United Nations, Levels and Trends in Child Mortality: Report 2014. New York, 10017 USA.

Whitworth, A and Stephenson, R. (2002). Birth spacing, sibling rivalry and child mortality in India. *Social science and medicine* (55), 2107-2119.

Subramanian, S.V.,Shailen, N., Michelle, I.,Dave, G.,Helen, L., and George S. D., (2006). The mortality divide in India: The differential contributions of gender, caste and standard of living across the life course. *American Journal of Public Health,* 96(5): 818-825.

APPENDIX

Model 1- Regressions of 2003 NDHS

Dead	Coefficient	Standard Error	Z	P > |z|	95% Confidence Interval
Birth Interval					
<=24months	-0.358	0.296	-1.21	0.227	-0.939, 0.222
>24months	-0.661	0.218	-3.03	0.002	-1.087, -0.234
TT injection	-0.632	0.201	-3.15	0.002	-1.026, -0.239
Skilled Delivery	-0.219	0.211	-1.04	0.299	-0.632, 0.194
Toilet Facility	-0.290	0.171	-1.68	0.094	-0.622, 0.049
Maternal age at Birth					
20-35years	0.176	0.264	0.67	0.505	-0.342, 0.694
>35years	0.804	0.331	2.43	0.015	0.156, 1.452
Maternal Education					
Primary	0.515	0.212	2.43	0.015	0.099, 0.930
Secondary/Higher	0.131	0.255	0.51	0.608	-0.369, 0.640
Water Source	-0.018	0.189	-0.09	0.926	-0.388, 0.353
Antenatal care	0.010	0.195	0.05	0.959	-0.371, 0.391
ITN Usage	-0.047	0.236	-0.2	0.844	-0.509, 0.416
Cons	-1.887	0.289	-6.54	0.000	-2.452, -1.321

Number of observation =2103

LR chi 2(12) =36.85

Prob > chi2 =0.0002,

Pseudo R-squared =0.0306

Model 2- Regressions of 2013 NDHS

Dead	Coefficient	Standard Error	Z	P > |z|	95% Confidence Interval
Birth Interval					
<=24months	0.064	0.109	0.59	0.554	-0.149, 0.278
>24months	-0.428	0.096	-4.44	0.000	-0.617, 0.239
TT injection	-0.132	0.106	-1.24	0.213	-0.340, 0.076
Skilled Delivery	-0.054	0.086	-0.63	0.530	-0.221, 0.114
Toilet Facility	-0.089	0.068	-1.31	0.189	0.223, 0.044
Maternal age at Birth					
20-35years	-0.268	0.128	-2.09	0.036	-0.520, 0.017
>35years	0.222	0.146	1.52	0.127	-0.063, 0.508
Maternal Education					
Primary	-0.028	0.087	-0.33	0.744	-0.198, 0.507
Secondary/Higher	-0.383	0.095	-4.05	0.000	-0.569, 0.142
Water Source	-0.054	0.069	-0.78	0.437	-0.190, 0.200
Antenatal care	0.003	0.109	0.02	0.980	-0.211, 0.082
ITN Usage	-0.004	0.067	-0.05	0957	-0.135, 0.217
	-2.11	0.154	-13.78	0.000	-2.419, 1.817
Cons					

Number of observation=18471

LR chi 2(12) =139.02

Prob > chi2 =0.0000

Pseudo R-squared =0.0171