SPATIOTEMPORAL PATTERNS OF INFANT AND CHILD MORTALITY IN NIGERIA, 1990 – 2015

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SPATIOTEMPORAL PATTERNS OF INFANT AND CHILD MORTALITY IN NIGERIA, 1990 - 2015

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CERTIFICATION

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DEDICATION

To

My late mother,

Mrs. Josephine Ife Ayoade (nee Wilson)

ABSTRACT

High Infant Mortality Rates (IMRs) and Child Mortality Rates (CMRs) are major health challenges in most developing countries, with undesirable socioeconomic consequences. In Nigeria, previous studies have mainly examined the determinants of Infant and Child Mortality (ICM) based on micro level data, with little attention to the spatiotemporal variations at the national level. In addition, the influence of socioeconomic inequalities on IMRs and CMRs nationwide over time has been minimally examined. This study, therefore, was designed to analyse the spatiotemporal patterns and the influence of socioeconomic inequalities on ICM in Nigeria.

Mosley and Chen, World Health Organization Social Determinants of Health Models and Concept of Health Equity constituted the framework. State-level data on ICM, child's sex, antenatal care, breastfeeding, vaccination, wealth index, religion, education and age of mothers were derived from the 2003, 2008 and 2013 Nigeria Demographic and Health Surveys and annual World Bank datasets (1990-2015). The extracted data were linked to their corresponding spatial units for geospatial analysis. Descriptive statistics, Moran's Index, Getis-Ord Gi* Statistic, ANOVA, Stepwise regression, Rate Ratio (RR) and Rate Difference (RD) were used for the analysis at $p \leq 0.05$.

IMRs were 81.9±44.6 (2003), 69.4±18.7 (2008) and 60.6±17.8 (2013) per 1000 live births, whileCMRs were 47.0±36.3 (2003), 37.7±19.9 (2008) and 23.6±14.6 (2013) per 1000 children surviving to age one. Both IMRs and CMRs declined over time in Bayelsa, Borno, Kaduna and Ekiti States. The IMRs increased in Imo, Oyo, Anambra, Abia, Lagos, Yobe, Kebbi and Sokoto States, while CMRs increased in Imo, Cross River, Delta and Katsina States. The IMRs were clustered but insignificant for all periods, while CMRs were significantly clustered in 2003 (0.40), 2008 (0.56) and 2013 (0.53). The hot spots of IMRs and CMRs were mainly among states in the Northwest and Northeast while cold spots were mainly among states in the Northcentral and Southwest geo-political zones. The IMRs ($F_{(2;108)}$=4.82) and CMRs ($F_{(2;108)}$=8.01) varied significantly over time across states. Wealth Index, breastfeeding duration and antenatal care explained most of the variations onIMRs and CMRs in 2003 (R^2=0.54; 0.54), 2008 (R^2=0.46; 0.66) and 2013 (R^2=0.64; 0.73) at the state level. Most of the annual variations in IMRs and CMRs (1990-2015) (R^2=0.99; 0.99) were accounted for by rates of vaccination, urbanization and inflation.Socioeconomic inequalities on IMRs and CMRs increased mainly in states in the Northeast and Southsouth geo-political zones. Between wealth groups, inequalities markedly increased for infant mortality in Yobe (RR: 1.35 to 7.07; RD: 16 to 58 per 1000 live births) and for child mortality in Benue (RR: 1.05 to 3.58; RD: 2 to 23 per 1000 children surviving to age one).

Contiguous states in Nigeria have similar or near similar rates of Infant and Child Mortality and these are influenced mainly by the Wealth Index. High and increasing socioeconomic inequalities onInfant and Child Mortality persist, despite significant reductions in mortality rates over time. Implementation of place - and group - specific strategies in tackling Infant and Child Mortality while regularly evaluating their impact is required.

Key words: Infant and child mortality, Spatiotemporal patterns, Socioeconomic inequalities in Nigeria

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KEY ABBREVATIONS

CI/CC – Concentration Index/Concentration Curve

CMR – Child Mortality Rate

CPI – Consumer Price Index

DHS – Demographic and Health Survey

GIS – Geographic Information System/Science

GDP – Gross Domestic Product

GNI – Gross National Income

IMR – Infant Mortality Rate

LBW – Low Birth Weight

LISA – Local Indicator of Spatial Autocorrelation

LSMS – Living Standard Measurement Surveys

MICS – Muliple Indicator Cluster Survey

MTCT – Mother-to-child-transmission

NPC – National Population Commission

PAF/PAR – Population Attributable Fraction/Population Attributable Risk

PSU/EA – Primary Sampling Unit/Enumeration Area

RR – Rate Ratio

RD – Rate Difference

SES/SEP – Socioeconomic Status/Socioeconomic Position

SII – Slope Index of Inequality

SPSS – Statistical Package for the Social Sciences

U5MR – Under 5 Mortality Rate

UNDP – United Nations Development Programme

UNICEF – United Nations Children's Fund

UN-IGME – United Nations Inter-Agency Group for Child Mortality Estimation

USAID – United States Agency for International Development

WHO – World Health Organization

DEFINITION OF TERMS

Infant Mortality Rate: Infant mortalityrefers to deaths occurring between birth and the age of one and is sometimes defined as the probability of a child dying before the first birthday. Infant Mortality Rate (IMR) is expressed as the number of deaths in the first year of life per 1,000 live births in the same period.

Child Mortality Rate: Child mortality refers to deaths occurring between the ages of one and fourand is sometimes defined as the probability of a child dyingbetween the first and fifth birthdays. Child Mortality Rate (CMR) is expressed as the number of child deaths per 1,000 children surviving to the age of one in the same period.

Under 5 Mortality Rate: Under 5 mortality refers to deaths occurring among children under the age of fiveand is sometimes defined as the probability of a child dyingbetween birth and the fifth birthday.Under 5 Mortality Rate (U5MR) is expressed as the number of under 5 deaths per 1,000 live births in the same period.

Health Inequality is a broad term used to describe variations and disparities in health.

Socioeconomic Inequality in health or Inequity in health refers to differences, variations or disparities in mortality (or morbidity) across subgroups within a population defined mainly by socioeconomic and geographic characteristics. These are health inequalities that are generally regarded as unfair and avoidable because they reflect the unequal and often unfair distribution of underlying social determinants of health such as wealth/income distribution, education, living conditions etc.

Absolute Inequality Measures reflect the magnitude of the difference in mortality between/among subgroups. Absolute measures retain the same unit of measure as the health indicator being examined. Absolute measures include Rate Difference (RD), Slope Index of Inequality (SII) and Absolute Population Attributable Fraction (PAF).

Relative Inequality Measures reflect proportional differences in mortality between/among subgroups. Relative measures are unitless. They include Rate Ratios (RR), Relative Population Attributable Fraction (PAF), Concentration Index (CI) and Concentration Curve (CC).

CHAPTER ONE

INTRODUCTION

1.1Backgroundto the study

Reducing infant and child mortality remains a majorchallengeworldwide. This is particularlyso for developing countries and regions that are continuously faced with problems of political unrest, poverty/economic crisis, corruption, poor infrastructure, low food security, weak health care delivery systems and the devastating impact of HIV/AIDS and infectious diseases(Adetunji, 2000; Thiam et al, 2006; UNICEF, 2009; UNDP, 2013; WHO 2016/17). Infant mortality is the probability of dying before the first birthday (NPC and ICFInternational, 2014). This includes the probability of dying during the first 28 days of life (Neonatal mortality) and the probability of dying after the first month of life but before the first birthday (Post neonatal mortality).On the other hand, the terms child mortality and under 5 mortality are sometimes used interchangeably in the literature to refer to child deaths before the age of 5. However, a distinction is often made between child mortality which refers to the probability of dying between the first and fifth birthday and Under 5 mortality which refers to the probability of dying between birth and the fifth birthday (NPC and ICF International, 2014). Both infant and Under 5 mortality are measured and expressed per 1000 live births while child mortality is measured and expressed per 1,000 children surviving to age one.

Garenne and Gakusi, (2006); Black et al, (2010); Liu et al,(2015); UNICEF,(2015); and WHO, (2015) have shown thatsome progress has been made in reducing infant and child mortally rates worldwide especially in the last two decades. World wide, infant mortality rates (IMRs) have fallen by 52% from 65 deaths per 1,000 live births in 1990 to 31deaths per 1,000 live births in 2016 while in absolute terms the number of infant deaths dropped from 8.8 million in 1990 (i.e. 24,000 infant deaths everyday) to 4.2 million (i.e. 12,000 infant deaths everyday) in 2016 (UN-IGME, 2017). Likewise, global under 5 mortality rates (U5MRs) fell by 56% from 93 deaths per 1,000 live births in 1990 to 41 deaths per 1,000 live births in 2016 while in absoluteterms the number of child deaths fell from 12.6 million in 1990 (i.e. 35,000 child deaths everyday) to 5.6 million (i.e. 15,000 child deaths everyday) in 2016 (UN-IGME, 2017). However,progress varies widely asmortality rates in children under 5 remains shockingly highwith large disparities in infant and child mortality within regions and countries. At the regional level, infant and child deaths are largely concentrated in developing regions which have the highest infant and under 5 mortality rates (33 and 45 deaths per 1000 live births, respectively) compared to developed regions (5 and 6 deaths per 1000 live births, respectively) (UNDP, 2017).

Over the years, Sub Saharan Africa has consistently had the highest rate of child deaths worldwide. In 2016, 1.9millioninfant deaths (54 deaths per 1000 live births) occurred in this region alone with most (53%) of these deaths occurring in the neonatal period (i.e. the first 28 days of life). Similarly, 2.8 million under 5 deaths (79deaths per 1000 live births) occurred in Sub Saharan Africa (UN-IGME, 2017). In addition, the proportion of global under 5 deaths occurring in this regionincreased from 30.1% in 1990 to almost half (49.2%) in 2016 (UN-IGME, 2015; 2017).At the country level, IMRs range from as low as 2 deaths per 1000 live births in countries like Finland, Iceland and Japan to as high as 89 deaths per 1000 live births in the Central African Republic. Similarly, U5MRs range from as low as 2 deaths per 1000 live births in countries like Finland and Iceland to as high as 133deaths per 1000 live births in Somalia (UN-IGME, 2017). Developing countries have the highest infant and child mortality rates. Nigeria in particular, has the second highest absolute number of infant deaths worldwide (476,000) after India (867,000) and one of the highest infant mortality rates (67 deaths per 1000 live births) after Mali (68), Democratic Republic of Congo (72), Lesotho (72), Chad (75), Sierra Leone (83) and the Central African Republic (89). Similarly, Nigeria has the second highest absolute number of under 5 deaths (733,000) after India (1.1million) and one of the highest under 5 mortality rates (104 deaths per 1000 live births) after Mali (111), Sierra Leone (114), Central African Republic (124), Chad (127) and Somalia (137)(UN-IGME,2015; 2017). The risk of child death is also high in Nigeria with 1 child out of every 15 dying before their first birthday and 1 in 8 before the age of 5 (NPC and ICF International, 2014).

The UN-IGME Reports (2015; 2017) have shown thata vast majority (more than 70%) of infant and under 5 deaths worldwide are directly due to diseases and conditions such as pneumonia, diarrhea, malaria,neonatal infections and malnutrition. Theseare preventable and/or treatable through cost effective and timely maternal, newborn and child health interventions such as vaccinations, use of insecticide treated nets,improved infant feeding practices, access to improved water sources, removal of financial and socio-cultural barriers to health care, comprehensive antenatal and postnatal careamong others.International health organizations and researchers (Balk et al, 2004; IHME, 2010; Sartorius et al, 2011; Kazembe et al, 2012; Uthman, 2012; Nicolai et al, 2015; WHO, 2015; UNDP, 2017; UN-IGME, 2017) have also shown that children tend to have a higher risk of dying before the age of 5 if they are born in poor homes, rural areas or to a mother with little or no education compared to those born in wealthier families, urban areas and to educated mothers. In Nigeria in particular, similar disparities have been identified especially in rural and urban areas and within communities (Ojikutu, 2008; Adepoju et al, 2012; Kayode, 2012; Osirike and Idehen, 2013; Bako et al, 2016; Adewuyi et al, 2017). Such inequalities/disparities in infant and child mortality have been attributed to differences in bio-demographic characteristics and unevenness in the distribution of resources and access to health care.

The World Health Organization (WHO, 2008; 2015; 2017) and United Nations Children Fund (UNICEF, 2015) have consistently emphasized that developing countries like Nigeria can significantly improve child survival rates. They suggest that this is possible by ensuring that policies/interventions are based on regular in-depth assessments of the levels, patterns, trends and root causes of infant and child mortality particularly at sub-national levels. They have also recently called for the adoption of an equity focused approach to childhood mortality. This involves investigating and addressing inequalities in infant and child mortality that are systematic (i.e. show a consistent pattern by geographic location or socioeconomic status), socially determined, avoidable and therefore capable of being significantly minimized or eliminated with the implementation of appropriate policies/programmes (Whitehead and Dahlgren, 2007).

1.2Statement of the problem

Evidences from UNICEF, World Bank, WHO and UN reports indicate that developing countries/regions have made the least progress in reducing under 5 mortality. Sub-Saharan Africa, in particular, still has the highest level of infant andchild mortality rates. Studies (Rutstein, 2000; Amouzou and Hill, 2004; Fotso et al, 2007) havefoundthat reductions in infant andchild mortality rates among Sub-Saharan African countries have slowed down significantly or stalledcompletely and may even have increased in some countries.In addition, Ajidagba, (2014); UNDP, (2015); WHO, (2015); UN-IGME, (2017) have shown that most Sub-Saharan African countries, including Nigeria, failed to meet the MDG 4 target of a two-third reduction in under 5 mortality. Additionally, UNICEF estimates that about 60 million children under 5 will die between 2017 and 2030 with half of these deaths occurring in Sub Saharan African countries like Nigeria if current trends of the last decade continue.

This raises several key questions with particular reference to Nigeria: Why doinfant and child mortalityrates differ over space? What are the underlying factors and processes responsible for these inequalities and their effects on infant and child mortalityratesover space and time? Is place/location a major contributor to inequalities in infant and child mortality? To what extent do disparities in infant and child mortality reflect differences in socioeconomic status/socioeconomic position (SES/SEP)of parents over space and time? and what are the most effective approaches for measuring, monitoring and tackling inequalities ininfant and child mortality?

Addressing these questions hold the key to better understanding the problem and achieving large scale reductions in infant and child mortality in Nigeria. However, doing so will require a comprehensive/systematic examination of the spatial, temporal and socioeconomic inequalities of infant and child mortality rates nationwide. Previous studies have either briefly or not examined these aspects or dimensions of the problem of infant and child mortality in Nigeria. Also, reports and studies from international health organizations do not examine these aspects of infant and child mortality at subnational levels.

1.3 Rationale for the study

Over the years, researchers have investigated various aspects of child mortality at the international, national and sub-national levels. Researchers have mainly investigated the spatial patterns (Kalipeni, 1992; Joseph and Kramer, 1997; Rodrigues et al, 2013), trends (Ayoola et al, 2005;Ayele et al, 2016) and spatiotemporal patterns(Castro and Simoes, 2009; Aigbe and Zannu, 2012; Cocchi et al, 2014) of infant and child mortality. Most of these studies have also examined associations between child mortality and bio-demographic (Kennedy, 2014; Akinyemi et al, 2015), socioeconomic (Akuma, 2013; Xiaojia et al, 2015), behavioural (Mondal et al, 2009; Adediji, 2015), health care (Shi et al, 2004; Bandal et al, 2016), environmental (Marchie and Ayanwu, 2009) and macroeconomic factors (Kirigia et al, 2006; Lykens, 2009). Researchers have adopted a variety of techniques ranging from qualitative methods, simple correlation, multivariate regression analysis and spatial autocorrelation measures to generalized entropy indices, GIS mapping and modeling techniques.However,key aspects of infant and child mortality have been neglected or not well investigated at subnational levels in many developing countriesincludingNigeria.

First of all, most of the existing sub-national studies in Nigeria, have focused on investigating levels and/or short term trends in under 5 mortality at particular communities/LGAs or health care facilities. Although these studies have their advantages, there are major limitations. These studies fail to incorporate both spatial and temporal dimensions in their studies. In addition, findings from these studies are not comparable nationally. For example, Abu et al (2015) examined the prevalence of under 5 mortality and its determinants in 30 communities in 10 Local Government Areas in Benue state through a questionnaire survey and focus group discussions. They identified malaria, measles and birth complications as key determinants. This and other small scale studies (Becher et al, 2004; Bello and Joseph, 2014Almeida et al, 2014) provide insight into child mortality in the study area. However, they do notanalyzegeographic patterns of under 5 mortality at multiple scales. They also neglect the element of time which is vital for assessing whether or not child mortality rates have significantly declined. Similarly, hospital based studies (Onayade et al, 2006; Lornejad et al, 2013 and Ezeonwu et al, 2014) examine records of child mortality sometimes over time but these studies ignorethe concept of space and spatial scale. Hence, these studies have notassessed the spatial patterns and changes in the patterns of infant and child mortality subnationally across Nigeria.

Secondly, with regards to determinants of infant and child mortality, many researchers (Adetunji, 1994; 1995; Alam and David, 1998; Lawoyin, 2001; D'souza, 2003; Mondal, 2009; Ayenigbara and olorunmaye, 2012; Bello and Joseph, 2014; Abu et al, 2015; Bako et al, 2016) have largely focused on very specific categories of determinants (usually proximate/individual level factors) often to the exclusion of important wider socioeconomic and contextual factors that significantly influence both child survival and individual level factors. In addition, they have ignored the fact that factors that explain variations in infant and child mortality can change significantly over space and time.

Thirdly, Murray, Gakidou and Frenk(1999); Wagstaff, (2000); Victora et al, (2003); Marmot, (2005); Schneider et al, (2005); Tugwell et al, (2007); Arcaya et al, (2015) and Barreto (2017) among others have argued that the real issue is not just inequalities/disparities in infant and child mortality but whether they represent social inequalities i.e. "differences which are unnecessary and avoidable but, in addition are also considered unfair and unjust" (Whitehead, 1990). Hence, social inequalities (sometimes called socioeconomic inequalities, social class differences, inequities or disparities) in infant and child mortalityhave been assessed using inequality measures such as concentration indices. Findings have shown that absolute figures can be misleading because declines in total infant and child deaths can often hide significant increases in the proportion of child deaths amongstsocioeconomic groups(Hosseinpoor et al, 2005;

Bassani, 2010; Dallolio et al, 2012; Quentin et al, 2014; Anyamele et al 2015).In the literature, socioeconomicinequalities in child health outcomes including mortality have been assessedbased on one or two SES indicators. For example, majority of the studies from the United States have examined child mortality among social groups stratified by race or relative income (Wilkinson, 2000; Schneider et al, 2002) while British researchers tend to focus on social class/occupational groups (Marmot et al, 2010; Weightman et al, 2012). However, assessing infant and child mortality in terms of income and occupation alone is inadequate for accurately assessing the extent of the disparities in child mortality amongst socioeconomic groups over space and time.

Fourthly, with regards to methodology; researchers have adopted a variety of measures ranging from ratios to entropy indices. However, there are still debates as to which inequality measure is most appropriate for the comprehensive assessment and monitoring of inequalities in health(Wagstaff et al, 1991; Mackenbach and Kunst, 1997; Alleyne et al, 2002; Schneider et al, 2003; Arcaya et al, 2015). Hence, this study is designed to: (1) incorporate the element of space, time and scale in the analysis of infant and child mortality; (2) investigatea broad range of determinants (including largely ignored macroeconomic and health care factors) of infant and child mortality and (3) assess socioeconomic inequalities in infant and child mortality over time based on multiple Socioeconomic Status (SES) indicators using a combination of both relative and absolute inequality measures.

1.4Research Questions

1) What is the spatial pattern of infant and child mortality in Nigeria and has the patternchanged significantly over time?
2) Which factors explain the spatiotemporal patterns of infant and child mortality in Nigeria?
3) Are there significant socioeconomic inequalities (or disparities) in infant and child mortality rates amongst socioeconomic groups across states in Nigeria?
4) Have the rates of infant and child mortality across states and among socioeconomic groups in Nigeria reduced significantly over the years?

1.5Aim and Objectives

The aim of this study is to analyze the spatiotemporal patterns ofinfant and child mortality in Nigeria.

The objectives of the study are to:

i) analyze the spatiotemporal patterns of infant and child mortality in Nigeria;
ii) investigate bio-demographic, socioeconomic, macroeconomic, health care related and environmental factorsthat may explain infant and child mortality rates in Nigeria; and
iii) assess socioeconomic inequalities in infant and child mortality between and among socioeconomic groups over time in Nigeria based on multiple SES indicators.

1.6The study area

Nigeria is located in West Africa on the Gulf of Guinea and lies between latitude 4° and 14° North of the Equator and longitude 3° and 15° East of the Greenwich Meridian (Figure 1.1). Nigeria has a total land area of 923.768km^2 and a total population size of approximately 196 million making Nigeria the most populated country in Africa and 7th most populated country worldwide (Population Reference Bureau, 2018). Nigeria is a middle income country with one of the largest economies in Africa. However, one of the main challenges facing Nigeria is poverty with 44% of the population (87 million) living in extreme poverty i.e. below $2 per day (World Data Lab, 2018). Persistent poverty and the widening income gaps between the wealthy few and the rest of the population has fuelled crime and terrorism and negatively affected the health and survival chances of Nigerians. The leading causes of death in Nigeria are malaria, lower respiratory infections, diarrheal diseases, HIV and malnutrition.These are conditions that are preventable or easily treatable and manageable especially with access to affordable and good quality health care. However, Nigeria's health caredelivery system is characterized by the lack of adequate facilities, poor coverage due to the uneven distribution of available facilities, shortage of well trained staff and supplies and poor management and corruption (Duru and Nwagbos,2007; Abdulraheem et al,2011; WHO, 2017). In addition, poor access to clean water and sanitation services is amajor challenge. About 70 million Nigerians lack access to safe and clean water sources and over 110 million lack access to adequate sanitation services with 29% stillpracticing open defecation (UNICEF, 2015).

Generally, the standard of living in Nigeria is poor which has contributed to the burden ofdisease and mortality especially among children. According to the UN-IGME (2017) report, Nigeria loses about 1,304 infants and 2,008 under 5 year olds everyday making Nigeria the second major contributor to infant and child mortality worldwide. There are no detailed and comprehensive studies of the spatial and temporal patterns of infant and child mortality and their determining factors in Nigeria. This study provides necessary information needed to formulate policies that will significantly reduce infant

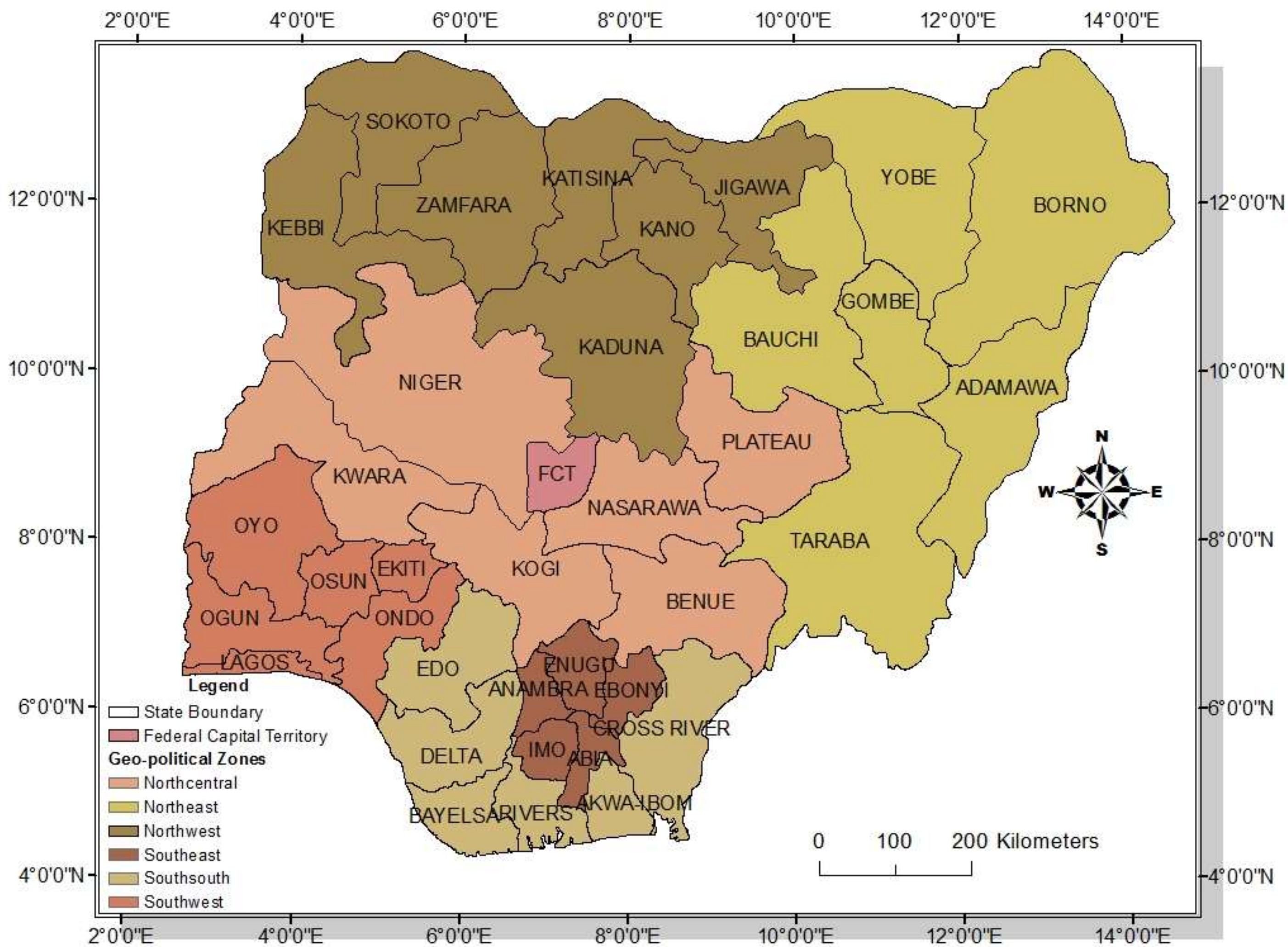


Figure 1.1: The Study Area (Source: Author)

and child mortality in Nigeria and enable the country to achieve the Sustainable Development Goal (SDG) 3.2 target of 25 or fewer under 5 deaths per 1000 live births by 2030.

1.7 Structure of the study

This thesis is made up of five main chapters. The first is the introduction chapter which includes subsections on the background to the study, statement of the problem, rationale for the study, research questions, aim and objectives of the study, and study area. The second is the literature review and conceptual framework. The literature review subsection examines the key themes in the literature on infant and child mortality both worldwide and in Nigeria. The subsection on conceptual framework examines the underlying concepts/models as well as the synthesized model developed for the study.

The third is the chapter on methodology which includes subsections on the study design, data sources, sampling technique, research hypotheses and techniques of data analysis. The fourth is the results and discussion. In this chapter, results are presented and discussed for infant, child and under 5 mortality with regards to 4 main themes: (1) Spatial variations and patterns; (2) Temporal patterns and trends; (3) Determinants; and (4) Socioeconomic inequalities. The final chapter is the summary and conclusions which includes subsections on the study's contributions to knowledge and recommendations.

CHAPTER TWO
LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter examines the main themes in previous studies carried out on infant and child mortality globally and in Nigeria and also examines the underlying concepts that served as a framework for this study.

2.2 Literature Review

Globally, a substantial number of studies have been carried out on child mortality by researchers in various fields with the aim of improving child survival and overall child health.The following themes in studies of infant and child mortality in the literature are reviewed here.

1) Spatial and temporal patterns of infant and child mortality
2) Determinants of infant and child mortality
3) Socioeconomic inequalities in infant and child mortality
4) Studies on infant and child mortality in Nigeria

2.2.1 Spatial and temporal patterns of infant and child mortality

Traditional studies on the spatial and temporal patterns of infant and child mortality can be divided into three main groups based on geographical scale. The first group are international/cross national studies that examine and compare patterns and trends in infant and child mortality between and amongst countries. For example, Garenne and Gakusi (2006) examined and compared levels and trends in under-5 mortality in 32 countries in Sub Saharan Africa based on data obtained from 66 Demographic and Health Surveys (DHS) and World Fertility Surveys from 1950 to 2000. They identified periods of major increases and decreases in child mortality. Similarly, Burgert et al (2015) examined spatial patterns of a range of child health indicators including child mortality across 27 countries in Sub-Saharan Africa, Nigeria included based on Demographic and Health Survey (DHS) data and identified a high-high clustering of under 5 mortality rates (U5MR) along West African countries using exploratory spatial data techniques.Wang et al (2014) examined the levels and trends in under 5 mortality rates for 188 countries from 1970-2013 based on more than 29,000 surveys, census, vital registration and sample registration data points. Results showed some declines in U5MRs worldwide especially between 2000 and 2013. Similarly, Gayawan et al (2016) examined geographical variations in infant and child mortality across 10 West African countries and selected North and South African countries based on DHS data. They found significant variations in U5MRs mainly due tomaternal and child related factors while IMRs did not vary significantly except in three neighbouring regions of Liberia and Sierra Leone. These and other similar cross-national studies (Shen and Williamson, 1999; Brockerhoff and Hewett, 2000; Balk et al, 2004; Storegard et al, 2008; Fayehun, 2010; Kamiya, 2010; Rajaratnam et al, 2010; You et al, 2015) have drawn attention to the broad contrasts in infant and child mortality between developed and developing regions over time.

The second group are large scale population based sub-national studies that focused on variations in infant and child mortality across sub-national units. These studies often reflect inequalities in infant and child mortality by ethnicity, religion, gender and place of residence. For example, Lee (1991) examined long term changes in infant mortality for 55 regions in Britain from 1861 to 1971 using inequality measures. Results showed a stable pattern before 1900, followed by a general decline in later years. Also, Joseph and Kramer (1997) examined the spatial pattern of changes in infant mortality rates in Canada between 1987 and 1994 and identified marginal increases in infant mortality in several provinces.

A series of sub-national studies in the USA and UK have identified persistently higher childhood mortality rates among Blacks, Hispanics and minority racial/ethnic groups (Singh and Yu, 1995; Antunes and Waldman, 2002; MacDorman and Matthews, 2009; Hollowell et al, 2011; Rodrigues et al, 2013; Cocchi et al, 2014). Similar patterns have been identified in developing countries. For example, using GIS mapping techniques, Ur-Rehman et al (2010) examined the spatial pattern of infant and under 5 mortality rates in Pakistan from 2001 to 2009 based on data obtained from the Demographic and Health Survey (DHS), Multiple Indicator Cluster Survey (MICS) and the Living Standard Measurement Survey (LSMS). The result was a set of GIS based maps showing areas with the highest concentration and risk of child mortality. Similarly, Sartorius et al (2011) employed Bayesian spatial models, Moran's I and Kulldorf's spatial scan statistics to examine and map the spatial pattern of infant mortality in South Africa. Their study showed marked geographical differences in infant mortality across and within provinces. In Nigeria in particular, regional studies have found that the Northern predominantly Hausa-Fulani and Muslim states tend to have the highest levels of under 5 mortality compared to the Southern predominantly Christian Yoruba and Igbo states. For example, Aigbe and Zannu (2012) examined the distribution of infant and child mortality rates among the six geopolitical zones in Nigeria based on data from the 1999 and 2008 NDHS. Results showed a concentration of high under 5 mortality rates in the Northeast and that the Southwest was the only zone that experienced some reduction in under 5 mortality rates over the 10 year period between both surveys.

The third group are local/small scale studies focused on investigating infant and child mortality at the community and/or Local Government Area level (Ojikutu, 2008; Fayehun and Omololu, 2011; Osirike and Idehen, 2013; Bandal et al, 2016) and urban-rural level (Alaba et al, 2012; Alabi et al, 2015). This also includes facility based studies that rely mainly on hospital administrative data and mortality records (Kullima et al, 2009; Agan et al, 2010; Onayade et al, 2010; Fawole et al, 2011). Some researchers have also examined patterns and changes in child mortality before and after the introduction of specific policies/interventions such as the Safe Motherhood Initiative in Nigeria (Ujah, 2009) and major political changes/shifts (Nolte et al, 2000; Soto and Lorant, 2011; Aggrey, 2015).

2.2.2 Determinants of infant and child mortality

Two broad categories of determinants are recognized in the literature – proximate determinants which include bio-demographic and environmental factors, nutrition, illness/injury and health care (Mosley and Chen, 1984) and socioeconomic determinants including wider socio-political factors (WHO, 2008).

Researchers in various fields have found that where a child lives can have a significant impact on whether or not that child survives past the age of 5. Adetunji (1994) examined the effect of rural-urban residence and other factors on infant mortality in Nigeria between 1965 and 1979 using data from the 1981/82 Nigeria fertility survey. Findings showed higher risks of infant death in rural areas and showed place of residence to be significantly associated with infant mortality rates. Similarly, Van de Poel et al (2007) investigated the rural-urban gap in infant mortality rates in 6 Central and West Sub-Saharan African countries – Benin, Central African Republic, Chad, Guinea, Mali and Niger- using DHS data. They found that rural areas did indeed have higher IMRs than urban areas even after controlling for a range of socioeconomic and demographic factors. They also found that differences in household environmental characteristics explained two-thirds of the differences observed although they did not take into account potentially important community characteristics such as availability of health care services which other studies (Defo, 1996; Sastry, 1996; 1997) have identified as key contributors to place differences in infant and child mortality. On the other hand, Carvalho et al (2015) examined inequalities in infant mortality among 39 neighbourhoods in Southeastern Brazil from 2001 to 2010 based on a living conditions index and identified higher IMRsin neighbourhoods with the worst living conditions.

Population density/urbanization has been examined as a potential predictor of variations in child mortality. For example, Antai and Moradi (2010) examined trends in urban population growth and urban U5MRs between 1983 and 2003 in Nigeria using multilevel regression analysis. They found that U5MRs increased significantly with the increase in urban population after adjusting for bio-demographic and socioeconomic characteristics. Studies with similar finding include those by Root 1997; Akoto and Tambashe, 2002; Balk et al, 2004; Kassebaum et al, 2014 and Ezeh et al, 2015. These studies have found significant differences in infant and child mortality between and within regions, rural and urban areas, neighbourhoods within cities and even between households. These differences have been mainly attributed to underlying differences in individual, household and area level characteristics such as differences in the physical environment (e.g. weather and exposure to pollutants) and built environment (e.g. availability of health care services) as well as differences in socioeconomic and behavioural characteristics (e.g. income/wealth, utilization of health care services, access to clean water and sanitation services).

Bio-demographic factors (i.e. maternal and child related factors) have been identified in most studies as major determinants of infant and child mortality particularly in developing countries. Maternal age at first childbirth is a major factor often identified in literature. Studies have found a U-shaped relationship between under 5 mortality especially in infancy and the age of mothers at childbirth with higher mortality rates occurring among children born to teenagers and women over 35. Using Poisson regression, Finlay el al (2017) examined the association between maternal age at first birth and infant mortality in 55 low and middle income countries from 1990 to 2008 using DHS data from 118 surveys. Results showed that infant mortality was lowest among women that had their first child between the ages of 27 and 29. Studies with similar findings includeAntai, 2011; Adepoju et al, 2012; Blanc et al, 2013; Yaya et al, 2017 among others. Birth order and spacing is another major factor highlighted. Higher mortality rates have been found among first born children and children of multiple births especially at infancy. This is mainly because multiple births tend to have a much higher risk of low birth weight (LBW). Using univariate and multivariate regression, Uthman et al (2008) observed that children born from multiple births in Nigeria were more than twice as likely to die at infancy than those born from single births holding other factors such as child's sex, household living conditions, mother's education and mother's Body Mass Index (BMI) constant.

Empirical studies have also found that children born shortly after a previous birth have a higher risk of mortality. This is because short intervals between births often leads to the competition for resources such as breastmilk and increases the risk of disease transmission between closely spaced siblings. Also, the risk of prematurity and LBW increases when mothers have not fully recovered from a previous birth. Hobcraft et al (1985) examined the relative importance of a number of demographic determinants on infant and child mortality in 39 countries. They observed a higher than average mortality rate among first born children. They also found that the effects of short birth intervals persisted even after controlling for other factors. Similarly, Ezeh et al (2014) examined the risk factors associated with neonatal mortality in Nigeria using descriptive analysis and cox regression based on a stepwise backwards elimination procedure. Results showed a short birth interval of less than or equal to 2 years to be one of the most significant factors associated with neonatal death. Other well known factors include: child's sex (Adetunji, 1994; Choe et al, 1995); place of delivery and type of birth (Agrawal, 2007; Adelaja, 2011; Akinyemi et al, 2015); diseases/illnesses such as HIV/AIDS, diarrheal and respiratory diseases (Adetunji, 2000; Brabin et al, 2001; Sartorius et al, 2010; Walker et al, 2012; Adegboye and Kotze, 2014; Liu et al, 2016) among others.

A large proportion of inequalities in infant and child mortality have also been attributed to socioeconomic factors. Poverty and/or income in particular has been linked with higher levels and risks of child death through its effect on nutrition, birth weight, exposure to diseases, access and use of health care services, education, knowledge of contraceptives etc. (Sastry, 1997; Ayenigbara and Olorunmaye, 2012; Weightman et al, 2012). More recently, several researchers have suggested that it is not just absolute income that affects child health but the relative distribution of income (i.e. income inequality) within society (Kawachi et al, 1997; Lynch et al, 1998; Wilkinson, 2000 and Pickett, 2006). Social capital i.e. "social relationships, networks and values that facilitate collective action for mutual benefit" (Story, 2015) has recently emerged with the "relative income hypothesis" as a determinant of health at both individual and societal levels although there have been mixed findings as to its impact on health (Hendryx et al, 2002; Hage, 2009; Leonard, 2005). Nevertheless, some studies (Jack and Jordan, 1999; Fantahun et al, 2007; Story, 2015) have found some link between indicators of social capital such as participation in community activities and women's groups, social exclusion/isolation, and feelings of trust and safety among mothers and CMRs.

Education is a major factor highlighted in the literature. Higher literacy rates among women have been found to encourage the adoption of a wide range of healthy behaviours particularly the use of antenatal care, postnatal care and preventive health care services such as immunization services (Caldwell and McDonald, 1982; Vella et al, 1992; Caldwell and Caldwell, 1993; Agha, 2000; Kyei, 2011; Lee, 2016). However, some studies have found that higher levels of education may not guarantee higher levels of service use or lower levels of child mortality. Adetunji (1995) examined the link between maternal education and infant mortality in Ondo state, Nigeria in an attempt to explain why IMRs were higher among children of mothers with secondary education than those with less education. Findings showed other factors such as duration of breastfeeding and maternal age at childbirth were the most significant factors that explained the observed pattern. Similarly, Desai and Alva (1998) examined the effect of maternal education on infant mortality and other child health indicators in 22 developing countries using descriptive statistics and logit regression. Although they found a strong correlation between maternal education and child mortality, further analysis showed that the effect of maternal education on child mortality reduced significantly after introducing individual socioeconomic characteristics and community level controls using fixed effect models. Hence, they suggest that investments in maternal education might not necessarily have a strong positive impact on children's health.

Race/ethinicity has also been identified as an important factor. MacDorman and Matthews (2009) examined patterns and trends in IMRs in the U.S. between 1995 and 2005 and found persistently higher mortality rates among Black American and Puerto Rican infants. Similarly, Hollowell et al, (2011) found marked variations in infant mortality between racial/ethnic groups in the U.K. with the highest rates seen among Pakistani and Caribbean infants and the lowest rates among white and Bangladeshi infants. Researchers in developing countries have also identified ethnicity as a determinant of child mortality. Adedini et al (2015) examined ethnic differences in under 5 mortality in Nigeria based on the 2008 NDHS and found substantial differences in U5MRs with children from Yoruba, Igbo and minority ethnic groups having significantly lower risks of under 5 death than those from the Hausa/Fulani/Kanuri tribes.Studies have also identified other socioeconomic factors such as occupation especially of women (Oliveira et al, 2007; Malderen et al, 2013), gender discrimination (Brinda et al, 2015) among others.

Links between behavoiural/lifestyle factors and under-5 mortality have also been documented. For example, smoking especially second hand smoke and alcohol consumption have been associated with still birth, LBW and perinatal mortality (Chase et al, 2002; Gray et al, 2009; Akinyemi et al, 2016). The duration of breastfeeding has been identified as a key predictor of infant and child mortality especially in developing countries (Akwara, 1994; Mondal et al, 2009; Ghaemmagham et al, 2013; Bello and Joseph, 2014; Sankar et al 2015; Gebretsadiks et al, 2016). Other factors identified include nutrition and dietary choices (Lantz et al, 1998; Uthman, 2009; Victora et al, 2011), Immunization uptake(Haroun et al, 2007; Nwogu et al, 2008; Nankabirwa et al, 2015), the decision to give birth at a health facility with the assistance of a skilled health worker (Adelaja, 2011; Sajedinejad et al, 2015), family planning/use of modern contraceptive methods(Saha, 2012; Chola et al, 2015; McGovern and Canning, 2015) among others. However, isolating the effects of behavioural factors from those of socioeconomic factors can be difficult because there are socioeconomic differentials in the adoption of both risky and healthy behaviours.

Various environmental factors have also been highlighted as directly and indirectly contributing to under-5 mortality particularly in developing countries. Key factors often identified are access to improved water sources and sanitation services. Iyun (2000) found domestic environmental conditions particularly source of drinking water to be key predictors of child mortality in two socioeconomically different towns- Ota and Iseyin- in Southwestern Nigeria. Similarly, Barufi et al (2012) analyzed regional patterns of infant mortality in Northeastern Brazil from 1980 to 2000 and found a strong link between improvements in water and sanitation facilities and observed reductions in infant mortality in the study area. Similarly, Demombynes and Trommlerova (2012) found that the decline in infant mortality observed in Kenya could be explained mainly by the improvements in access to sanitation facilities and the use of improved water sources.Also, Osirike and Idehen (2013) examined the spatial pattern and determinants of infant mortality in Benin city, Nigeria and identified access to improved sanitation services and other housing conditions as key factors.

Air and water pollution has also been shown to explain variations in infant and child mortality. Sohel et al (2010) examined the spatial patterns of foetal loss and infant mortality in Bangladesh using Moran’s I and spatial scan statistic and found a link between spatial patterns of arsenic concentrations and IMRs. Other important environmental factors identified includehousing conditions such as overcrowding and the quality and type of housing (Lee, 1991; Mesike and Mojekwu, 2012; Balk et al 2004; Arslan et al, 2013; Adebowale et al, 2017), air pollution (Loomis et al,1999; Sohel et al, 2010), use of solid fuels in cooking (Janjua et al, 2012; Ezeh et al, 2014; Gbemisola et al, 2016; Naz et al, 2017) and weather conditions (Becher et al, 2004; Gemperli, 2004; Ryland et al, 2013). Aspects of the cultural environment have also been identified in the literature such as gender based violence during pregnancy (Kim and Saada, 2013; Osifo et al, 2016); attitudes/perceptions towards contraceptives and prenatal services (Aremu et al, 2011,Akinyemi et al, 2013), little or no decision making power among women (Kawachi et al, 1999; Shen and Williamson, 1999) among others.

Health care has been identified as a major factor influencing child survival. In developed countries, studies (Macinko et al, 2006; Loudon, 2000; Wang, 2002; Muldoon et al, 2011) have attributed the large decline in child mortality particularly in the late 1930s to 80s to improvements in the overall standard of maternal and child care provided by skilled health workers. On the other hand, studies in Nigeria and other developing countries (Okafor, 1990, Zere et al, 2013; Bandal et al, 2016) have attributed high infant and child mortality rates and inequalities particularly between urban and rural areas to inadequate provision and poor access and management of available health care services. Key indicators identified include the provision and distribution of skilled birth attendants (SBAs) (Terra de souza et al, 1999; Rutstein, 2000; Lawn et al, 2005), the level of access to and utilization of delivery, child care and vaccination services (Mondal et al, 2009; Olusanya, 2010; Buzai, 2013), private and government expenditure on health care (McGuire, 2006; Anyanwu and Erhijakpor, 2007) among others.

Some researchers particularly in developed countries have argued that macroeconomic factors best explain patterns and inequalities in infant and child mortality because of their ability to influence other determinants through international, national and local policies and global forces. Key factors often highlighted include economic productivity indicators such as GDP, GNI and the human development index (Hales,1999; Schell et al, 2007; Lykens, 2009; Bourne, 2012; Barufi et al, 2012; Eneji et al, 2013).It is clear that explaining inequalities in infant and child mortality has and still is the subject of intense ongoing debate worldwide. While some point to the importance of proximate determinants and the socioeconomic factors that operate through them, more recent studies suggest/emphasize that wider socio-political and macro-environmental factors provide better explanations for variations in infant and child mortality rates.

2.2.3 Socioeconomic inequalities in infant and child mortality

The Black Report published in the UK in 1980 is a major study that draws attention to socioeconomic inequalities in health. The study showed that inequalities in health outcomes by SES/SEP had been increasing since world war Π in spite of improvements in overall health over time. Also, the Whitehall study carried out by Marmot and others in the UK began in 1967 and has since examined the health of more than 17,000 civil servants classified according to employment grade. Their study has shown that mortality rates and number of sick leaves from work fell with an increase in the grade of civil servants. Other well known studies with similar findings such as the Ottawa charter and health for all framework (1986); Acheson Report (1988); WHO SDH document (1998; 2003) and recent Marmot reports (2010) have sparked international debates and studies on socioeconomic inequalities in various health outcomes including infant and child mortality. For example, Schneider et al (2002) examined income related trends in infant mortality in the Americas from 1955 to 1995 using analysis of variance, Gini coefficients and Lorenz curves. Socioeconomic inequalities were assessed based on capital Gross National Product (GNP) distribution adjusted for purchasing power. Their study showed that IMRs declined significantly but that trends did not differ significantly among socioeconomic groups.

Castro and Simoes (2009) examined both spatiotemporal and socioeconomic inequalities in infant mortality at regional levels in Brazil between 1980 and 2005. Socioeconomic inequality was assessed using inequity ratios and concentration indices while spatial clustering was investigated using Moran's I. They found significant reductions in overall IMR; however, the relative gap between better off and worse off regions remained unchanged. Hajizadeh et al (2014) carried out a comparative analysis of socioeconomic inequalities in infant mortality in 53 low and middle income countries based on DHS data using relative and absolute concentration indices. Results showed a concentration of infant deaths among socioeconomically disadvantaged groups. Similarly, Quentin et al (2014) assessed and compared socioeconomic inequalities in child mortality based on wealth quintiles in 10 African cities using rate ratios and the concentration index. They identified considerable gaps in child mortality between the least and most disadvantaged wealth groups in all cities. Other similar studies (Wagstaff, 2000; Goldani et al, 2002; Smith et al, 2007; Barros et al, 2010; Axelson et al, 2012; Rumble and Pevalin, 2013) have also investigated and identified social class differences in child mortality and other related health outcomes.

Although there is a long history of research on socioeconomic inequalities in child mortality in developed countries, the need to further reduce child mortality makes the study worthy of investigation particularly in developing countries.

2.2.4 Studies on infant and child mortality in Nigeria

Over the years, several studies have been carried out in an attempt to understand the problem of infant and child mortality in Nigeria. One of the most well known earliest studies on child mortality in Nigeria is the 1979 study carried out by Caldwell. The study examined the relationship between maternal education and child mortality based on two surveys carried out in Ibadan city and parts of Southwestern Nigeria in 1975. Caldwell identified maternal education as a key factor and concluded that improvements in maternal education could significantly influence child mortality. Caldwell's study encouraged more studies on determinants especially on maternal education and infant and child mortality in developing countries although many studies both within and outside Nigeria have since found the effect of maternal education on child mortality to be inconsistent. For example, Iyun (1992) examined the relationship between maternal related factors and child mortality in parts of Southwestern Nigeria and found that age of mother at marriage, BCG vaccination and ownership of certain household items played a significant role in explaining spatial inequalities in child mortality while the impact of maternal education on child mortality was found to be inconsistent at both household and regional levels.

Empirical studies have also examined associations between child mortality and child related biodemographic factors such as child's sex and place of residence as well as other maternal related factors apart from maternal education such as maternal age at first birth, marital status, religion, preceding birth intervals, birth order and household sizeamong others. For example,Lawoyin (2001) examined infant mortality in a rural community in Southwestern Nigeria and found first birth order and mother's age at child birth to be key predictors of infant mortality. Contrary to most studies, he also found that females were twice as likely as males to die in infancy in the study area. Similarly, Ayotunde et al (2009) examined the relationship between maternal age at birth and under 5 mortality in Nigeria based on the 2003 NDHS using bivariate and logistic analysis. Results showed that under 5 mortality was significantly pronounced among the children of young mothers under 20 and older mothers over 35.

Ayenigbara and Olorunmaye (2012) investigated the causes of infant mortality in Akoko Southwest LGA of Ondo state based on information obtained from 210 mothers. They identified short birth intervals, mother's age at birth, poverty and lack of health care as key predictors. Oyefara, (2013) examined the link between maternal age at first birth and child mortality among Yoruba women in Nigeria based on data obtained on 1,000 Yoruba women in Osun state through a questionnaire survey. Using descriptive and statistical techniques they found a significant relationship between age at fisrt birth especially among women under 20 and child mortality across key sociodemographic characteristics of the women interviewed. Adebowale (2017) examined the relationship between high risk birth and infant mortality in Nigeria. He developed an intra-demographic birth risk assessment scheme (IDBRAS) based on information on maternal age at childbirth, parity and preceeding birth interval from the 2013 NDHS. He found that the risk of infant mortality was significantly higher among mothers with medium and high IDBRAS.

Links between child mortality and household socioeconomic and environmental factors have also been examined.For example, Ahonsi (1995) investigated the determinants of neonatal, post neonatal, infant and child mortality based on data from the 1986 Ondo state DHS survey. Child survival was found to be affected mainly by maternal and child factors, sanitation and water supply as well as access to health care services. Bello and Joseph (2014) investigated the determinants of infant and child mortality in Atiba LGA, Oyo state. Data was obtained from 150 respondents and analyzed using both descriptive analysis and regression. Poverty, malaria, postnatal care and breastfeeding as major determinants of infant and child mortality in the study area. Edeme et al (2014) examined the relationship between household income and child mortality based on the 2012 Multiple Indicator Cluster Survey and 2012 General Household Survey. Findings showed that household income had a significant impact on neonatal mortality but not on under 5 mortality. Similarly, Izugbara (2014) examined the association between household level variables and under 5 mortality in Nigeria based on the 2008 NDHS and identified poverty, number of children ever born in a household, number of children under 5 in the household, place of residence, maternal and paternal age and level of education as critical determinants of under 5 mortality. Adebowale et al (2017) investigated the relationship between housing materials and under 5 mortality in Nigeria based on the 2013 NDHS and found that the risk/probability of under 5 mortality was higher among children living in houses built with poor/inadequate building materials. Similar studies include those by Iyun, 2000; Fink et al, 2011; Koffi et al, 2013; Adarabioyo, 2014; Ezeh et al, 2014; Gbemisola et al, 2016; Yaya et al, 2017.

Empirical studies have also examined relationships between infant and child mortality and health and health care related factors in Nigeria and have identified factors such as the provision, access and use of antenatal and child health care services, infant feeding practices, place of delivery and assistance at birth as important determinants of under 5 mortality. For example, Findley et al (2013) found a significant increase in early breastfeeding and other Maternal, Newborn and Child Health (MNCH) related behaviours as well as declines in infant and child mortality due to the MNCH program in rural communities in Katsina, Yobe and Zamfara state between 2009 and 2013.Similarly, Adedini et al (2014) examined the effects of barriers to health care on under 5 mortality in Nigeria based on the 2008 NDHS using bivariate and multivariate analysis. They found barriers to health care to be an important predictor of child survival. However, the risk of under 5 mortality was significantly higher among children whose mothers had cultural barriers to health care compared to those that had resource-related and physical barriers to health care. Nwaokoro et al (2015) identified pre-pregnancy, antenatal and post-natal factors such as birth spacing, birth complications, place of delivery among others as key determinants of infant mortality in Owerri, Imo state. Similarly, Adebowale and Udjo (2016) examined the relationship between infant mortality and a maternal health care access index based on the 2013 NDHS and found that IMRs were significantly higher among children born to women with little or no maternal health care access.

Bako et al (2016) examined levels of under 5 mortality in Kaduna state based on data obtained through a questionnaire survey of 386 households. They identified distance to health care services as well as age at first marriage, current marital status, level of education and length of breastfeeding as major factors significantly associated with U5MRs in the state.These and similar determinant studies(Ogunjimi et al, 2012; Smith-Greenaway, 2013; Adedini, 2015; Chukwuocha et al, 2014; Enwerem et al, 2014; Chukwu and Okonkwo, 2015; Adewuyi et al, 2017; Aregbeshola and Khan, 2018) are mostlylocal studies that provide information on spatial variations in infant and child mortality and their determinants in a particular community/LGA at a particular time though not on changes over time. Hence their findings are generally not comparable over both space and time due to differences in data collection/processing, methodologies, time of study etc. They also largely ignore the influence of wider socioeconomic and macroeconomic factors.

A significant proportion of studies on infant and child mortality in Nigeria have been based on hospital records of under 5 deaths. For instance, Ezechukwu et al (2004) investigated the causes of neonatal mortality based on records of infant deaths between

1998 and 2001 obtained from Nnamdi Azikwe University Teaching Hospital, Nnewi. They identified prematurity, birth asphyxia and sepsis as the major causes of deaths. Similarly, Onayade et al (2006) assessed socio-demographic and other determinants of neonatal mortality based on records from Wesley Guild hospital, Ilesha, Nigeria and identified teenage pregnancy, LBW, premature births and neonatal tetanus as factors positively associated with neonatal death. Ojikutu (2008) examined the level and causes of under 5 mortality in Lagos State, Nigeria based on hospital records from 1997-2002 and questionnaires administered to 120 mothers. Data was analyzed using descriptive statistics and chi-square test. Findings showed maternal education and cultural beliefs on health and health care to be important determinants. Also, Bamgboye et al (2012) examined levels and causes of under 5 mortality in Lagos state based on hospital records from 2005-2007 and identified respiratory, gastrointestinal and infectious diseases as the major causes of under 5 mortality in the state. Other similar hospital based studies include those by George et al, 2009; Ekwochi et al, 2014 and Yaiba et al, 2015 among others. These studies have mainly identified direct and indirect medical causes of infant and child mortality in Nigeria but ignored spatial patterns of child mortality. Nevertheless, they have provided some insight into trends in infant and child mortality in Nigeria. The importance of improving the quality and availability of prenatal, delivery and postnatal health care services for child survival have been highlighted.

Improvements in the availability of nationally representative data and the adoption of new technologies such as GIS mapping, has led to the emergence of large scale cross-sectional studies on infant and child mortality in Nigeria. For instance, Adebayo and Fahmeir (2004) investigated the spatial pattern of neonatal and post neonatal mortality across states in Nigeria based on data from the 1999 NDHS. They also examined the non linear effects of age at child birth among mothers using geoadditive categorical regression models. They found spatial variations in both neonatal and post neonatal mortality as well as in their determinants. In a similar study carried out in 2005, Adebayo and Fahmeir examined the spatial pattern of child mortality in Nigeria using similar methodologies and the 1999 NDHS dataset. Children born to mother's that receive antenatal care, children born in health care facilities and those born after high preceding birth intervals were found to have less risk of dying before the age of 5. Similarly, Antai (2011) assessed regional variations in under 5 mortality in Nigeria based on data from the 2003 NDHS. He found that the risk of under 5 mortality was significantly higher for children of mothers with little or no education, mothers that did not use prenatal health care services and mothers resident in the Northeast and Southsouth regions.Fayehun and Omololu (2011) examined the impact of socio-cultural practices among different ethnic groups on child mortality and morbidity in Nigeria based on data from the 2003 NDHS and 40 focus group discussions and indepth interviews among selected ethnic groups. The lowest infant and under 5 deaths were among Yoruba children. However, variations in child mortality observed among different ethnic groups were found to be more of a reflection of the household environmental and socioeconomic conditions of mothers. Using descriptive statistics and logistic regression, Adepoju et al (2012) investigated the determinants of child mortality in rural Nigeria based on the 2008 NDHS and identified age at first birth, maternal education, child's sex and whether the child has ever been breastfed as significant factors influencing child mortality in rural Nigeria. Similarly, Uthman et al (2012) examined the spatial pattern of under 5 mortality in Nigeria using league tables, funnel plots, control charts and Moran's I. Findings showed wide variations across states though no attempt was made to explain them.

Fagbamigbe and Alabi (2014) examined differences in IMRs and their determinants between Northeastern and Southwestern Nigeria based on the 2008 NDHS. Findings showed significant differences in IMR by household socioeconomic and environmental characteristics between both zones. Similarly, Akinyemi et al (2015) examined the regional pattern and determinants of neonatal mortality in Nigeria between 1990 and 2013 using multiple proportional hazard models. Findings showed little improvement in neonatal survival. However, they identified antenatal care, health care delivery and short birth intervals as factors significantly associated with neonatal deaths. Adewuyi et al, (2017) investigated rural-urban differences in IMRs and associated risk factors in Nigeria based on the 2013 NDHS using multivariate logistic analysis. Results showed rural- urban differences with the highest mortality rates in rural areas. They also identified birth size, birth interval and ceasarian section delivery as key predictors of IMR in rural areas and poverty, birth size, male gender, birth interval, maternal obesity and ceasarian section delivery as key predictors of IMRs in urban areas. Similar studies include those by Adetoro and Amoo, 2014; Adekanmbi et al, 2015; Dahiru, 2015; Ezeh et al, 2015; Gayawan and Turra, 2015; Adewemimo et al, 2017; Morakinyo and Fagbamigbe, 2017 among others. Some of these studies have emphasized rural-urban and North-South differences in under 5 mortality in Nigeria.

From the foregoing, studies on infant and child mortality in Nigeria are mainly small scale or regional studies that have failed to examine and explain variations and long term changes in infant and child mortality at multiple geographical scales especially at the state level. Secondly, most studies have examined infant and child mortality solely within a proximate determinant framework. An overwhelming number of studies have focused almost exclusively on individual/household level explanatory factors thus ignoring other dimensions such as macroeconomic/structural factors. Thirdly, some researchers have focused solely on North-South or rural-urban differences in infant and child mortality without assessing socioeconomic inequalitites between better off and worse off groups over space. In addition, long term changes in socioeconomic inequalities in child mortality has not been investigated which is critical in assessing the impact of policies and economic changes on child survival amongst all socioeconomic groups. Fourthly, researchers have assessed health inequities in terms of income/wealth and/or education. However, one Socioeconomic Status (SES) indicator is unlikely to fully capture all dimensions of the relationship between SES and infant and child mortality over space. Finally, some reports (UN-IGME 2017; UNICEF 2016/17) have shown that infant and child mortality rates have fallen in Nigeria. However, researchers have not thoroughly examined the nature and magnitude of this decline across states and socioeconomic groups over time and the changes in the factors that explain them.

This study addresses these gaps by adopting a multiscale approach to the investigation and analysis of spatial, temporal and socioeconomic inequalities in child mortality and their determinants thereby providing a comprehensive picture of infant, child and overall under 5 mortality in Nigeria over space and time. This will identify the relative contributions of key determinants to the spatiotemporal pattern of infant and child mortality across states in Nigeria which is important for designing effective policies/interventions. Exploring the long term trends in child mortality among socioeconomic groups will indicate the magnitude of changes in infant and child mortality relative to SES thus providing information useful for assessing the effectiveness of past policies/interventions. Simultaneously comparing multiple indicators of SES and their impact on infant and child mortality and the use of absolute and relative inequality measures will enable a more meaningful comparative analysis of child mortality over space, time and amongst socioeconomic groups. It will also address international debates as to whether the choice of inequality measure can lead to significantly different conclusions about whether socioeconomic inequalities in child mortality are increasing or decreasing. This study also showcases the importance of monitoring and measuring long term spatial, temporal and socioeconomic inequalities in infant and child mortality and their determinants.

2.3 Conceptual framework

Researchers have put forward several conceptual frameworks and theories for explaining inequalities/disparities in health. However, the theoretical basis for this study will be a synthesized model based on the following:

- The concepts of equity in health and the social gradient in health
- The Mosley and Chen (1984) model
- The WHO Commission of Social Determinants of Health (CSDH, 2008) Model.

2.3.1 The concept of equity in health and the social gradient in health

The concept of equity in health is based on the argument that everyone should have equal/fair chance of survival, fair access to health care resources and the right to enjoy the highest sustainable standard of health in society irrespective of their location and Socioeconomic Status/Socioeconomic Position (SES/SEP) (WHO, 1946; Murray and Marks, 2007). The concept of equity in health therefore reflects a concern for the determinants that explain differences/disparities in health (health inequalities) as well as issues of unfairness and injustice in health (socioeconomic inequalities or inequities in health) (Kawachi et al, 2002; Whitehead and Dahlgren, 2007).

The concept of equity in health has grown in prominence in the last decade and has been incorporated into international and national health policies particularly with the increasing evidence of a social gradient in health outcomes including child mortality in both developed and developing countries (Black report, 1980; Wagstaff, 2000; Goldani et al, 2002; Hajizadeh et al, 2014). The social gradient of health is the “stepwise or linear decrease in mortality (and morbidity) with increasing SES/SEP” (Marmot, 2004). It refers to a phenomenon whereby individuals/groups with the lowest SES have higher mortality (and morbidity) levels than those with higher SES. Its impact is sometimes stated in terms of a ‘shortfall in health’ i.e. “the number of lives that could have been saved if all groups in society had the same high level of health (or SES) as the most advantaged group” (Donkin, 2004).

2.3.2 The Mosley and Chen (1984) Model

The Mosley and Chen (1984) Model is regarded as one of the most detailed and systematic frameworks for the study of child survival in developing countries. The Mosley and Chen theoretical framework is based on the following key assumptions:

1. In an optimal setting over 97% of newborn infants can be expected to live through their first 5 years of life.
2. A decline in the chances of child survival is due to the operation of social, economic, biological and environmental forces.
3. Socioeconomic (or exogenous) determinants i.e. social, cultural and economic factors operate through a number of proximate (or endogenous) determinants i.e. bio-demographic factors to determine child survival.
4. Specific diseases and nutrient deficiencies of the surviving population should be viewed as biological indicators of the operations of proximate factors.
5. Child mortality is the result of the cumulative consequences of multiple disease processes including their biosocial interactions.

Mosley and Chen's framework assumes that child health is a function of various socioeconomic and biological factors. They suggest that socioeconomic determinants can be categorized into three levels.

1. Individual level factors e.g. norms, attitudes and beliefs about disease causation
2. Household level factors e.g. income/wealth
3. Community/Area level factors e.g. health care systems, political economy, ecological factors, etc.

They argue that these factors determine child health and survival through a set of 14 biological or proximate factors (also referred to as intermediate or intervening factors)divided into five main categories (Figure 2.1):

1. Maternal related factors e.g. birth interval and maternal age
2. Environmental contamination e.g. source of drinking water and food, sanitary measures etc
3. Nutrient deficiency (malnutrition)e.g. breastfeeding patterns
4. Injury (accidental or incidental)
5. Personal illness and control e.g. health care and individual preventive measures.

The Mosley and Chen Model builds on previous models such as the Davis and Blake (1950) model of fertility which suggests that social and economic factors affect fertility

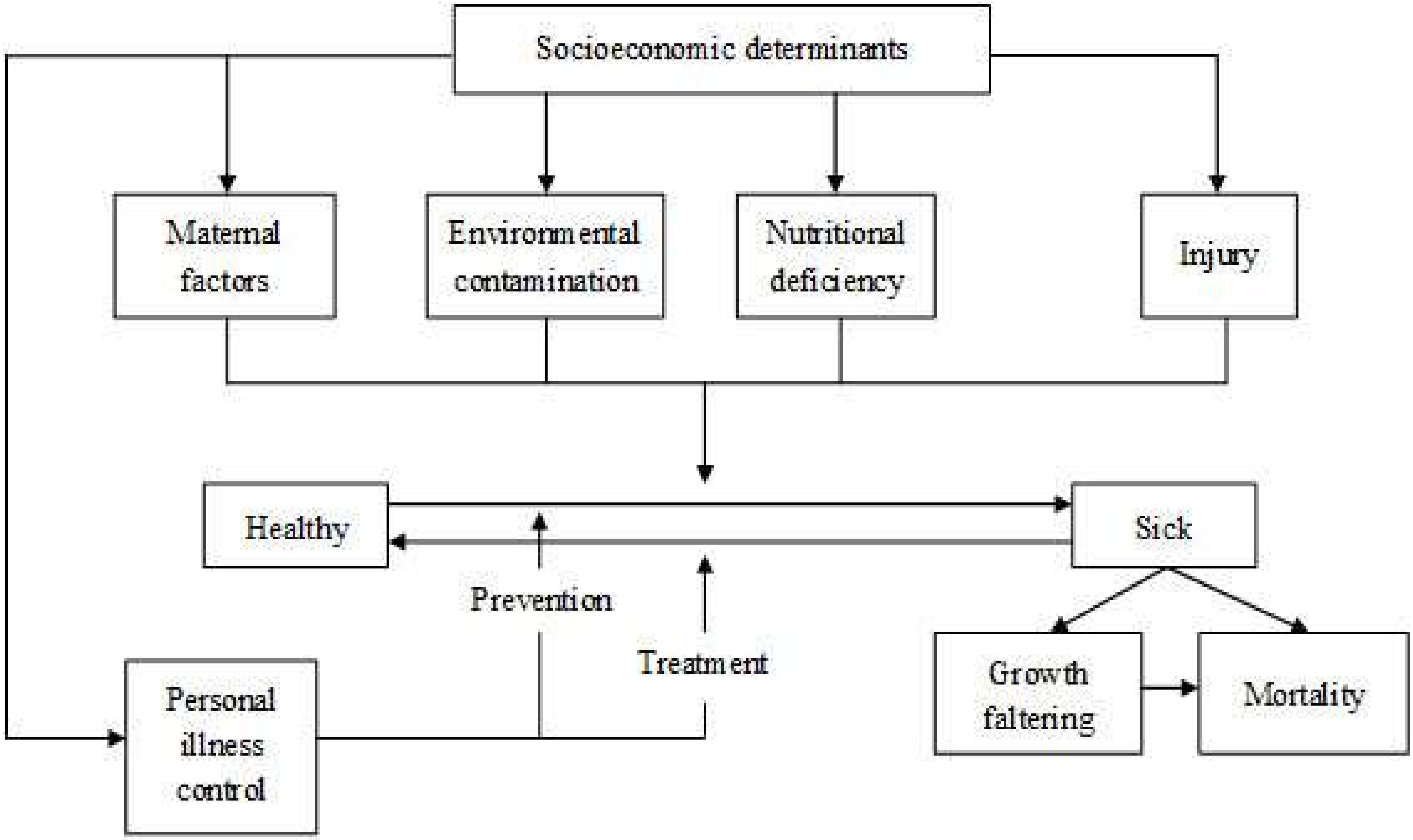


Figure 2.1: The Mosley and Chen 1984 Model

indirectly through intermediate factors. The extended version of this model incorporates structural/macroeconomic conditions that directly or indirectly influence proximate factors (Hill, 2003). The Mosley and Chen model is therefore a multidisciplinary framework for understanding child mortality as it combines social, economic, medical and biological explanations of child mortality.

2.3.3 The WHO Commission of Social Determinants of Health (CSDH, 2008) Model

The WHO CSDH Modeldescribes the overlapping multidirectional pathways that allow social determinants of health (SDH) (such as income, education, employment, housing conditions etc.) "when combined with social capital, political influences, individual characteristics and the health care system" (Beltran et al, 2011) to affect health outcomes.
The CSDH model (Figure 2.2)is made up ofthree key components:

1. The socio-economic-political context e.g. macroeconomic policies
2. Structural determinants and SES/SEP defined by income, education, occupation, gender, social class etc.
3. Intermediate factors e.g. behavioural, psychological and biological factors

The CSDH model shows that social, cultural and political mechanisms produce and maintain social hierarchiesin society by assigning individuals to different socioeconomic groups. The difference in SES/SEP then leads to differences in the exposure to health risk conditions and differences in the consequences or outcome of disease. The socioeconomic-political context includes a broad set of factors divided into 5 groups:

1. Governance
2. Macroeconomic policy e.g. trade policies
3. Social policies e.g. housing
4. Public policy e.g. education and health care
5. Culture and societal values

The Structural determinants and SES/SEP component emphasizes the interaction between the socioeconomic-political context and SES/SEP. Structural determinants generate social class divisions and define individual SES/SEP. Structural stratifiers include income, education,occupation, ethnicity and gender. The CSDH framework refers to the socioeconomic-political context, structural determinants and SES/SEP as social determinants of health inequities. Furthermore, the model suggests that these underlying structural determinants operate through a set of intermediate factors to influence health outcomes. These intermediary determinants are divided into 4 main categories:

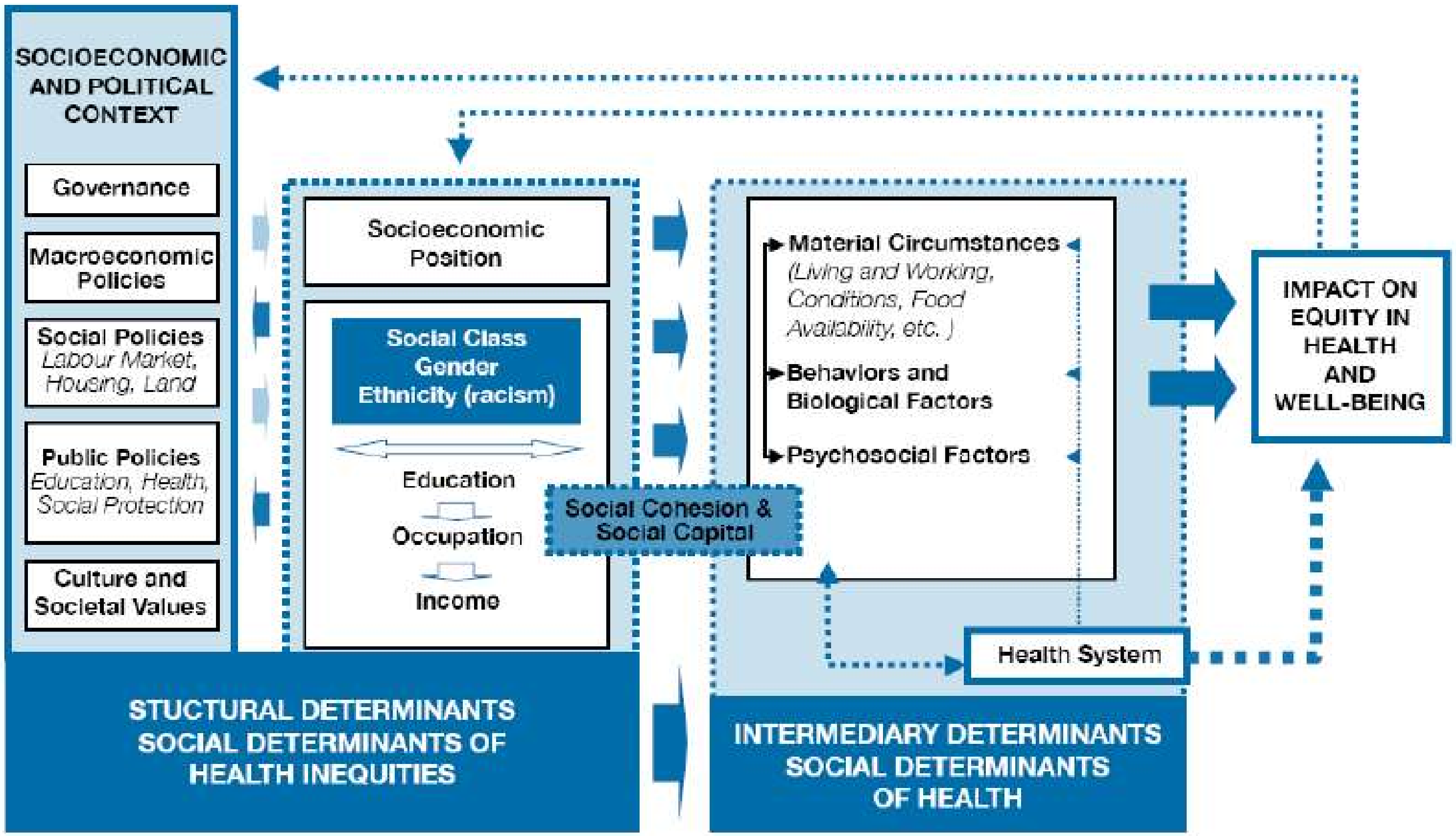


Figure 2.2: The WHO CSDH Model (WHO, 2008)

1) Material/socioeconomic circumstances linked to the physical environment e.g. living conditions
2) Psychosocial conditions e.g. lack of social cohesion and capital
3) Biological and behavioural/lifestyle factors e.g. nutrition and genetic predisposition to disease
4) Health care system.

The unequal distribution of these intermediary factors and differences in exposure to risk make up the main mechanism through which SES/SEP generates health inequalities.The CSDH model draws heavily from the Diderichsen and Hallqvist (1998) model of the social production of disease which suggests that health inequalities are generated and maintained in society through social structure or relations which create differences in SES/SEP which in turn produces differences in access to health resources and exposure to health damaging conditions (Whitehead et al 2001). It also draws from previous theories such as the materialist theory, psycho-social theories and eco-social theories. The CSDH model differs from other models because it emphasizes SES/SEP as the main determinant of inequity in health outcomes. Another key feature is that it recognizes the role of socio-political factors and emphasizes health system factors as a social determinant of health. The CSDH model provides a summary of major categories of determinants and how they either function alone or interact with each other through multiple pathways to result in inequalities in health over space and time (Krumeich, and Meershoek, 2014). This model therefore serves as a good guide for the study of child health outcomes.

2.3.4 A synthesized model

This study adopts a synthesized model based on the concepts/models earlier discussed (Figure 2.3). The model suggests that child health is determined by various macroeconomic and socioeconomic factors and that these factors work through proximate factors to determine child health outcomes. However, it is the uneven distribution of these determinants over space and differences in the access to and or experience of these determinants, that explain spatial and socioeconomic inequalities (or disparities) in child health outcomes. For instance, differences in SES (i.e. differences in the social and economic ranking/position of a person or group relative to others) means largely unfair differences in opportunities for education and employment, access to antenatal care etc. which not only influences child health generally but can lead to significantly large differences in the chances of survival across groups. In addition, the model recognizes the geographic concept of location/place as an important factor for child health based on the

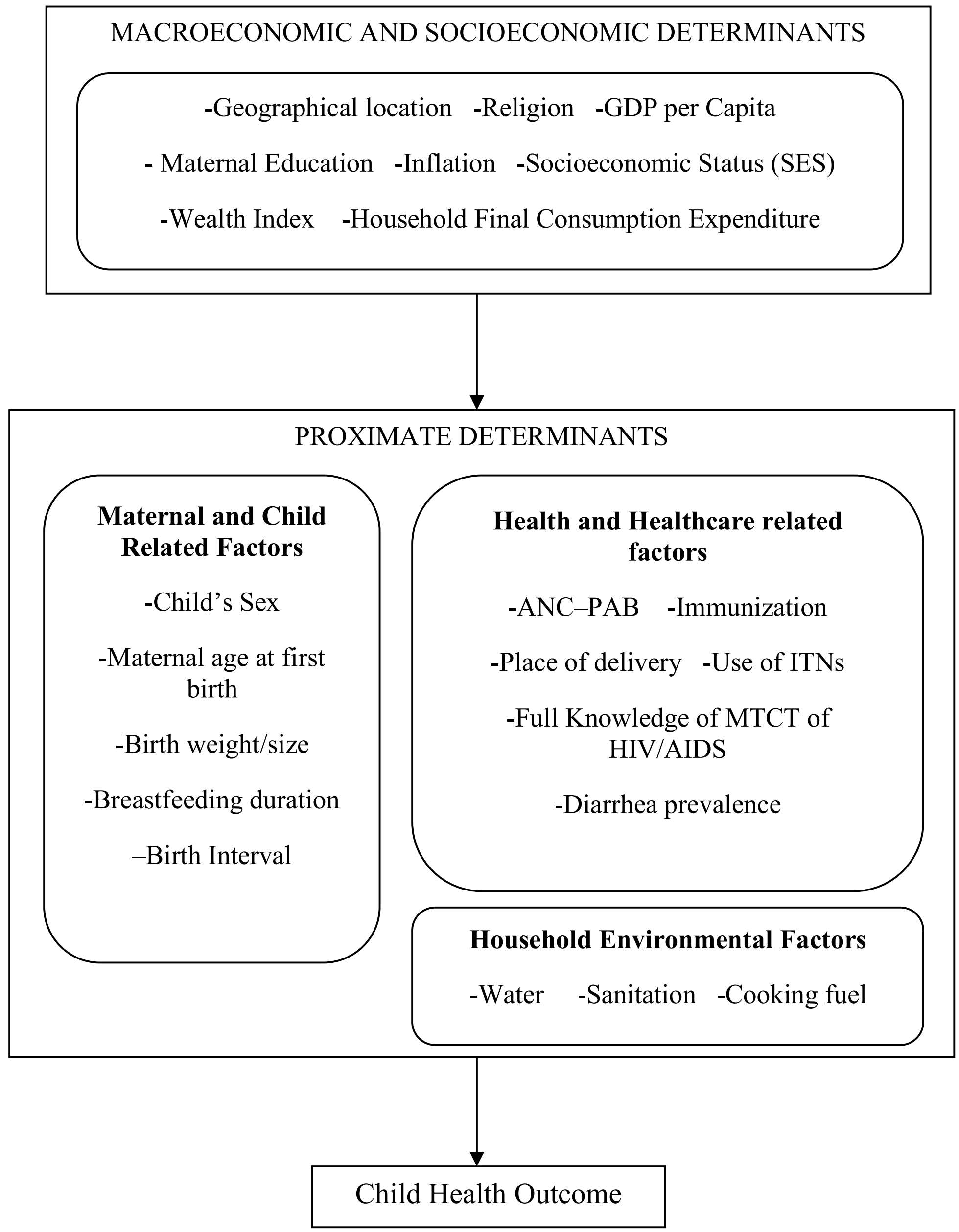


Figure 2.3: A Synthesized Model of Infant and Child Mortality in Nigeria (Author, 2019)

theory of spatial autocorrelation which is the basis of spatial pattern analysis in geographic research. Investigating and regularly monitoring the spatial and socioeconomic inequalities/disparities in child health outcomes and their determinants is necessary in developing effective policies that will lead to improvements in child health and survival for all children irrespective of their location and socioeconomic conditions.

The model improves on the WHO CSDH model that ignores the impact of geographic location on health and the Mosley and Chen Model that ignores the role of both socioeconomic status (SES) and geographic location in child health outcomes. The model provides insight into the factors and processes linked to infant and child mortality and has helped to guide the formulation of the following hypotheses: (1)There is no significant clustering of infant and child mortality in Nigeria, (2)There are no significant variations in infant and child mortality over time across states in Nigeria, (3) There is no significant decline in the trend of infant and child mortality in Nigeria and (4)There is no significant relationship between infant and child mortality and bio-demographic, socioeconomic, macroeconomic, health care related and environmental variables in Nigeria.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology used in this study. It deals with the type and sources of data, sampling frame and size, sampling technique and data collection procedure and most importantly the research hypotheses and the techniques of data analysis.

3.2 Research design

This study is both a descriptive and quantitative study based on large scale secondary data collected at the national, regional, state and rural-urban levelover time. This study hasadopted a multi-scale approach to address the research questions and objectives.

3.3 Type and sources of data

This study was based on secondary data from two main sources:

1) The Nigeria Demographic and Health Survey (NDHS)
2) World Bank World Development Indicator Database

3.3.1 The Nigeria Demographic and Health Survey (NDHS)

Since its establishment in 1984, the Demographic and Health Surveys (DHS) program has "collected, analyzed, and disseminated accurate and representative data on population, health, HIV and nutrition through more than 400 surveys in over 90 countries" (ICF International, 2021).The DHS program is coordinated by ICF International in partnership with different agencies both internationally and within the countries where the surveys are conducted. The surveys are funded by the United States Agency for International Development (USAID). Contributions from organizations such as the United Nations Population Fund (UNFPA) and the United Nations Children's Fund (UNICEF) as well as from the participating countries, also provide support for the surveys. The DHS data is widely viewed to be of high quality because of its high response rate, national coverage, high quality interviewer training and standardized data collection methods within and across countries which allows comparability across populations over time (Corsi et al, 2012; Uthman et al, 2012; Adekanmbi et al, 2015).

The NDHS in particular, is a large scale nationwide survey regularly conducted in Nigeria by ICF International, Calverton Maryland, USA and the National Population Commission (NPC) with the first survey carried out in 1990. TheChildren'sRecode (.sav) files for the 2003, 2008 and 2013 surveys used for this study contain records for each child under 5 born to each respondent which includes information on the date, month and year of birth and death (if dead), etc. as well as information on mothers for 5 years prior to each survey. Permission to download and use the 2003, 2008 and 2013 NDHS datasets was obtained from ICF international (See Appendix 1). Infant, child and under 5 mortality rates at thenational,regional,stateand rural-urban level were directly derived using the direct approach based on data on birth histories retrospectively collected during the NDHS covering a 5 year period before each survey.DHS sample weights were applied. Infant Mortality Rate(IMR) was defined as the number of deaths in the first year of life per 1,000 live births while Under 5 Mortality Rate(U5MR) was defined as the number of under 5 deaths per 1,000 live births. Child Mortality Rate (CMR) was defined as the number of child deaths i.e deaths between the first and fifth birthday per 1,000 children surviving to the age of one.

3.3.2 The World Bank World Development Indicator Database.

The World Bank established in 1945, provides open access to its World Development Indicator (WDI) database which contains national, regional and global level data on over 800 indicators including infant and under 5 mortality. The World Bank datasets are provided in excel format which can be directly accessed online. Annual infant and under 5 mortality rates for 25 years (1990-2015) were obtained from the World Bank along with data on key explanatory variables.

3.4 Sampling frame and size

Each NDHS has been based on the National Population Commission (NPC) census sampling frames designed to collect data at the national, zonal, state and rural-urban levels. The sampling frame provides a complete list of all clusters or enumeration areas (EAs) also referred to as primary sampling units (PSU) as well as the total population/households in each of the EAs. The sample design for the 2003, 2008 and 2013 NDHS was nationally representative. The DHS sample size is determined as the number of households/individuals that need to be interviewed in order to have statistically reliable survey results for an area or the country as a whole. The main target population are women of reproductive age 15-49 and their children although men are also interviewed in more recent surveys. Data was obtained on 6029, 28647 and 31482 children under 5 in the 2003, 2008 and 2013 NDHS, respectively (See Appendix 2). For further details, see the NDHS reports for 2003 (pp 211-216), 2008 (pp 457-462) and 2013 (pp 377-382).

3.5 Sampling technique and data collection procedure

The Demographic and Health Survey adopts a two-stage stratified sampling technique (Figure3.1). The first stage involves selecting clusters or EAs with probability proportional to population size. First of all, the EAs in the sampling frame are grouped into homogenous subgroups or strata by rural/urban areas and administrative units. This stratification process allows a representative sample to be drawn from each stratum orsubgroup. The number of clusters selected in each stratum depends on the ‘sample take’ i.e. the number of households that need to be interviewed per cluster to derive a representative sample. Clusters are randomly selected with probability proportional to population size.After the clusters are selected, all the households in each cluster or EA which make up the sampling frame are listed and updated during the reconnaissance survey. The household listing and updating exercise is carried out by the survey staff. Maps are drawn in the field showing positions of important landmarks and the location of structures in each cluster. This is because structures may have been built or old ones demolished or abandoned by families since the original sampling frame was created by the NPC. They also update information on the households themselves. The household listing exercise provides a complete list of residential households and also provides a precise map which guides the interviewers so they can carry out the actual survey more efficiently.

In the second stage, households to be interviewed per cluster are selected from updated household listings by equal probability systematic sampling.The DHS administers face to face interviews using questionnaires at the individual and household level.During each survey, women aged 15-49 were asked to provide a detailed history of live births in chronologicalorder going back 5 years before the survey. Information was collected on the sex, month and year of birth, number of births, survival status of all births, current age (if the child is alive) and age at death (if the child is dead). They also collected data on fertility, demographic characteristics, nutritional status of women and children, anthropometric indicators, health care, wealth/household assets among others. The DHS have extensive procedures for ensuring data quality and minimizing errors. These include the pretesting of all aspects of the data collection procedure before the actual survey, entering data almost simultaneously with data collection in order to monitor the quality of the survey teams and regular supervision of interviewers among others.Further details can be obtained from individual NDHS reports available onwww.measuredhs.com.

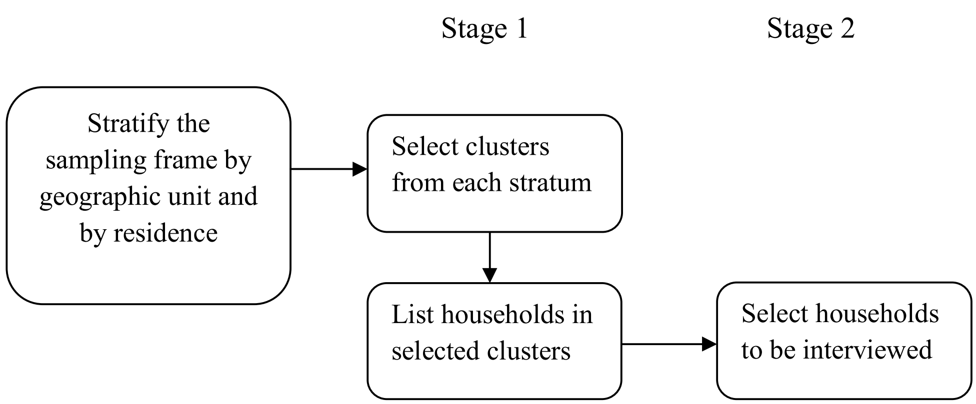


Figure 3.1: DHS Sampling Procedure

The World Bank derives itsinfant and child mortality figures by first of all compiling and assessing the quality of all available data from all nationally representative surveys such as the DHS, MICS and living standard measurement surveys (LSMS) as well as data from vital registration systems and censuses. Secondly, they apply a Bayesian B-spline reduction model, extrapolate to a target year and estimate uncertainty intervals (UN-IGME, 2015). Further details can be obtained fromwww.childmortality.org/methods.

3.6Research hypothesis and techniques of data analysis

3.6.1 Research hypotheses

The following hypotheses were formulated and tested in this study:

1) There is no significant clustering of infant and child mortality in Nigeria.
2) There are no significant variations in infant and child mortality over time across states in Nigeria.
3) There is no significant decline in the trend of infant and child mortality in Nigeria.
4) There is no significant relationship between infant and child mortality and bio-demographic, socioeconomic, macroeconomic, health care related and environmental variables in Nigeria.

3.6.2 Techniques of data analysis

3.6.2.1 Descriptive analytical techniques

A combination of descriptive statistics (frequency distributions, percentages, mean, standard deviation and coefficient of variation), tables and graphs was used to explore datasets and assess relationships between variables before carrying out more detailed and advanced analysis involving inferential statistics. Choropleth maps were generated for mortality rates using ArcGIS.

3.6.2.2 Spatial pattern analysis and mapping

Global and Local Morans I and Hot spot analysis(Getis ord Gi* statistic) were used to examine the pattern of infant, child and under 5 mortality rates and test for the presence of clusters in their distribution among states in Nigeria. The Global Moran's Index presented by Moran (1948, 1950) is a measure of spatial autocorrelation used to investigate whether or not there is a pattern of overall clustering of a variable over space. Moran's I measures spatial autocorrelation based on feature locations and their attribute values and can be used for both point and polygon data. Moran's I varies from -1 through 0 to +1. A Moran's I of

+1 indicates a high positive spatial autocorrelation (clustering), 0 indicates no spatial autocorrelation (random pattern) and -1 indicates a high negative spatial autocorrelation (dispersion). The Moran's I tool in ArcGIS calculates a Moran's Index value, z score (measure of standard deviation) and p value (probability that the observed pattern was created by some random process) to indicate the overall distributional pattern. When z scores are between -1.96 and +1.96 then a p value larger than 0.05 means the null hypothesis (which states that the pattern is random) is accepted. On the other hand, a p value less than the confidence level indicates a statistically significant spatial autocorrelation hence the null hypothesis is rejected. The null hypothesis can also be rejected if p value is small and z score falls outside the desired confidence level (Figure 3.2). Moran's I is expressed as:

$$I = \frac{N \sum_{i=1}^{n} \sum_{j=1}^{n} wij(Xi - \bar{X})(Xj - \bar{\ })}{(\sum_{i=1}^{n} \sum_{j=1}^{n} wij) \sum_{i=1}^{n} (Xi - \bar{X})^2} \quad (3.1)$$

Where,

N= no of observations Xi= variable value at a particular location

$\bar{X}$= mean of the variable wij = weight indexing location i relative to j

Xj = variable value at another location

However, the global Moran's I only evaluates whether the overall pattern is clustered, dispersed or random. It does not indicate where specific patterns occur. In other words, itdoes not identify whether there are statistically significant clusters of infant and child mortality in the study area. Hence a local measure of spatial autocorrelation was also adopted.

The Local Moran's Index by Anselin (1995) is a local indicator of spatial autocorrelation (LISA) measure used to identify the location of clusters (i.e. areas where similar values whether high or low are statistically clustered in space). In other words, Local Moran's Iidentify local variations in a variable by focusing on the relationshipbetween an area's attribute value and the attribute value of its neighbours. Local Moran's I was used to identify spatial outliers as well as concentrations of high and low infant, child and under 5 mortality rates among states in Nigeria. The local Moran's I tool calculates a local Moran's Index value, z score, p value and cluster/outlier type

(Cotype) which distinguishes between a statistically significant cluster of values (High-High, Low-Low)

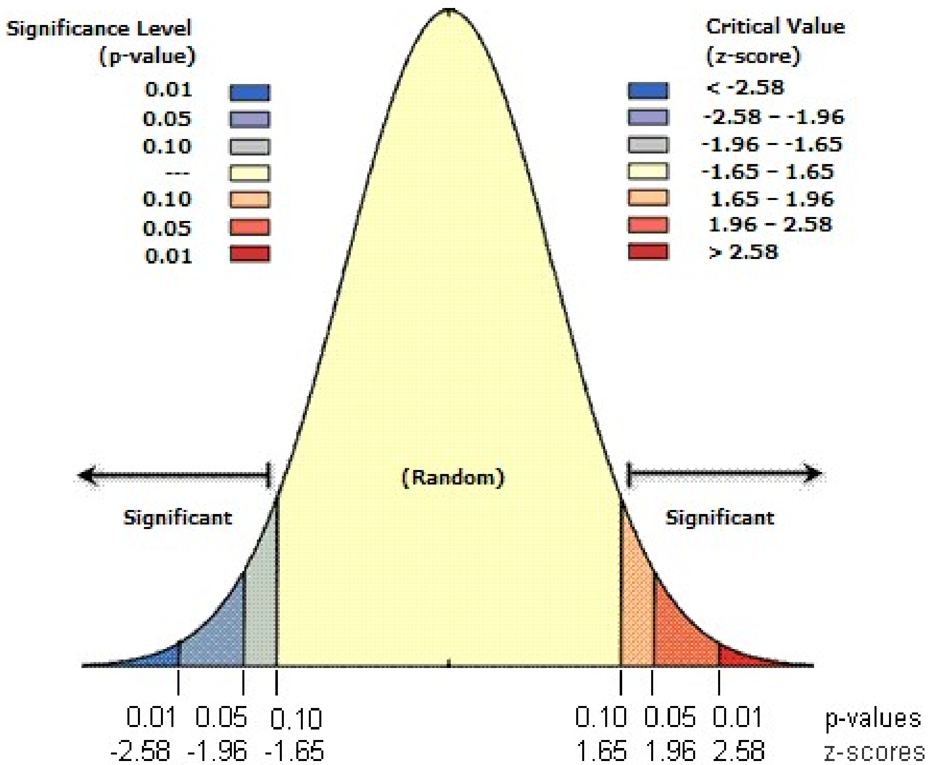


Figure 3.2: Visual Interpretation of p-values and z-scores (ESRI, 2013)

and spatial outliers (Low-High, High-Low) at the 0.05 confidence level.A positive value indicates that the state is surrounded by others with similar values (either high or low). Such a state is part of a cluster while a negative value indicates the state is surrounded by others with dissimilar values. Such a state is an outlier. The local Moran's I is expressed as:

$$Ii = \frac{xi - \bar{X}}{S_i^2} \sum_{j=1, j \neq i}^{n} wi, j \ (x_j - \bar{X}) \quad (3.2)$$

Where;

xi = variable value for feature i $\bar{X}$= mean of the variable

wij = spatial weight between feature i and j

$S_i^2 = \frac{\sum_{j=1, j \neq i}^{n} wi,j \ (x_j - \bar{X})^2}{n-1}$ and n= total number of features

Local Moran's I identifies spatial clusters but it does not indicate or measure the degree of clustering; hence a hot spot analysis (Getis-Ord Gi* statistic) was also adopted.

The Getis-Ord Gi* statistic is a local measure of spatial autocorrelation that identifies hot spots (statistically significant spatial clusters of high values) or cold spots (statistically significant spatial clusters of low values). A hot spot i.e. an area with a relatively high infant and child mortality rate value is statistically significant only when it is surrounded by other areas with high values while a cold spot i.e. an area with a relatively low infant and child mortalityrate value is statistically significant only when it is surrounded by other areas with low values. The Gi* statistic tool calculates a z score and p value for each state and provides a range of confidence levels indicating areas that deviate the most from the assumption of randomness. A high positive z score and small p value indicates the clustering ofstatistically significant high values (hot spots) while a low negative z score and small p values indicates the clustering of statistically significant low values (cold spots). A z score near zero indicates no obvious spatial clustering. The higher (or lower) the z score the more intense the level of clustering. The Getis-Ord local Gi* statistic is expressed as:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j} x_j - \bar{X} \sum_{j=1}^{n} w_{i,j}}{\sqrt{\frac{s\left[\sqrt{n \sum_{j=1}^{n} w_{i,j}^2 - (\sum_{j=1}^{n} w_{i,j})^2}\right]}{n-1}}} \quad (3.3)$$

Where;

xj = variable value for feature j wi, j = spatial weight between feature i and j

n= total number of features $\bar{X}= \frac{\sum_{j=1}^{n} x_j}{n}$ S = $\sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2}$

Moran's I and Getis-Ord Gi* statistics are inferential statistics i.e. their results are always interpreted in terms of the null hypothesis (no spatial correlation) with the aid of p values and zscores which are measures of statistical significance. These spatial autocorrelation measures are calculated based on a spatial weights matrix (wi,j) which measures the relative location of all points i and j. A polygon contiguity matrix which uses only common boundaries to define neighbours is used in this study.

3.6.2.3 Statistical Analysis

Analysis of Variance (ANOVA) was used to examine whether there were statistically significant differences in infant, child and under 5 mortality rates over time across states based on data from the 3 NDHS surveys. ANOVA was also carried out for infant, child and under 5 mortality rates across states based on wealth Index, child's sex, mother's level of education and mother's age group. A Post hoc test (Tukey HSD test) was carried for statistically significant results ($p \leq 0.05$) to identify specific groups that are significantly different. An effect size (i.e. the size of the difference or the overall effect of the ANOVA) was also calculated using Eta squared (η^2):

$$\eta^2 = \frac{Sumofsquaresbetweengroups}{Totalsumofsquares} \quad (3.4)$$

A value of 0.01 indicates a small effect, 0.06 indicates a medium effect and 0.14 indicates a large effect (Cohen, 1988).

Trend analysis of infant, child and under 5 mortality rates was carried out at the national level (1990-2015) based on World Bank datasets and at the state level based on the NDHS (1999-2013) datasets. Percent change in mortality rates was obtained as follows:

$$\frac{RMR - LMR}{LMR} X\ 100 \quad (3.5)$$

Where;

RMR = Recent mortality rate LMR = last mortality rate

Positive values indicate a percent increase whereas negative values indicate a percent decrease. Temporal pattern i.e. relative decrease (or increase) in mortality rates over space was mapped and Local Moran's I used to assess whether changes over time were random or concentrated. Graphs were used to examine the level of linearity while Run's test of randomness (Z) was used to indicate the presence or absence of trends. When z falls between -1.96 and +1.96, the series is said to be random which indicates that there is no trend. Run's test can be expressed as:

$$Z = \frac{r - \frac{n}{2} - 1}{\sqrt{\frac{n^2 - 2^n}{4\,(n-1)}}} \qquad (3.6)$$

Where; r = number of runs, n= sample size

In situations where trend was identified, a correlation and regression analysis was carried out to examine whether there is a general increase or decrease in infant and child mortality rates over time. The strength and direction of the correlation coefficient (r) indicates trend i.e. a significant 'r' indicates that there is a statistical trend in the series while the slope of the regression indicates the rate of trend. The regression equation for plotting the trend line is expressed as:

$$Y = a + bx + e \qquad (3.7)$$

Where:

Y= Mortality indicator; a = Intercept; e = error term; b = Regression coefficient of Y on X; X = Time Period.

Pearson's Bivariate Correlation Analysis was carried out to examine the relationship between each explanatory variable (X1….Xn) and the dependent variables (infant, child and under 5 mortality rates). Correlation coefficient ranges from +1 to -1. A coefficient of +1 indicates that each unit increase in the value of 'X' is associated with a unit increase in the value of 'Y' (perfect positive correlation) while a coefficient of -1 indicates a unit increase in the value of 'X' is associated with a unit decrease in the value of 'Y' (perfect negative correlation). Multiple Regression with a bi-directional elimination (standard) stepwise method was also used to identify the most significant explanatory variables while dealing with possible multicollinarity in the dataset. Stepwise multiple regression was used in this study instead of the Cox regression and logistic regression models for three main reasons. First of all, Cox regression is a survival analysis method which takes into consideration the time until the event (such as death) occurs and examines to what extent a set of factors affect survival chances hence findings are discussed in terms of hazard/risk ratios (Lambert and Royston, 2009; Adedini et al, 2015; Dahiru, 2015). However, the focus of this study was to identify variables that statistically explain variations in infant, child and under 5 mortality rates rather than on assessing the effect of independent variables on survival time. Secondly, logistic regression is used when the outcome or dependent variable is binary or dichotomous such as when dealing with alive or dead situations (Holmes and Hossain, 2008; Adekanmbi et al, 2015; Adeolu et al, 2016). However, the dependent variables in this study – infant, child and under 5 mortality rates – are not dichotomous variablesbut rates directly calculated from the NDHS data on birth histories of women aged 15-49. Thirdly, multiple regression has been used in similar studies (Mesike and Mojekwu, 2002; Schell et al, 2007; Adeyele and Ofoegbu, 2013; Neal and Falkingham, 2014; Fitrianto et al, 2016). Three sets of bivariate and multiple regression analysis were carried out separately based on national and state level datasets. One for infant mortality, one for child mortality and the other for under 5 mortality. However, the independent variables were the same for all three analyses.

To explain temporal variations at the national level (based solely on World Bank datasets), the relationships between each dependent variable (infant and under 5 mortality rates) and the variables stated below were examined over the period 1990-2014 (N = 24) (See Appendix 3).The multiple regression equation is mathematically expressed as:

$$Y= a + b_1X_1 + b_2X_2 + \ldots\ldots.. b_nX_n + \varepsilon \quad (3.8)$$

Where:

Y are the dependent variables -Infant Mortality (0-11 months)

-Under 5 Mortality (0-59 months)

a is the regression intercept; b is the slope; ε is the error term and

X_1 …… X_9 are the following independent variables at the national level:

1) Geographical factors

X_1 = Urban Population (% of Total Population)

2) Macroeconomic factors

X_2 = Inflation, consumer prices index (annual %)

X_3 = GDP per Capita (Annual %)

3) Socioeconomic factors

X_4 = Household final consumption expenditure (annual % growth)

4) Environmental factors

X_5 = Access to improved water sources (%)

X_6 = Access to improved sanitation services (%)

5) Health care factors

X_7= Proportion of children protected at birth against tetanus- PAB (%)

X_8 = Vaccinated against Measles (%)

X_9= DPT (%)

To explain spatial variations across states the relationships between each dependent variable (infant, child and under 5 mortality rates) and bio-demographic, socioeconomic, child health and infant feeding, environmental and health care variables stated below were examined based on state level datasets for the last three Demographic and Health Surveys conducted in Nigeria in 2003, 2008 and 2013 covering a 15 year period (N = 37) (See Appendix 4-8). The multiple regression equation is mathematically expressed as:

$$Y= a + b_1X_1 + b_2X_2 + \ldots\ldots b_nX_n + \varepsilon \qquad (3.9)$$

Where Y are the dependent variables -Infant Mortality (0-11 months)

-Child Mortality (12-59 months)

-Under 5 Mortality (0-59 months)

a is the regression intercept; b is the slope; ε is the error term and

X_1 …… X_{21} are the following independent variables at the state level:

1) Geographical and Bio-demographic factors

X_1 = Place of residence (% Rural)

X_2 = Child’s sex (% male)

X_3 = Preceding birth intervals < 24 months (%)

X_4 = Mother’s age at first birth < 20 years (%)

X_5 = Mother’s age at first birth 34 years or older (%)

X_6 = Religion (% Christian)

X_7 = Religion (% Muslim)

2) Socioeconomic factors

X_8 = mother’s education (% with complete secondary school education or higher)

X_9 = Wealth Index (% poor- below 40%)

3) Child health and infant feeding

X_{10} = Birth Size (% small)

X_{11} = Breastfeeding (% exclusively breastfed within the first 6 months or until death if child died earlier)

X_{12} = Prevalence of diarrhea in children under 5 (%)

4) Environmental factors

X_{13} = Access to improved water sources (%)

X_{14} = Access to improved sanitation services (%)

X_{15} = Type ofcooking fuel (% using solid fuels)

5) Health Care

X_{16} = Antenatal care (% of women aged 15-49 that attended ANC at least 4 times during pregnancy in the 5 years preceding the survey)

X_{17} = Proportion of neonates protected at birth against tetanus- PAB (%)

X_{18} = % fully immunized (i.e. received all the 8 vaccines in the first year of life)

X_{19} = % delivered in a health care facility by a skilled health care provider

X_{20} = % of children under 5 that did not sleep under insecticide treated nets (ITNs)

X_{21}= % of women 15-49 with knowledge of preventing mother-to-child transmission of HIV/AIDS.

The explanatory variables listed above have been selected for this study based on the review of the literature, objectives of the study, available data and conceptual framework.Variables were categorized into 6 groups:

a) Geographical and bio-demographic factors

Place of residence/location has been found to significantly influence survival chances of children under 5 due to differences in cultural factors, disease prevalence conditions, access to health care etc. On one hand, studies have found that rural areas account for an overwhelming majority of infant and child deaths in developing countries (Antai, 2011; Adetoro and Amoo, 2014; Dettrick et al, 2014; Ezeh et al, 2015). On the other hand, as more people move into cities, more children are likely to be born and live in overcrowded areas, lack access to safe and reliable water sources,and be more exposed to air and water pollutants thus increasing the risk of infant and child mortality in the cities. Some studies have found a significant relationship between the rate of urban population growth/urbanization and therate of infant and child mortality (Sastry, 2002; Antai and Moradi, 2010; Barrett, 2010; Fink and Hill, 2013).

Many studies have found that male infants tend to have a higher risk of premature birth and mortality due to biological factors such as a lower resistance to infection than females and a larger body size and head circumference that leads to complications during delivery (WHO, 2015). Researchers have also reported mortality rates to be generally higher among male children not just in infancy but also among older children (Sartorius et al, 2011; Pongou, 2013; Boco, 2012; Adedini et al, 2015; Lee et al, 2016). Some studies have found mortality rates to be higher among female children particularly in parts of Africa and Asia due to cultural and behavioural factors such as preference for male children, discrimination in child care in favour of male children etc (Xinhua, 1995; Arnold et al, 1996; Lawoyin, 2001). Most studies have found that these factors have very little if any effect on sex differentials inmortality and that female children still have an advantage over males due to genetic/biological factors (Das Gupta, 1987; Chahnazarian, 1988; Mishra et al, 2004)

Birth intervals/spacingis one of the main determinants of infant and child mortality identified in the literature. Short intervals between births often means the woman has little or no time to fully recover from the previous birth which can adversely affect foetal growth leading to LBW, weakened immune systems and other complications (UNICEF, 2015). Studies have found that short birth intervals (especially intervals <24 months) are associated with infant and child mortality while a longer birth interval improves chances of survival. Ronsmans (1996) examined the effect of short birth intervals on child mortality rates in rural Senegal and found that children born within two years of a subsequent birth were four times more likely to die than those born more than two years after a previous birth. Rutstein (2005) carried out a similar study but on a larger scale. He examined the association between birth intervals and infant and child mortality in 17 developing countries between 1990 and 1997 using bivariate and multivariate analysis. He found that infant and child mortality rate decreased with increasing birth interval. Studies with similar findings include those byCurtis, 1993and Abir et al, 2015.

A mother's age at first birth is another key factor identified by researchers. Most countries recognize an 18 year old girl as an adult however, a woman giving birth before her 20th birthday is regarded as a teenage mother (UNICEF, 2008). According to the WHO (2016), about 16 million girls aged 15-19 give birth every year. Most (95%) of these births are in Sub-Saharan Africa. On one hand, evidence from studies indicate that young mothers aged 15-19 are less likely to be physically, emotionally and financially prepared to have and care for a child. They are also less likely to receive antenatal care significantly increasing the risk of preterm birth and LBW. On the other hand, studies show that older women are more likely to be prepared to have and care for a child. However, the risk of birth complications and LBW increases significantly for women 34 years or older (Midhet et al, 1998; Francis et al, 2012; Blanc et al, 2013; Finlay et al, 2017). Closely related to age at childbirth is the age at which a woman marries. Early marriage often leads to early child bearing and high fertility rates which has been linked to poor spacing of births, LBW and other implications that increase the risk of infant and child mortality (Raj et al, 2010; Finlay et al, 2017).Age at first birth is expected to have more of an impact on child mortality. This is because some women have their first child before marriage while some women may get married early but have their first child later on.

Evidence from studies indicates that religious affiliation influence values, beliefs and behaviours/practices with regards to fertility, nutrition and the use of antenatal care, contraceptives and child health care services which affects chances of child survival (McQuillan, 1996; Becher et al, 2004; Antai et al, 2009; Adepoju et al, 2012; Adedini et al, 2015). It is important to note that in this study, those practicing other religions apart from Christianity and Isalm were excluded due to the very small sample size.

b) Socioeconomic factors

The proportion of mothers with complete secondary education and higher is examined here as a possible explanatory factor for patterns of mortality in children under 5 in Nigeria. The literature indicates that higher education levels among mothers reduce the probability of infant and child mortality because educated women are more likely to be employed and have greater autonomy and decision making power in the home with regards to child bearing and the utilization of health care services (Sharma, 1998; Nattey et al, 2013; Seeramareddy et al, 2013). Some studies have found that the effect of maternal education on child mortality rates reduce or weaken significantly after controlling for individual socioeconomic characteristics and community level factors (Desai and Alva, 1998; Kembo and Ginneken, 2009).

Poverty/SESis the major underlying cause of infant and child mortality identified in the literature. A commonly used measure of poverty or standard of living is the wealth index (WI) which is a composite measure of a household's cumulative living standard. The WI is constructed in the NDHSbased on data collected on household ownership of assets such as radios, cars, type of sanitation facilities in the home etc. Each asset is assigned a weight or factor score generated using principal component analysis. The weighted scores are standardized and divided into five quintiles- lowest (poorest), second (poorer), middle, fourth (richer) and highest (richest). For this study, quintiles were recoded into three- poor (bottom 40%), middle (next 20%) and rich (top 40%). Studies have shown that children born in households in the poorer and poorest quintile experience the highest mortality rates compared to those born in better off households (Hertel-Fernandez et al, 2007; Antai, 2011; Axelson et al, 2012; Adekanmbi et al, 2015; Adepoju, 2015). The WI does not provide information on income or expenditure levels. On the other hand, the household final consumption expenditure formerly called private consumption measured annually by the World Bank refers to themarket value of all goods and services including durable goods purchased by households. It therefore reflects the changes in total expenditure by households**.**

c) Child health and infant feeding

Birth weight/size is an indicator of a child's vulnerability to the risk of childhood diseases (UNICEF, 2015). Reports indicate that children weighing <2.5kg at birth have a higher risk of early childhood death. Studies have identified birth weight as an important predictor of infant and child mortality (Joseph and Kramer, 1997; Machado and Hill, 2003; Dibben et al, 2006; Uthman, 2007). Since some mothers in the NDHS survey did not have information on exact weight, they were also asked whether their child at birth was very large, larger than average, average, smaller than average or very small. This subjective information on birth size has been used as a proxy indicator for birth weight in many studies (Mbuagbaw and Gofin, 2010; Adekanmbi et al, 2012; Islam, 2014). This was further recoded into small, average and large for this study.

Breastfeedinghas for a long time been recognized as a major determinant of child health and survival.The WHO recommends that infants be breastfed within 1 hour of birth exclusively for the first 6 months of life and continue to be breastfed along with appropriate complementary foods up to 2 years and beyond(WHO, 2016). Early and full breastfeeding has been empirically proven to significantly reduce the risk of infant mortality and improve chances of survival beyond the age of 5 (Adetunji ,1995; Lykens et al, 2009; Abimbola et al, 2012; Adepoju et al, 2012).

Most childhood deaths have been directly attributed to the prevalence of infant and childhood diseases and infections such as anaemia, malaria and diarrhea, most of which are easily treatable or avoidable (Perry et al, 2005; Scott et al, 2014; Liu et al, 2015).Diarrheal diseases in particular, remain one of the major causes of under-5 death accounting for about 340,000 under-5 deaths every year (WHO, 2016).

According to the WHO, children that have received one dose of the Bacille Calmette–Gue´rin (BCG) vaccine against tuberculosis, all 3 doses of the diphtheria, pertussis and tetanus (DPT) vaccine, at least 3 doses of the poliomyelitis vaccine and the measles vaccine during the first year of life are fully immunized. Studies have proven that vaccinating children significantly improves survival chances (Fotso et al, 2007; Nwogu et al, 2008; McGovern and Canning, 2015).

The use of insecticide treated nets (ITNs) has been identified as one of the most cost effective interventions for preventing malaria and related deaths in children under-5 (UNICEF, 2016). Studies have shown a significant decline in child mortality with the increased use of ITNs in developing countries (Oresanya et al, 2008; Fullman et al, 2013; Afoakwah et al, 2015).

d) Environmental factors

Studies have found that poor access to safe and clean improved water sources and sanitation services often means more exposure to contaminants increasing the occurrence and transmission of diseases that contribute significantly to infant and child mortality (Sohel et al, 2010; Gayawan and Turra, 2015; Adeolu et al, 2016). In this study, the WHO and UNICEF definition was adopted to classify the major source of drinking water as reported by respondents into improved and unimproved water sources. Improved water sources include water piped into dwelling/yard/plot, public tap/standpipe, protected dug well, protected spring, bottled water, rain water and tubewell/boreholes while unimproved water sources include unprotected dug well, unprotected spring, cart with small tank, tanker truck and surface water (NPC and ICF International, 2014).

Likewise, access to adequate sanitation services measured based on the type of toilet facility available to respondents was classified into improved and unimproved sanitation facilities based on WHO and UNICEF definitions. Improved sanitation facilities include flush to piped sewer system, flush to septic tank, flush/pour flush to pit latrine, composting toilet, ventilated improved pit latrine and pit latrine with slab while unimproved sanitation facilities include flush/pour elsewhere, pit latrine without slab/open pit, bucket and hanging toilet (NPC and ICF International, 2014).

Indoor air pollution due to the use of solid fuels (coal/lignite, wood, straw/shrubs/grass, agricultural crops and animal dung) for cooking and heating has been found to elevate the risk of respiratory diseases (e.g. pneumonia) and mortality in children under 5 in developing countries. Wichmann and Voyi (2006) examined and identified a significant association between the use of solid fuels for cooking and child mortality in South Africa after controlling for mothers age at birth, water source, wealth index and overcrowding. Ezeh et al (2014) carried out a similar study in Nigeria in 2013 and found that 42.9% and 36.3% of postnatal and child deaths respectively could be attributed to the use of solid fuels. Studies with similar findings include those by Chen et al, 1990; Smith et al, 2000; Gbemisola et al, 2016 and Sulaiman et al, 2017.

e) Macroeconomic factors

Inflation as measured by the consumer price index (CPI) reflects the "annual percentage change in the cost to the average consumer of acquiring a 'basket' of goods and services" (World Bank, 2016). The CPI is a statistical estimate constructed by the World Bank using the prices of a sample of representative items whose prices are collected periodically. The Gross Domestic Product (GDP) per capita reflects the average income per person Evidence from recent studies show a strong negative relationship between these macroeconomic factors and child mortality especially IMRs. Using multiple regression, Neal and Falkingham (2013) examined the relationship between Gross National Income and neonatal, post neonatal and early child mortality in 65 countries based on data from DHS and the World Bank. They found that increases in GNI over time were associated with lower reductions in mortality especially post neonatal and child mortality. Studies with similar findings include Lykens et al, 2009; Barufi et al, 2012; Ude and Ekesiobi, 2014; Hashiani et al, 2015 among others.

f) Maternal health care

Antenatal care (ANC) is critical for the treatment and management of diseases and conditions during pregnancy and has been linked to improvements in foetal health and birth weight (WHO, 2006). The WHO recommends at least 4 ANC visits for women without complications. Studies have found that women that use ANC are more likely to have their children vaccinated and use health care services for their children in later years leading to significant reductions in child mortality (Vaahtera et al, 2000; Akanda, 2010; Metcalfe et al, 2013). Neonatal tetanus injections are a major component of ANC. Women are expected to receive at least two doses of tetanus toxoid injections during pregnancy to avoid neonatal tetanus in infants.Neonatal tetanus is the leading cause of infant death during the neonatal period in developing countries (UNICEF, 2016). Mortality rates have been found to be significantly lower among children whose mothers were immunized against tetanus during pregnancy and childbirth (Blencowe et al, 2010; Singh et al, 2012).

Hospital delivery has been identified as an important determinant in the use of child health care services. Studies have shown that children born in health care facilities with the assistance of skilled health personnel have a significantly higher survival rate than those not born in health care facilities (Morris et al, 2003; Antai, 2009; Akinyemi et al, 2013). Researchers argue that one reason for this is that hospital delivery is an important determinant in the use of health care services especially immunization services. Also deliveries outside health care facilities are more likely to be handled by untrained individuals and carried out under unhygienic conditions. Thirdly, assistance from skilled health care workers ensures the early detection and management of complications and diseases thereby reducing the risk of mortality.

Over 90% of HIV infections and deaths in children under 5 are the result of mother to child transmission (MTCT) during pregnancy, childbirth or through breast milk and most occur in Sub-Saharan Africa (DeCock et al, 2000). A third (32%) of all cases of MTCT worldwide occurs in Nigeria (NACA, 2015). Studies have shown that HIV infected children have high mortality rates with most dying before the age of 2 (Newell et al, 2004; Wilson, 2013; Tlou et al, 2016). Increased awareness of how to prevent MTCT of HIV is likely to have a significant impact on child survival especially in infancy. In each survey, respondents were asked whether HIV/AIDS could be transmitted during pregnancy, delivery and breastfeeding and whether drugs can be taken to reduce the risk of MTCT of HIV/AIDS during pregnancy. Respondents that answered yes to all four questions are regarded as having a full knowledge of MTCT of HIV/AIDS.

3.6.2.4 Inequality measures

Generally, there are two main groups of inequality measures: Relative measures and Absolute measures. Relative measures reflect proportional differences in the health outcome variable while absolute measures reflect the magnitude of the difference in the health outcome variable among and between groups. Both measures express the difference between mortality rates in terms of a specified reference group. In the literature, the group with the highest SES is generally adopted as the reference group in health inequality studies. However, the group with the highest SES may not always have the lowest mortality rates. Other reference groups adopted in the literature include mean group rate, total population rate, a particular area rate such as the state capital rate and a particular health target rate such as the SDG 3.2 target rate for under 5 mortality (Low and Low, 2004; Keppel et al, 2005; Shavers, 2007; Gray et al, 2009).

This study adopts as a reference the group with the highest socioeconomic status or group more likely to have lower mortality rates. Socioeconomic inequalities in infant, child and under 5 mortality rates were assessed between and among socioeconomic groups defined by multiple SES indicators: mother's education, wealth index, mother's age, child's sex and religion (Table 3.2). Assessments were carried out at the national, regional, state and rural-urban level based on data from the 2003, 2008 and 2013 NDHS using a combination of the following relative and absolute inequality measures:

1) Rate Ratio (RR) and Absolute Difference (RD) are commonly used range measures for assessing inequality between the two extreme categories of socioeconomic groups. The RR is expressed as Ri/Rr while the RD is expressed as Ri – Rr. Where Ri is the mortality rate for group A (the non-reference group or worse off socioeconomic group) and Rr is the mortality rate for Group B (or the reference group or better off socioeconomic group). Large values indicate high levels of inequality.

2) The Population attributable fraction/risk (PAF/PAR) is a measure used to determine the reduction possible in the rate of a health indicator if each socioeconomic group experienced the lowest rate possible (usually the rate of the most advantaged group). It has been shown to be useful for setting health goals and formulating policies (Lynch and Harper, 2005). PAF was used to estimate the proportion of infant and child deaths that could have been avoided or prevented if all the socioeconomic groups had the same rate of mortality as the group with the lowest mortality rate. Population Attributable Fraction is defined as the difference between the general rate and the lowest rate expressed as a percentage of the general rate. Unlike the range measures, PAF considers all socioeconomic groups and not just the extreme subgroups hence it measures the impact of the total population. The higher the value, the more pronounced the inequality in infant and child mortality amongst groups. It can be expressed as:

$$\text{PAF/PAR} = \frac{\sum_{i=1}^{n} Pi(\frac{Ri}{Rr} - 1)}{1 + \sum_{i=1}^{n} Pi(\frac{Ri}{Rr} - 1)} \quad (3.10)$$

Where,

Ri= rate of mortality in the non reference group;

Rr = rate of mortality in the reference group;

Pi = proportion of population in the socioeconomic group

Table 3.1: Inequality Measures

	SES Indicators (Reference group)	**Simple Measures**		**Complex Measures**	
		Absolute	Relative	Absolute	Relative
Ordered groups	Maternal Education (Secondary and higher)	Rate difference and PAR	Rate ratio and PAR%	Slope index of inequality	Concentration index and curve
	wealth index (Highest wealth group)				
	Age Cohorts (35-49 years)				
Non-ordered groups	Sex (Female)	Rate difference and PAR	Rate ratio and PAR%	-	-
	Religion (Christian)				
Source: Author					

3) The Slope Index of Inequality (SII) is a regression based measure that reflects the socioeconomic dimension of inequalities in a health variable. It is defined as the slope of the regression line showing the relationship between a group's health and its relative rank in the socioeconomic distribution (Wagstaff et al, 1991). The SII is derived by ordering subgroups from the most disadvantaged to the least disadvantaged and then regressing their infant, child and under 5 mortality rate (y-axis) against the cumulative proportion of births ranked by the SES indicator (x-axis). The slope of the regression line was estimatedby the weighted least square method. The SII was obtained in excel using the following formula:

$$Y * \sqrt{a} = 0 + \sqrt{a} + \ b * \sqrt{a} \qquad (3.11)$$

Where:

a is the proportion of the population in each group

Y is the mortality rate

b is the relative rank variable

One important advantage of The SII is that it reflects the socioeconomic dimension of health inequalities because it ranks socioeconomic groups by SES indicator. Secondly, it reflects the experiences of the entire population since it takes into account intermediate socioeconomic groups unlike pair wise measures. Thirdly, it is sensitive to changes in the distribution of the population across socioeconomic groups. However, the SII can only be used when the SES indicator is measured on an ordinal scale. The SII can be interpreted as the absolute effect/change in the frequency of the health variable (i.e. infant, child and under 5 mortality) of moving from the lowest to the highest socioeconomic group. Positive values indicate mortality is more prevalent in the least disadvantaged group while negative values indicate mortality is more pronounced in the most disadvantaged group.

4) Concentration Index (CI) and Concentration curve (CC): The CI measures the degree of inequality between socioeconomic groups with respect to a given health variable. It is a relative measure that indicates the extent to which mortality is concentrated among groups. The concentration index was calculated in excel using the following formula:

$$CI = (p_1L_2 - p_2L_1) + (p_2L_3 – p_3L_2) + ……. + (p_{T-1} L_T – p_TL_{T-1})(3.12)$$

Where:

p = cumulative percentage of the population in the socioeconomic group (T)

Lt = corresponding concentration curve ordinate

The CI and SII are related by the formula:

$$CI = 2var(x)\left(\frac{\beta}{\mu}\right) \qquad (3.13)$$

Where:

μ is the mean level of mortality

$var(x)$ is the variance of the relative rank variable

β is the slope coefficient taken from the regression for the SII

Values of the CI usually range between -1 and +1. A negative value indicates mortality is concentrated among the most disadvantaged while a positive value indicates a concentration of mortality among the least disadvantaged. A CI of zero indicates no inequality. The concentration curve (CC) plots the cumulative proportion of infant and child mortality (y-axis) against the cumulative proportion of the live births ranked by the SES indicator starting from the least to the highest (x-axis). The curve is then compared to the 45^0 line of equality. If infant and child mortality is concentrated in lower (higher) socioeconomic groups, the CC lies above (below) the diagonal. The greater the area between the diagonal and CC, the greater the level of inequality.

One advantage of the CI is that it accounts for changes in mortality and changes in the distribution of the population. Hence, it can be used to examine and graphically depict trends in socioeconomic inequalities. Secondly it reflects the experiences of intermediate socioeconomic groups just like the SII. Thirdly, it allows comparisons to be made over space and time. State CI values were computed and mapped to view socioeconomic inequality patterns over space and time.Results from both relative and absolute inequality measures were compared to assess whether overall socioeconomic inequalities in infant, child and under 5 mortality had improved or worsened over time in Nigeria.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the resuts of the study. It is divided into four main sections: (1) Spatial variations and patterns; (2) temporal patterns and trends; (3) determinants and (4) socioeconomic inequalities of infant, child and under 5 mortality.

4.2 Spatial variations and patterns of infant, child and under 5 mortality in Nigeria

Spatial analysis is fundamental to geographic research. The basis of spatial analysis is the theory that "everything is related to everything else but near things are more related than distant things" (Tobler, 1970). This phenomenon is referred to as spatial autocorrelation. Infant and child mortality rates, like any other variable, vary over space. Hence, examining the distribution and extent to which infant and child mortality rates are spatially correlated helps to incorporate the impact of geographical/spatial effects into the assessment of infant and child mortality. Such analysis identifies areas that deserve specific interventions/programmes and provides insight into possible causes and processes linked to infant and child mortality over space. This first section therefore examines the spatial pattern of infant, child and under 5 mortality rates in Nigeria in two major ways: (1) Descriptively with respect to demographic and socioeconomic characteristics and (2) Quantitatively by adopting statistical methods, spatial autocorrelation statistics and GIS. All mortality rates are estimates for 5 years preceding the survey.

4.3 Spatial variations of Infant Mortality Rates (IMRs) in Nigeria

4.3.1 Spatial variations of infant mortality ratesby place of residence

Table 4.1 showsinfant mortality rates in Nigeria based on data from the 2003, 2008 and 2013 NDHS which covers the 5year period preceding each survey(1999-2003, 2004-2008 and 2009-2013, respectively). Out of the 6,029 under 5 children in the 2003 survey, 541 (9%) died before their first birthday. The infant mortality rate (IMR) of 89 deaths per 1,000 live births implies 1 in 11 did not survive to the age of one. IMRs in rural areas (99 deaths per 1,000live births) exceeded IMRs in urban areas (68 deaths per 1,000 live births) by 31%. Regional differences in IMR are also evident. The Northeasthad the highest IMR (100deaths per 1,000 live births) while the Southeast had the lowest (53 deaths per 1,000 live births). Nasarawa and Ebonyi states had the highest IMRs (190 and 177 deaths per

Table 4.1:Direct Estimate of IMRs (per 1,000 live births) in Nigeria

Location		2003 NDHS	2008 NDHS	2013 NDHS
Residence	Urban	68	56	51
	Rural	99	78	70
Regions	Northcentral	90	71	57
	Northeast	100	80	64
	Northwest	95	75	72
	Southeast	53	80	72
	Southsouth	99	69	50
	Southwest	55	52	51
States	Abia	44	83	78
	Abuja	0	62	53
	Adamawa	145	101	79
	Akwa Ibom	67	67	56
	Anambra	28	50	62
	Bauchi	89	80	81
	Bayelsa	100	98	43
	Benue	104	94	69
	Borno	108	88	27
	Cross River	65	45	42
	Delta	135	83	60
	Ebonyi	177	74	84
	Edo	58	50	30
	Ekiti	77	93	51
	Enugu	63	82	63
	Gombe	78	62	68
	Imo	9	106	72
	Jigawa	119	55	86
	Kaduna	102	71	37
	Kano	87	93	68
	Katsina	78	66	49
	Kebbi	86	62	88
	Kogi	63	55	38
	Kwara	0	33	53
	Lagos	52	51	57
	Nasarawa	190	61	60
	Niger	76	79	49
	Ogun	84	70	54
	Ondo	89	43	64
	Osun	36	30	36
	Oyo	10	57	42
	Plateau	94	74	70
	Rivers	126	62	58
	Sokoto	77	84	78
	Taraba	137	79	74
	Yobe	57	57	58
	Zamfara	123	67	108
National		89	71	64
Author's direct estimates of IMRs based on 5 years preceding the survey				

1,000 live births, respectively) while Imo state had the lowest (9 deaths per 1,000 live births). Figure 4.1 shows the spatial patterns of IMRs over Nigeria.

Out of the 28,647 under 5 children in the 2008 survey, 2038 (7.1%) died before the age of one. The IMR (71 deaths per 1,000 live births) implies that 1 in 14 children died in their first year of life. IMRs were 28% higher in rural areas (78 deaths per 1,000 live births) than in urban areas (56 deaths per 1,000 live births). Regional variations in infant mortality are also evident. IMRs ranged from 52 deaths per 1,000 live births in Southwestern Nigeria to as high as 80 deaths per 1,000 live births in both the Northeastern and Southeastern part of the country. Imo state had the highest IMR (106 deaths per 1,000 live births) while Osun state had the lowest (30 deaths per 1,000 live births). In other words, the risk/chance of infant death varied from 1 in 9 children in Imo state to 1 in 33 in Osun state. Figure 4.2 shows the spatial patterns of IMRs over Nigeria.

Out of the 31,482 under 5 children in the 2013 survey, 2,005 (6.4%) died before the age of one. The IMR (64 deaths per 1,000 live births) implies 1 in every 16 did not survive to their first birthday. IMRs were 27% higher in rural areas (70 deaths per 1,000 live births) than in urban areas (51 deaths per 1,000 live births). Regionally there were significant variations in IMRs with the Northwest having the highest IMR (72 deaths per 1,000 live births) and the Southsouth having the lowest (50 deaths per 1,000 live births). Zamfara state had the highest IMR (108 deaths per 1,000 live births) while Borno state had the lowest (27 deaths per 1,000 live births). Figure 4.3 shows the spatial pattern of IMRs over Nigeria.

4.3.2 Spatial variations of infant mortality rates by demographic characteristics

4.3.2.1 Spatial variations of infant mortality rates by child's sex

With regards to the 2003 survey, IMRs were higher among male children (98 deaths per 1,000 live births) than among female children (82 deaths per 1,000 live births). IMRs also differed between the sexes in both rural and urban areas. In rural areas, IMRs among males (109 deaths per 1,000 live births) exceeded IMRs among females (87 deaths per 1,000 live births) by 20%. In urban areas, IMRs were about the same among male and female children (67 and 69 deaths per 1,000 live births, respectively). IMRs between the sexes also varied within and across regions with male children consistently having the highest rate of infant mortality except in the Northcentral and Southwestern parts of the

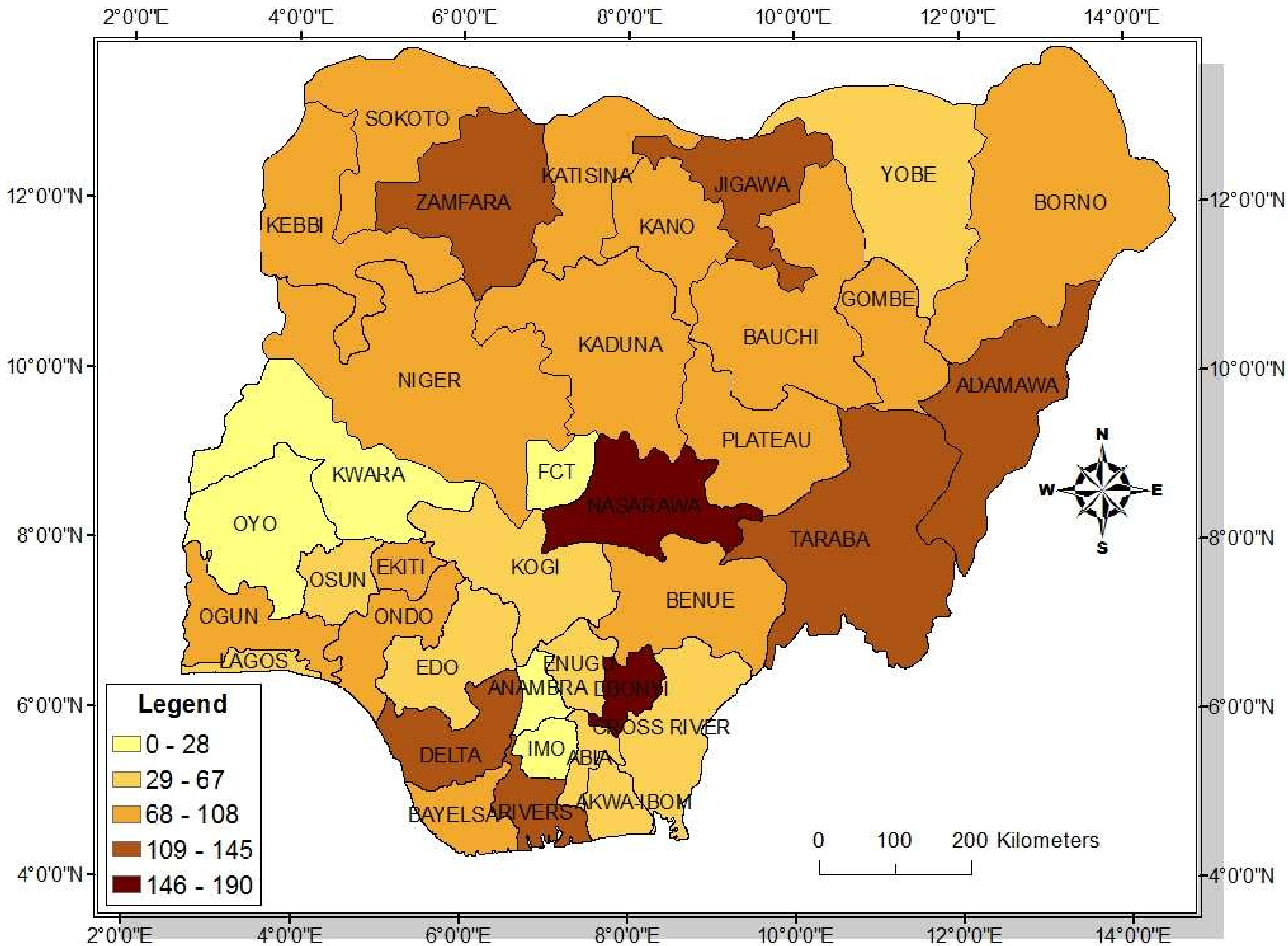


Figure 4.1: The Spatial Distribution of Infant Mortality Rates in Nigeria (2003)

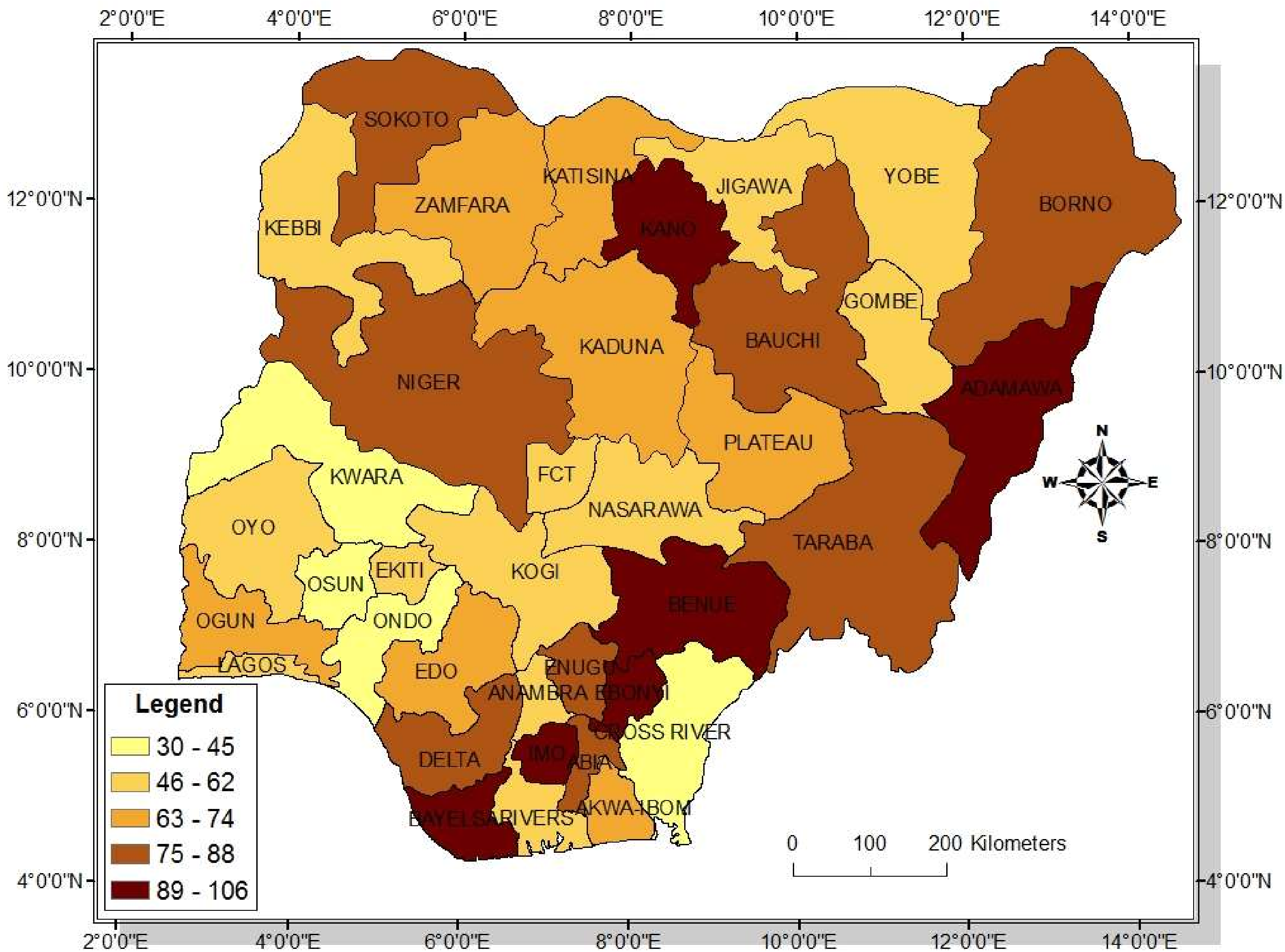


Figure 4.2: The Spatial Distribution of Infant Mortality Rates in Nigeria (2008)

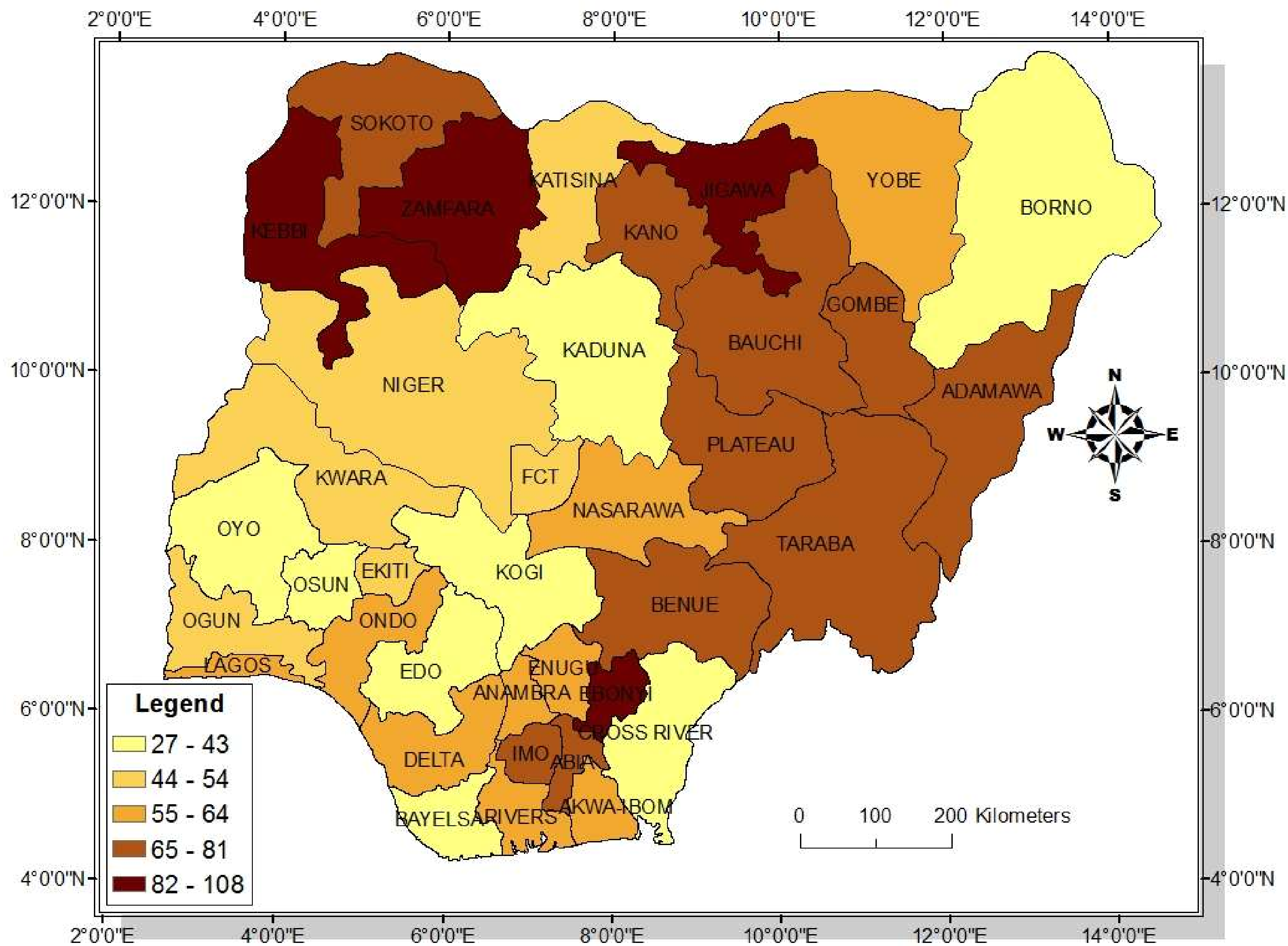


Figure 4.3: The Spatial Distribution of Infant Mortality Rates in Nigeria (2013)

country (See Appendix 9a). Across states, IMRs among males ranged from 18 deaths per 1,000 live births in Oyo state (with the exception of states that reported no infant death) to as high as 259 deaths per 1,000 live births in Ebonyi state. IMRs among females ranged from 13 deaths per 1,000 live births in Imo state to 214 deaths per 1,000 live births in Nasarawa state (Table 4.2). The mean IMR among males (86 deaths per 1,000 live births, SD=56.5) exceeded the mean IMR among female children (80 deaths per 1,000 live births, SD= 58.6). There was also a high level of variability in the distribution of IMRs among both female and male children across states (73% and 66%, respectively).

Based on the 2008 survey, IMRs were still higher among males (77 deaths per 1,000 live births) than among females (65 deaths per 1,000 live births). In rural areas, IMRs among males (86 deaths per 1,000 live births) exceeded IMRs among females (70 deaths per 1,000 live births) while IMRs in urban areas were slightly higher among males (56 deaths per 1,000 live births) than among females (55 deaths per 1,000 live births). Regionally, IMR among males ranged from 57 deaths per 1,000 live births in the Southwest to 85 deaths per 1,000 live births in the Southeast while IMRs among females ranged from 47 deaths per 1,000 live births in the Southwest to 75 deaths per 1,000 live births in the Northeast (See Appendix 9b). At the state level, IMRs ranged from 24 deaths per 1,000 live births in Kwara to 125 deaths per 1,000 live births in Bayelsa state among male children while IMRs among female children ranged from 13 deaths per 1,000 live births in Osun state to 94 deaths per 1,000 live births in Imo. The average IMR among males was 76 deaths per 1,000 live births (SD=24.3) and 63 deaths per 1,000 live births (SD= 18.5) among females. The distribution of IMRs among male and female children varied across states by approximately 32% and 29%, respectively.

Like the previous surveys, IMRs were higher among males (69.1 deaths per 1,000 live births) than among females (58 deaths per 1,000 live births) in 2013. In rural areas, IMRs among males (76 deaths per 1,000 live births) exceeded IMRs among females (65 deaths per 1,000 live births). In urban areas, IMRs among males (58 deaths per 1,000 live births) also exceeded IMRs among females (45 deaths per 1,000 live births). Regionally, IMRs are also consistently higher among male children (See Appendix 9c). Across states,IMR among male children ranged from 19 deaths per 1,000 live births in Kogi state to 131 deaths per 1,000 live births in Zamfara state while IMR among female children ranged from 20 deaths per 1,000 live births in Borno state to 84 deaths per 1,000 live births in Imo state. The mean IMR among male children was 65 deaths per 1,000 live births

Table 4.2: IMRs (per 1000 live births) by Child's Sex across States in Nigeria.

	2003 NDHS		2008 NDHS		2013 NDHS	
STATE	Male	Female	Male	Female	Male	Female
Abia	71	0	84	79	84	70
Abuja	0	0	69	62	58	49
Adamawa	189	109	114	89	76	82
Akwa Ibom	79	56	59	74	66	50
Anambra	38	18	52	51	88	36
Bauchi	118	61	67	93	92	71
Bayelsa	63	143	125	67	43	44
Benue	107	101	114	76	70	68
Borno	110	105	102	75	32	20
Cross River	106	22	58	30	49	33
Delta	130	140	82	85	73	46
Ebonyi	259	120	114	70	90	80
Edo	78	29	84	66	29	31
Ekiti	0	177	44	57	50	52
Enugu	65	61	75	88	78	51
Gombe	92	76	72	50	73	66
Imo	0	13	113	94	59	84
Jigawa	88	155	54	56	101	72
Kaduna	95	109	65	77	43	30
Kano	85	88	111	76	67	68
Katsina	103	50	71	62	57	42
Kebbi	132	35	66	56	99	80
Kogi	31	104	74	28	19	58
Kwara	0	0	24	39	56	49
Lagos	69	33	47	56	68	46
Nasarawa	170	214	76	48	71	48
Niger	89	66	81	78	50	48
Ogun	53	102	89	52	62	46
Ondo	39	167	44	42	66	62
Osun	67	0	45	13	36	37
Oyo	18	0	69	45	34	50
Plateau	56	127	75	74	72	69
Rivers	181	73	57	69	59	58
Sokoto	76	88	105	62	83	74
Taraba	92	194	98	56	78	70
Yobe	77	36	56	58	54	62
Zamfara	158	97	67	68	131	84
Mean	86.0	80.2	75.7	62.7	65.3	56.3
SD	56.5	58.6	24.3	18.4	22.6	16.7
CV (%)	65.7	73.0	32.1	29.4	34.6	29.7
Author's direct estimates & calculations based on 5 years preceding the survey						

(SD=22.6) and 56 deaths per 1,000 live births (SD=16.7) among female children. The distribution of infant mortality rates among male and female children varied across states by approximately 35% and 30%, respectively.

4.3.2.2 Spatial variations of infant mortality rates by mother's age

With regards to the 2003 survey, IMRs were higher among children born to mothers under 20 years (102 deaths per 1,000 live births) and mothers over 34 (98 deaths per 1,000 live births) than among children born to mothers aged 20 to 34 years (86 deaths per 1,000 live births). The same variations were observed in both rural and urban areas as well as across regions (See Appendix 10a). Regionally, children born to women under 20 and over 34 also had the highest rate of infant mortality except in the Southwestern and Northcentral part of the country where the highest IMR was found among children born to mothers aged 20-34. Table 4.3 shows that across states, the mean IMR among children born to teenage mothers was 84 deaths per 1,000 live births (SD=119.0), 80 deaths per 1,000 live births (SD=49.9) among children born to mothers aged 20-34 and 84 deaths per 1,000 live births (SD=67.9) among those born to women over 34. IMR varied the most among children with teenage mothers with a CV > 100 (142.3) suggesting significant variations in IMRs for this group across states.

With regards to the 2008 survey, IMRs were higher among children with very young mothers (98 deaths per 1,000 live births) and mothers over 34 (79 deaths per 1,000 live births) than among children born to mothers aged 20 to 34 (66 deaths per 1,000 live births). Similar variations were found regionally as well as in both rural and urban areas(See Appendix 10b). Across states, the mean IMR among children with mothers under 20 was 83 deaths per 1,000 live births (SD=65.3), 66 deaths per 1,000 live births (SD=18.4) among children with mothers aged 20-34 and 76 deaths per 1,000 live births (SD=28.3) among children with older mothers. IMRs across states varied the most among children with mothers under 20 (79%).

In 2013, IMRs were also found to be higher among children born to very young women (92 deaths per 1,000 live births) and women over 34 (60 deaths per 1000 live births) than among children born to women aged 20 to 34 (68 deaths per 1,000 live births). IMRs also varied across regions and in both rural and urban areas (See Appendix 10.c).

Table 4.3: IMRs (per 1000 live births) by Mother's age group across states in Nigeria.

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	15-19	20-34	35-49	15-19	20-34	35-49	15-19	20-34	35-49
Abia	N/A	0	100	0	73	135	0	92	50
Abuja	N/A	0	0	0	63	64	0	46	80
Adamawa	500	161	91	135	91	118	85	80	72
Akwa Ibom	0	18	189	94	67	59	57	65	28
Anambra	0	12	77	250	51	44	167	46	100
Bauchi	157	63	128	100	85	56	174	74	68
Bayelsa	0	91	143	107	105	63	67	33	48
Benue	59	112	95	159	89	97	0	78	50
Borno	81	116	98	125	78	111	23	20	55
Cross River	143	49	77	36	43	51	46	40	46
Delta	286	123	143	0	83	95	188	60	47
Ebonyi	N/A	121	278	0	85	116	105	66	125
Edo	0	88	0	0	77	70	0	30	31
Ekiti	N/A	69	111	100	52	48	0	50	57
Enugu	0	53	83	83	67	107	50	66	66
Gombe	0	103	71	95	53	74	125	53	97
Imo	0	12	0	0	99	121	67	74	67
Jigawa	74	106	182	55	48	70	78	86	88
Kaduna	83	79	180	100	65	77	67	34	36
Kano	140	75	93	160	81	109	69	63	76
Katsina	167	79	38	97	63	61	53	37	85
Kebbi	167	82	80	140	63	33	83	84	103
Kogi	0	45	135	31	49	77	36	30	61
Kwara	0	0	0	74	32	24	200	59	33
Lagos	0	58	43	111	44	68	0	67	33
Nasarawa	143	229	59	125	66	36	0	72	28
Niger	0	88	40	46	82	81	117	43	56
Ogun	0	86	44	56	58	96	0	46	74
Ondo	0	138	0	0	46	38	87	45	97
Osun	N/A	56	0	91	19	64	0	28	69
Oyo	0	13	0	59	53	70	156	35	48
Plateau	0	112	0	227	75	57	182	67	68
Rivers	286	106	211	0	56	87	63	46	91
Sokoto	0	88	103	53	75	117	141	75	70
Taraba	267	139	111	125	68	100	152	80	35
Yobe	125	62	22	39	54	71	42	57	65
Zamfara	0	143	83	196	66	40	196	107	86
Mean	83.7	80.3	83.9	82.9	65.5	75.7	77.7	57.5	64.6
SD	119.0	49.9	67.9	65.3	18.4	28.3	65.3	20.6	23.9
CV (%)	142.3	62.2	80.9	78.8	28.1	37.4	84.0	35.9	36.9

Author's direct estimates and calculations based on 5 years preceding the survey

Across states, the mean IMR among children of teenage mother's was 78 deaths per 1,000 live births (SD=65.3), 58 deaths per 1,000 live births (SD=20.6) among mother's aged 20 to 34 and 65 deaths per 1,000 live births (SD= 23.9) among children born to women over 34. IMRs across states varied the most among children with mothers under 20 (84%)

4.3.3 Spatial variations of infant mortality rates by socioeconomic characteristics

4.3.3.1 Spatial variations of infant mortality rates by mother's educational level

Based on the 2003 survey, children born to women with no education had the highest IMR (101 deaths per 1,000 live births). This rate fell by 40% to 60 deaths per 1,000 live births among children born to mothers with secondary and higher level of education. In urban areas, IMRs were higher among children with uneducated mothers (106 deaths per 1,000 live births) but fell sharply by 69% to 33 deaths per 1,000 live births among children born to women with secondary and higher level of education. The pattern in rural areas was slightly different. The children of women with primary school education had the highest rate of infant mortality (105 deaths per 1,000 live births). However, children with the most educated mothers still had the lowest IMR when compared to other groups (88 deaths per 1,000 live births). Regionally, children born to women with primary education and higher had the highest IMRs except in the Southeast and Northwest (See Appendix 11a). Table 4.4 shows that across states, the mean IMR was highest among children born to women with primary education (88 deaths per 1,000 live births, SD=66.6). However, IMR varied the most among children with the most educated mothers (126.5%) suggesting significant variations in the impact of higher education among mothers on IMRs across states.

Children born to women with no education had the highest IMR (79 deaths per 1,000 live births) in the succeeding 2008 survey. A similar pattern was observed in both rural and urban areas and across regions. In rural areas, IMRs were higher among the children of uneducated mothers (81.8 deaths per 1,000 live births). In urban areas, IMRs among children of uneducated mothers and mothers with primary education were about the same (63 deaths per 1,000 live births) with 49 deaths per 1,000 live births among mothers with secondary and higher education (See Appendix 11b). Across states, the mean IMR was higher among children born to women with no education (70.21 deaths per 1,000 live births, SD=43.33) and primary education (70.78 deaths per 1,000 live births, SD=23.99). IMRs were relatively more uniformly distributed across states among mothers

Table 4.4: IMRs (per 1000 live births) by Mother's educational level across states in Nigeria.

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	1	2	3	1	2	3	1	2	3
Abia	0	111	0	0	130	62	0	52	86
Abuja	0	0	0	73	61	56	56	65	56
Adamawa	197	71	87	118	92	61	70	60	99
Akwa Ibom	71	63	60	0	94	51	167	41	56
Anambra	0	56	15	0	46	53	37	119	50
Bauchi	95	80	0	69	125	54	92	43	33
Bayelsa	0	0	188	133	90	99	67	52	36
Benue	169	91	20	93	82	114	65	78	57
Borno	125	146	32	92	96	33	21	67	28
Cross River	0	56	96	0	36	57	46	47	40
Delta	0	190	130	118	77	85	45	65	57
Ebonyi	150	148	400	130	66	98	106	112	46
Edo	0	104	0	145	78	57	95	35	19
Ekiti	0	77	95	71	75	39	250	77	48
Enugu	143	51	56	140	99	54	37	58	68
Gombe	30	172	192	71	45	44	73	110	35
Imo	N/A	0	9	0	63	115	N/A	156	58
Jigawa	127	59	0	48	102	0	91	55	83
Kaduna	151	40	40	71	78	61	40	47	29
Kano	94	113	32	105	59	77	79	44	36
Katsina	76	74	96	66	61	67	50	53	47
Kebbi	99	0	0	62	54	53	88	102	83
Kogi	0	117	0	49	73	45	56	53	21
Kwara	0	0	0	35	64	16	46	66	45
Lagos	0	57	59	20	82	47	71	98	47
Nasarawa	318	108	67	63	70	38	61	61	55
Niger	66	156	42	87	71	11	51	26	52
Ogun	87	132	44	82	89	41	49	73	37
Ondo	250	74	143	29	30	56	34	99	51
Osun	0	0	67	77	22	25	0	48	32
Oyo	0	33	0	127	53	25	5	81	36
Plateau	0	119	108	116	59	66	66	48	89
Rivers	250	145	115	0	54	69	39	58	59
Sokoto	72	250	0	87	55	77	81	0	78
Taraba	121	273	0	94	88	22	71	79	76
Yobe	51	59	143	58	42	71	65	26	0
Zamfara	139	44	0	69	58	26	45	78	0
Mean	80.0	88.3	63.1	70.2	70.8	54.7	64.3	65.7	49.3
SD	85.1	66.6	79.9	43.3	23.9	26.6	44.7	29.7	23.1
CV (%)	106.4	75.4	126.5	61.7	33.9	48.7	69.6	45.2	46.8

Author's direct estimates and calculations based on 5 years preceding the survey
1: No Education; 2: Primary Education; 3: Secondary and Higher Education

with primary education (33.90%) and secondary and higher education (48.72%) than among those with no formal education (61.72%).

Based on the 2013 survey, children born to uneducated mothers had the highest IMR (72 deaths per 1,000 live births) while those born to women with secondary and higher education had the lowest (49 deaths per 1,000 live births). IMRs were also found to be the lowest among children with the most educated mothers in both rural and urban areas (60 and 43 deaths per 1,000 live births, respectively) (See Appendix 11c). Across states, children born to women with secondary and higher education had the lowest mean IMR (49 deaths per 1,000 live births, SD=23.1) while the children of women with primary education had the highest (66 deaths per 1,000 live births, SD=29.7). IMR varied highly across states among children with uneducated mothers (69.6%) compared to mothers with primary education (45.2%) and secondary and higher education (46.8%).

4.3.3.2 Spatial variations of infant mortality rates by wealth index

Based on the 2003 survey, children born into the wealthiest homes (highest wealth group) had the lowest IMR (59 deaths per 1,000 live births) compared to those in the lowest and middle wealth group (112 and 95 deaths per 1,000 live births, respectively). In other words, the chance of infant death varied from 1 in 9 in the poorest wealth group to 1 in 17 in the highest wealth group. In rural areas, IMR ranged from 113 deaths per 1,000 live births (1 in 9) among children in the poorest homes to 68 deaths per 1,000 live births (1 in 15) in the highest wealth group. Similarly, in urban areas children in the highest wealth group had the lowest IMR (53 deaths per 1,000 live births) compared to those in the middle and lowest wealth group (117 and 105 deaths per 1,000 live births, respectively). Differences in IMR by wealth were also identified across regions (See Appendix 12a). Children in the lowest wealth group had the highest mean IMR across states (111 deaths per 1,000 live births, SD=68.5). IMR also varied highly across states for children in the middle and highest wealth group with a CV of 105% and 135%, respectively compared to the lowest wealth group (62%) indicating uniformly high mortality rates among the poorest across states (Table 4.5).

In the succeeding 2008 survey, children born into the poorest householdsstill had the highest IMR (80 deaths per 1,000 live births) compared to those in the middle and highest wealth group (76 and 57 deaths per 1,000 live births, respectively). This implies that the chance of infant death varied from 1 in 12 in the lowest wealth group to 1 in 18 in the

Table 4.5: IMRs (per 1000 live births) by Wealth Index across states in Nigeria.

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	Poor	Middle	Rich	Poor	Middle	Rich	Poor	Middle	Rich
Abia	167	0	0	105	90	80	63	71	82
Abuja	0	0	0	36	46	70	0	86	51
Adamawa	172	63	71	116	70	59	98	54	60
Akwa Ibom	118	47	0	79	69	57	87	50	50
Anambra	250	53	23	37	42	52	82	123	53
Bauchi	72	188	60	77	110	49	93	37	32
Bayelsa	53	0	250	124	86	88	0	35	49
Benue	142	39	81	104	73	71	73	62	62
Borno	104	121	105	100	81	48	20	25	44
Cross River	125	42	33	52	50	36	48	21	66
Delta	265	174	85	106	67	82	140	82	42
Ebonyi	191	111	N/A	97	93	75	110	95	23
Edo	0	0	143	98	112	61	49	34	27
Ekiti	111	N/A	48	88	27	39	0	65	49
Enugu	125	111	32	80	95	67	54	62	68
Gombe	86	93	53	69	42	51	64	79	72
Imo	167	0	0	33	88	120	170	48	63
Jigawa	121	63	500	55	48	83	87	96	49
Kaduna	169	91	66	91	62	54	32	66	17
Kano	106	52	95	95	142	50	80	51	45
Katsina	91	72	80	66	68	61	53	37	48
Kebbi	87	143	59	64	58	53	88	94	85
Kogi	200	43	27	48	49	63	23	47	36
Kwara	0	0	0	22	78	29	53	52	53
Lagos	0	0	52	0	35	54	N/A	105	56
Nasarawa	189	125	240	74	56	49	58	67	55
Niger	61	150	31	92	71	59	52	45	51
Ogun	94	375	45	108	73	54	48	60	52
Ondo	63	0	167	17	85	40	55	99	53
Osun	0	0	42	73	68	12	63	19	38
Oyo	48	0	0	83	72	47	4	45	52
Plateau	103	91	57	84	63	38	72	67	67
Rivers	177	311	52	63	85	56	73	33	64
Sokoto	78	95	0	89	59	72	87	40	52
Taraba	178	33	0	88	95	15	84	33	84
Yobe	64	107	47	66	23	44	68	23	10
Zamfara	144	108	0	74	35	39	115	71	66
Mean	111.3	80.5	70.7	74.2	69.2	56.1	65.1	58.8	51.9
SD	68.4	84.8	95.5	28.8	24.9	20.3	37.3	25.9	17.0
CV (%)	61.5	105.3	135.2	38.8	36.1	36.2	57.4	44.0	32.8
Author's direct estimates and calculations based on 5 years preceding the survey									

highest wealth group. In urban areas, children born into households in the lowest wealth group had the highest IMR (92 deaths per 1,000 live births) while in rural areas, children born into households in the middle wealth group had the highest IMR (82 deaths per 1,000 live births) (See Appendix 12b). Across states, children in the lowest wealth group had the highest mean IMR (74 deaths per 1,000 live births, SD=28.8) but the distribution of IMRs across states was roughly the same (36-39%) among all wealth groups.

Based on the 2013 survey, children born into homes in the highest wealth group had the lowest IMR (50 deaths per 1,000 live births) like in the previous surveys, while those in the lowest wealth group had the highest (76 deaths per 1,000 live births). This implies that the chance of infant death varied from 1 in 13 in the lowest wealth group to 1 in 20 in the highest wealth group. The same pattern was observed in both rural and urban areas (See Appendix 12c. Regionally, IMRs are generally lower among children from the richest homes except in the Northeast, Southsouth and Southwest. Across states, the average IMR was highest among children in the lowest wealth group (65 deaths per 1,000 live births, SD=37.3). However, IMRs were more uniformly distributed in the highest wealth group (33%) compared to the middle (44%) and lowest (57%) wealth groups.

4.4 Spatial pattern analysis of infant mortality rates in Nigeria

4.4.1 Test of hypothesis 1a:There is no significant clustering of infant mortality in Nigeria

4.4.1.1 Global Moran's I analysis

A Global Moran's I analysis was performed to assess whether IMRs had no tendency to cluster in space. Results of the Global Moran's I (See Appendix 13) shows a positive spatial autocorrelation of IMRs in Nigeria based on the 2003 (MI = 0.15, p = 0.10), 2008 (MI= 0.15, p=0.09) and 2013 (MI = 0.17, p = 0.07) surveys though not at a 95% confidence level. The positive z scores (1.65, 1.68 and 1.83, respectively) also indicates a clustered pattern. However, the null hypothesis is not rejected since the evidence of spatial correlation or dependence is not statistically significant ($p \leq 0.05$).

4.4.1.2 Local Moran's I analysis

The Global Moran's I indicatedsome clustering of IMRs in Nigeria. However, to identify the location of local clusters i.e. concentrations of both high and low IMRs within Nigeria further detailed analysis was carried out using the Local Moran's I. Results showed significant ($p<0.05$) clusters of IMRs based on each survey (See Appendix 14). In 2003, three significant clusters were identified: high-high, low-low and low-high (Figure 4.4a). Taraba state with a significant index of 0.96 ($p = 0.007$) indicates that the state not only had a relatively high IMR but was also surrounded by states with high IMR (High-High cluster). Both Kwara and Oyo states with a significant index of 1.22 ($p = 0.002$) and 1.52 ($p = 0.004$), respectively are clusters of low values (Low-Low). In other words, both states not only had relatively low IMRs but were surrounded by states with low IMRs. This suggests that these states share specific characteristics with neighbouring states that may explain the concentration of relatively lower IMRs. The Federal Capital Territory with an index of -1.06 ($p = 0.03$) is a Low-High cluster (outlier). The negative sign indicates dissimilar values. In other words, Abuja had a relatively low IMR but was surrounded by states with much higher values. The fact that Abuja has a significantly lower IMR than neighbouring states suggests that key factors responsible for a lower IMR are state-specific.

Two significant clusters were identified in 2008: low-low and low-high (Figure 4.4b). Kwara, Osun and Ekiti states with a significant index of 1.58 ($p = 0.00$), 2.11 ($p = 0.00$) and 1.61 ($p=0.00$), respectively are clusters of relatively low values (Low-Low cluster) which suggests that these states share specific characteristics with neighbouring states that may explain the concentration of relatively low IMRs. Cross River state with an index of -1.04 ($p = 0.03$) is a Low-High cluster (outlier). In other words, Cross River state had a relatively low IMR but was surrounded by states with significantly higher values. In 2013, only high-high clusters were identified (Figure 4.4c). Sokoto and Kebbi state with a statistically significant index of 2.03 ($p=0.002$) and 1.52 ($p=0.005$), respectively indicate that both states not only had high IMRs but were also surrounded by states with relatively high IMRs (High-High cluster).

Across the survey years, relatively lower IMRs were in the Southwest and Northcentral region and relatively higher IMRs in the Northwest and NorthEast. This suggests that neighbouring states generally had similar underlying factors/conditions responsible for the spatial pattern of IMRs over time. The only exception was Abuja and Cross River states in the 2003 and 2008 surveys, respectively which had IMRs that varied significantly from their neighbours.

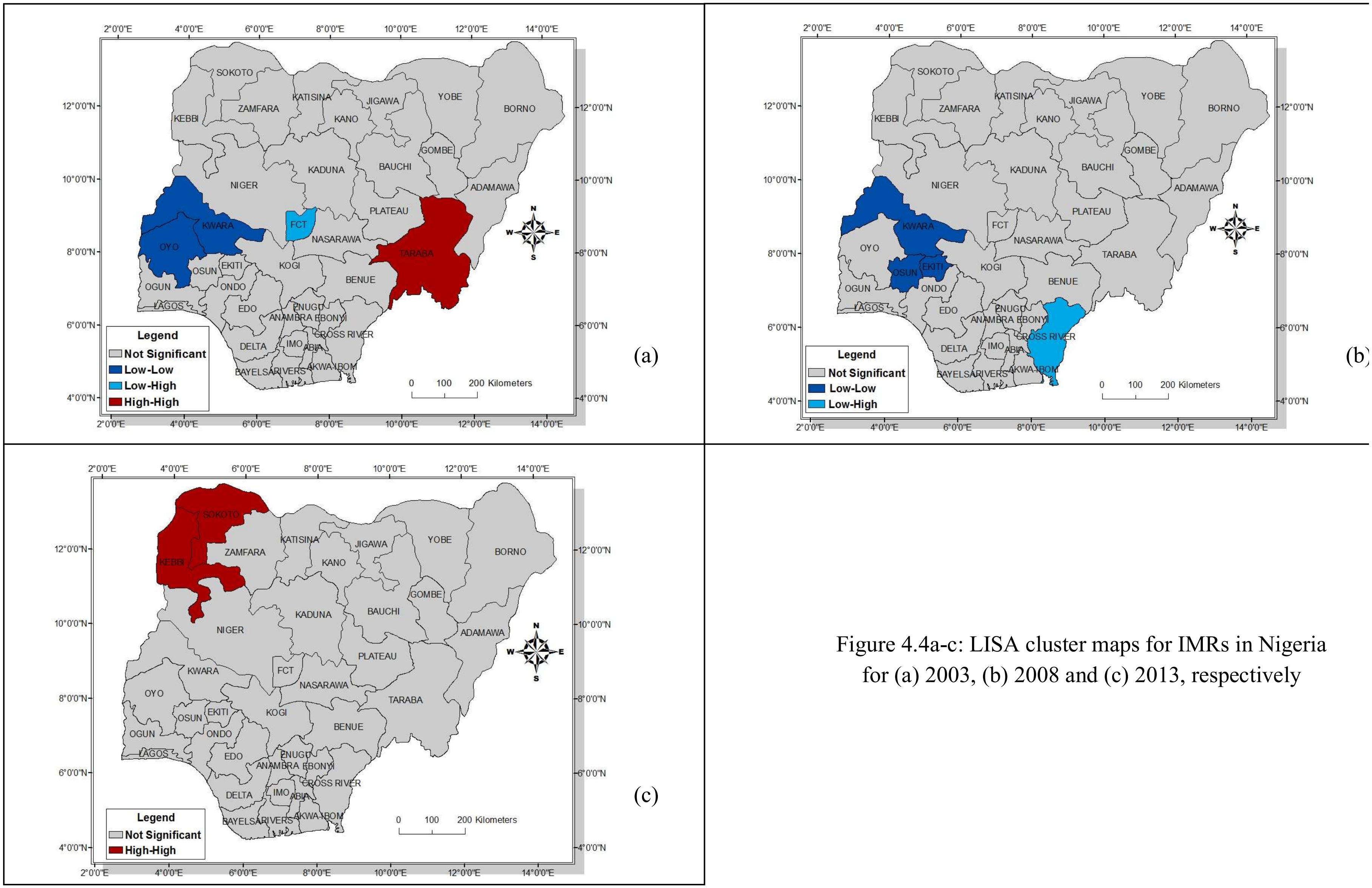


Figure 4.4a-c: LISA cluster maps for IMRs in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

4.4.1.3 Hot spot analysis (Getis-Ord Gi* statistic)

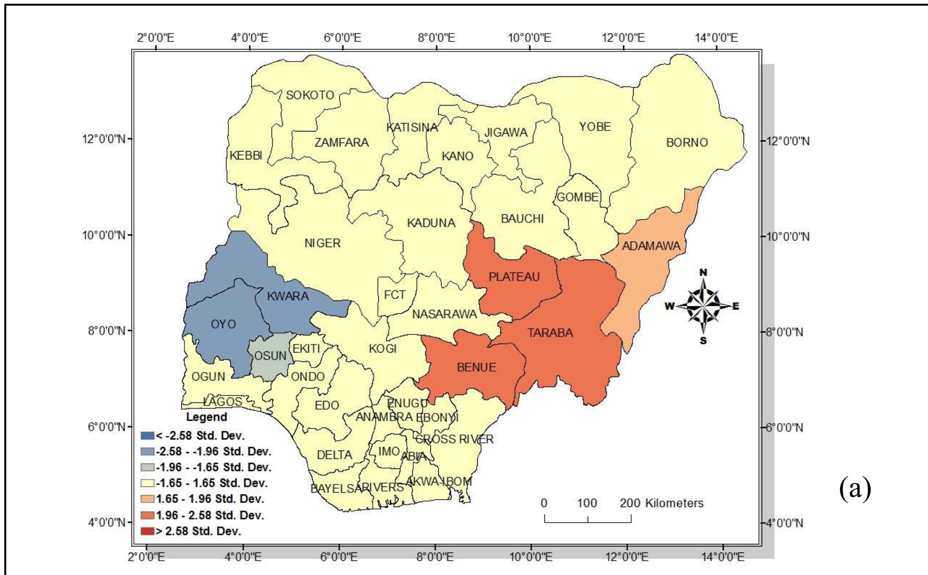
Figure 4.5 and Appendix 15 show the degree of clustering of IMRs in Nigeria for the 2003, 2008 and 2013 surveys. With regards to the 2003 survey, Oyo (p=0.02) and Kwara (p=0.02) states are significant cold spots at a 95% confidence level signifying the maximum spatial clustering of relatively low IMRs while Taraba (p=0.01), Plateau (p=0.03) and Benue (p=0.03) are significant hot spots at a 95% confidence level signifying the maximum spatial clustering of relatively high IMRs. Osun (p=0.05) and Adamawa (p=0.09) states are significant cold and hot spots, respectively at a 90% confidence level. Findings generally support the local Moran's I test by identifying significant hot and cold spots in the Northeast and Southwest regions of Nigeria, respectively.

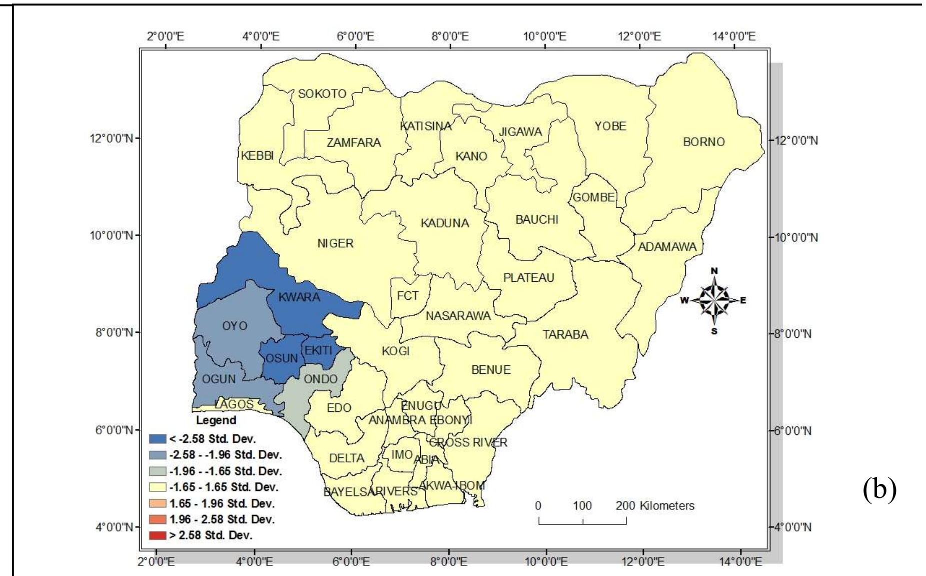
The hot spot analysis results for 2008 show no significant hot spots but significant cold spots at various levels of confidence was identified. This is similar to results from the local Moran's I (Figure 4.5b). Kwara (p value=0.01), Ekiti (p=0.00) and Osun state (p=0.00) are significant cold spots at a 99% confidence level signifying the maximum spatial clustering of relatively low IMRs. Oyo (p=0.01) and Ogun state (p=0.01) are significant cold spots at a 95% confidence level while Ondo state (p=0.07) is a significant cold spot at a 90% confidence level. The hot spot analysis results for 2013 (Figure 4.5c) show Kwara (p=0.02) and Ondo states (p=0.03) are significant cold spots at a 95% confidence level while Oyo (p=0.09), Ekiti (p=0.10) and Abuja (p=0.07) are significant cold spots at a 90% confidence level. Taraba (p=0.07) and Kebbi (p=0.02) states are significant hot spots at a 90% and 95% confidence level, respectively while Sokoto state (p=0.002) is a significant hot spot at a 99% confidence level signifying the maximum spatial clustering of relatively high IMRs.

4.5 Spatial variations of child and under 5 mortality rates in Nigeria

4.5.1 Spatial variations of child and under 5 mortality by place of residence

Table 4.6 shows child mortality rates in Nigeria based on data from the 2003, 2008 and 2013 NDHS which covers the 5year period preceding each survey. 306 (5.1%) out of the 6,029 under 5 children in the 2003 survey, survived to the age of one but died before the age of five. The child mortality rate (CMR) of 55 deaths per 1,000 children surviving to the age of one implies that 1 in 18 died between their first and fifth birthday. CMRs in rural areas (66 deaths per 1,000 children surviving to the age of one) exceeded mortality rates in urban areas (32 deaths per 1,000 children surviving to the age of one) by 52%.





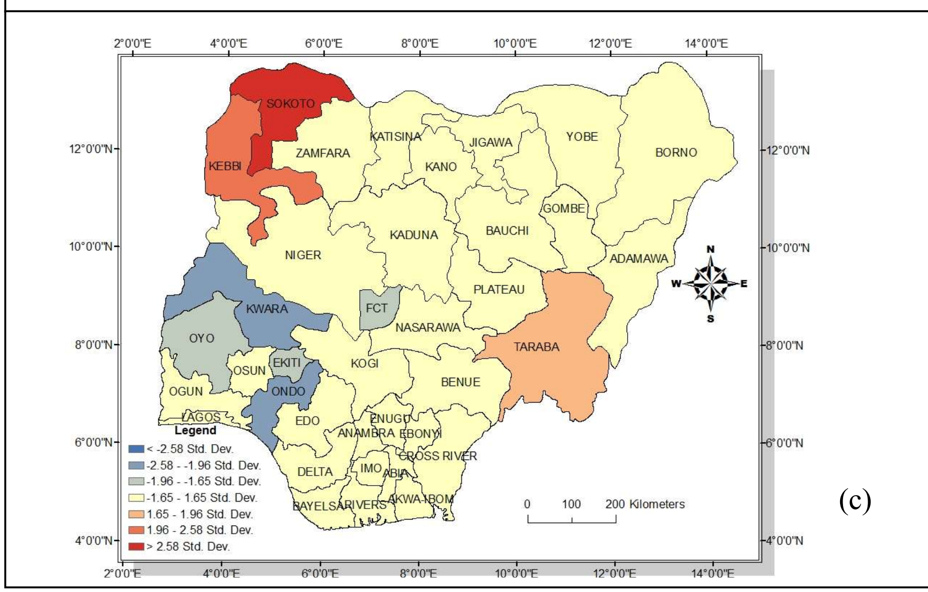


Figure 4.5a-c: Gi* statistic (Hot spot) maps for IMRs in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

Table 4.6:Direct Estimate of CMRs (per 1,000 children surviving to age one) in Nigeria

Location		2003 NDHS	2008 NDHS	2013 NDHS
Residence	Urban	32	26	15
	Rural	66	51	36
Regions	Northcentral	43	35	18
	Northeast	76	53	36
	Northwest	71	65	40
	Southeast	12	34	20
	Southsouth	36	30	17
	Southwest	21	15	13
States	Abia	0	34	10
	Abuja	53	21	10
	Adamawa	40	55	21
	Akwa Ibom	30	48	16
	Anambra	0	45	13
	Bauchi	78	62	55
	Bayelsa	111	32	14
	Benue	28	22	25
	Borno	69	44	22
	Cross River	12	19	22
	Delta	14	24	15
	Ebonyi	48	30	33
	Edo	49	22	15
	Ekiti	28	28	5
	Enugu	17	22	16
	Gombe	92	52	44
	Imo	9	29	18
	Jigawa	123	72	53
	Kaduna	42	47	9
	Kano	55	77	36
	Katsina	41	65	43
	Kebbi	56	40	37
	Kogi	68	33	18
	Kwara	0	12	16
	Lagos	17	13	7
	Nasarawa	39	23	26
	Niger	58	72	17
	Ogun	20	12	12
	Ondo	24	27	23
	Osun	37	13	5
	Oyo	20	10	20
	Plateau	19	26	11
	Rivers	54	34	16
	Sokoto	93	82	52
	Taraba	33	42	26
	Yobe	133	54	40
	Zamfara	132	54	54
National		55	43	29
Author’s direct estimates of CMRs based on 5 years preceding the survey				

Regionally, CMR ranged from 12 deaths per 1,000 children surviving to the age of one in the Southeast to as high as 76 deaths per 1,000 children surviving to the age of one in the Northeast. Yobe, Zamfara and Bayelsa states had the highest CMRs (over 110 deaths per 1,000 children surviving to the age of one) while Imo, Anambra, Abia and Kwara states had the lowest (less than 10 deaths per 1,000 children surviving to the age of one). Figure 4.6a shows the spatial patterns of CMRs over Nigeria.

With regards to under 5 mortality, 847 (14%) out of the 6,029 live births did not survive to the age of 5. The overall under 5 mortality rate (U5MR) of 141 deaths per 1,000 live births implies 1 in 7 children died before their 5th birthday. Table 4.7 also shows that U5MRs are considerably higher in rural areas (158 deaths per 1,000 live births) than in urban areas (98 deaths per 1,000 live births) by 38%. Regionally, U5MR ranges from 64 deaths per 1,000 live births in the Southeast to as high as 168 deaths per 1,000 live births in the Northeast. Zamfara state had the highest U5MR (239 deaths per 1,000 live births) while Imo state had the lowest (18 deaths per 1,000 live births). In other words, the risk/chance of under 5 death varied from 1 in 4 children in Zamfara state to 1 in 56 in Imo state. Figure 4.6b shows the spatial patterns of U5MRs over Nigeria with the highest U5MRs clearly among states in the North and parts of the Southsouth

For the 2008 survey, 1,148 (4%) out of the 28,647 children under 5 survived to the age of one but died before their 5th birthday. The CMR of 43 deaths per 1,000 children surviving to the age of one implies that 1 in 23 died between their first and fifth birthday. CMRs in rural areas (51 deaths per 1,000 children surviving to the age of one) exceeded mortality rates in urban areas (26 deaths per 1,000 children surviving to the age of one) by 49%. There are also substantial regional differences in CMRs with the highest in the Northwest and the lowest in the Southwest (65 and 15 deaths per 1,000 children surviving to the age of one, respectively). CMRs ranged from 10 deaths per 1,000 children surviving to the age of one in Oyo state (1 in 104) to 82 deaths per 1,000 children surviving to the age of one in Sokoto state (1 in 12). Figure 4.7a shows the spatial patterns of CMRs across Nigeria with the lowest CMRs clearly in the Southwest.

With regards to under 5 mortality, 3,187 (11.1%) out of the 28,647 live births died before their 5th birthday. The U5MR of 111 deaths per 1,000 live births implies 1 in 9 children died before the age of 5. U5MRs are also significantly higher in rural areas (125 deaths per 1,000 live births) than in urban areas (80 deaths per 1,000 live births) by 36%. Regionally, U5MR ranges from 66 deaths per 1,000 live births in the Southwest to as high

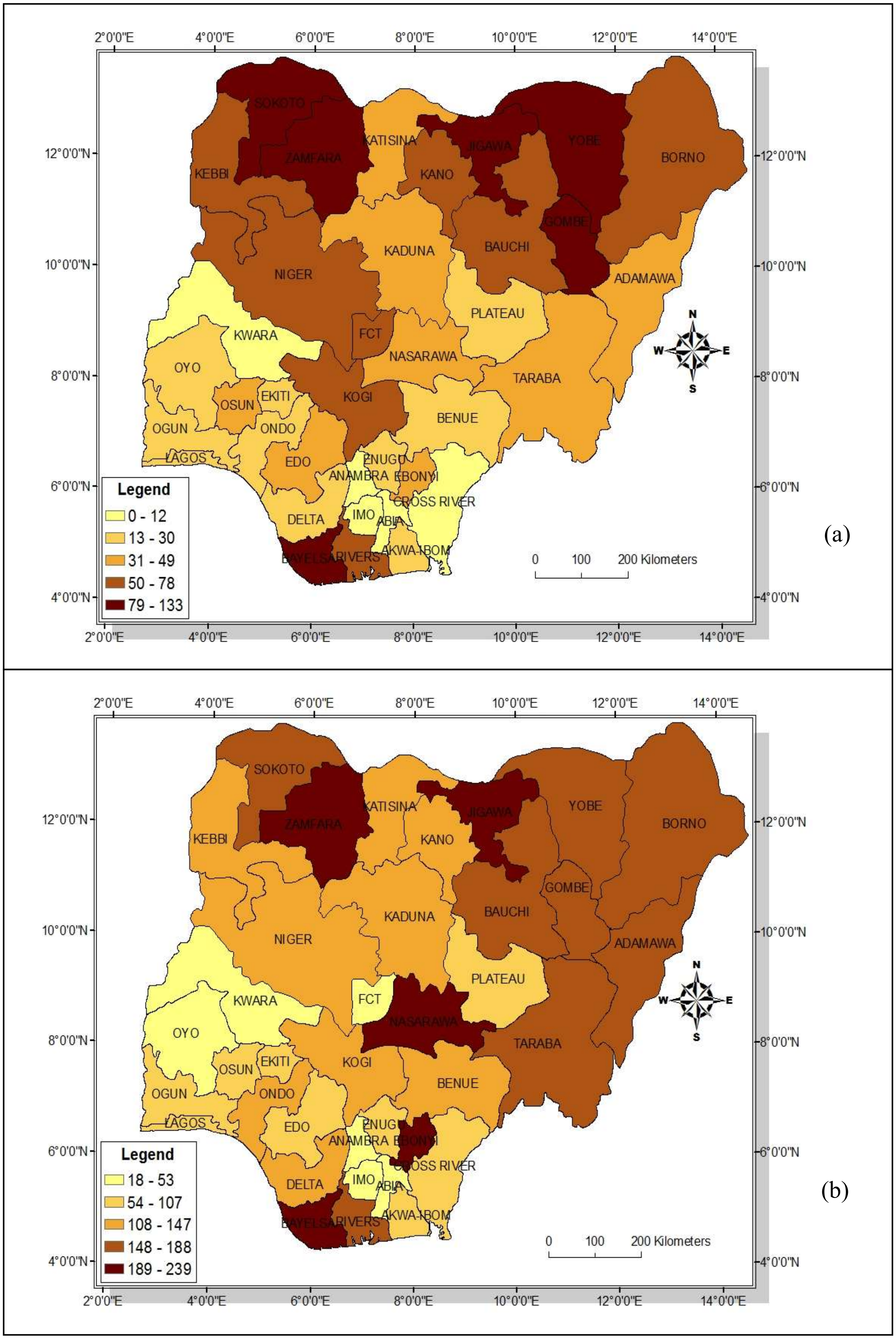


Figure 4.6a and b: The Spatial Distribution of Child and Under 5 Mortality Rates in Nigeria (2003, NDHS)

Table 4.7:Direct Estimate of U5MRs (per 1,000 live births) in Nigeria

Location		2003 NDHS	2008 NDHS	2013 NDHS
Residence	Urban	98	80	65
	Rural	158	125	104
Regions	Northcentral	129	104	74
	Northeast	168	128	98
	Northwest	159	135	110
	Southeast	64	111	90
	Southsouth	132	97	66
	Southwest	74	66	63
States	Abia	44	114	87
	Abuja	53	81	63
	Adamawa	188	151	98
	Akwa Ibom	96	113	73
	Anambra	28	93	74
	Bauchi	161	136	131
	Bayelsa	233	126	56
	Benue	129	114	92
	Borno	170	129	49
	Cross River	86	63	61
	Delta	147	105	74
	Ebonyi	216	95	114
	Edo	93	76	45
	Ekiti	103	120	61
	Enugu	78	102	80
	Gombe	162	110	111
	Imo	18	130	90
	Jigawa	227	123	135
	Kaduna	140	114	45
	Kano	137	163	101
	Katsina	116	126	90
	Kebbi	137	100	123
	Kogi	126	84	56
	Kwara	25	43	68
	Lagos	68	63	64
	Nasarawa	221	83	84
	Niger	130	146	65
	Ogun	94	81	65
	Ondo	133	67	85
	Osun	107	43	41
	Oyo	30	66	61
	Plateau	103	99	80
	Rivers	178	93	75
	Sokoto	163	160	127
	Taraba	165	118	97
	Yobe	183	108	96
	Zamfara	239	118	156
National		141	111	91

Author’s direct estimates of U5MRs based on 5 years preceding the survey as 135 deaths per 1,000 live births in the Northwest. Kano state had the highest U5MR (163 deaths per 1,000 live births) while Osun and Kwara states both had the lowest (43 deaths per 1,000 live births). This implies that the risk/chance of under 5 death varied from 1 in 6 in Kano state to 1 in 23 in Osun and Kwara states. Figure 4.7b shows the spatial patterns of CMRs over Nigeria.

With regards to the 2013 survey, 843 (2.7%) of the 31,482 children under 5, survived to the age of one but died before their 5th birthday. The CMR of 29 deaths per 1,000 children surviving to the age of one implies that 1 in 35 died between their first and fifth birthday. CMRs were twice as high in rural areas (36 deaths per 1,000 children surviving to age one) than in urban areas (15 deaths per 1,000 children surviving to age one). Across regions, CMR ranged from 13 deaths per 1,000 children surviving to age one in the Southwest to 40 deaths per 1,000 children surviving to age one in the Northwest. Bauchi, Zamfara, Jigawa and Sokoto states had the highest CMR (Over 50 deaths per 1,000 children surviving to age one) while Osun, Ekiti, Lagos and Kaduna states had the lowest (less than 13 deaths per 1,000 children surviving to age one). Figure 4.8a shows the spatial patterns of CMRs with surprisingly low CMRs in a few states in the North.

Overall, 2,848 (9%) under 5 deaths occurred out of the 31,482 live births before the age of 5. The U5MR of 91 deaths per 1,000 live births implies 1 in 11 children died before the age of 5. Like the previous surveys, U5MRs are also significantly higher in rural areas (104 deaths per 1,000 live births) than in urban areas (65 deaths per 1,000 live births). Regionally, U5MR ranged from 64 deaths per 1,000 live births in the Southwest to as high as 110 deaths per 1,000 live births in the Northwest. Zamfara state had the highest U5MR (156 deaths per 1,000 live births) while Osun state had the lowest (41 deaths per 1,000 live births). This implies that the risk/chance of under 5 death varied from 1 in 6 in Zamfara state to 1 in 24 in Osun state. Figure 4.8b shows the spatial patterns of U5MRs with a surprisingly low U5MR in Borno state in the estreme Northeast.

4.5.2 Spatial variations of child and under 5 mortality by demographic characteristics

4.5.2.1 Spatial variations of child and under 5 mortality by child’s sex

With regards to the 2003 survey, CMR was slightly higher among female than among male children (57 and 55 deaths per 1,000 children surviving to the age of one, respectively). CMRs also differed between the sexes within and between rural and urban areas. In rural areas, CMR among male and female children was about the same (66 and

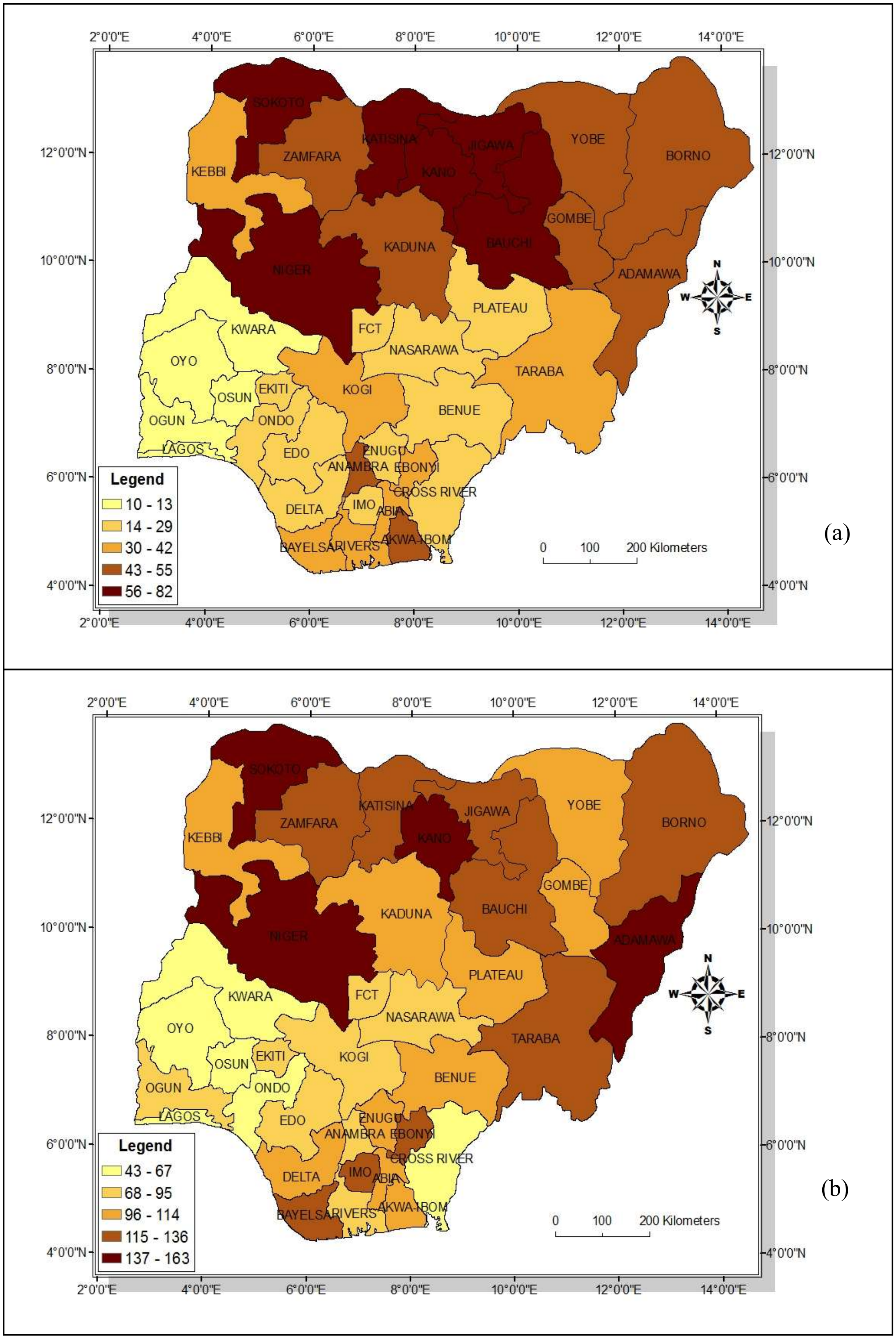


Figure 4.7a and b: The Spatial Distribution of Child and Under 5 Mortality Rates in Nigeria (2008, NDHS)

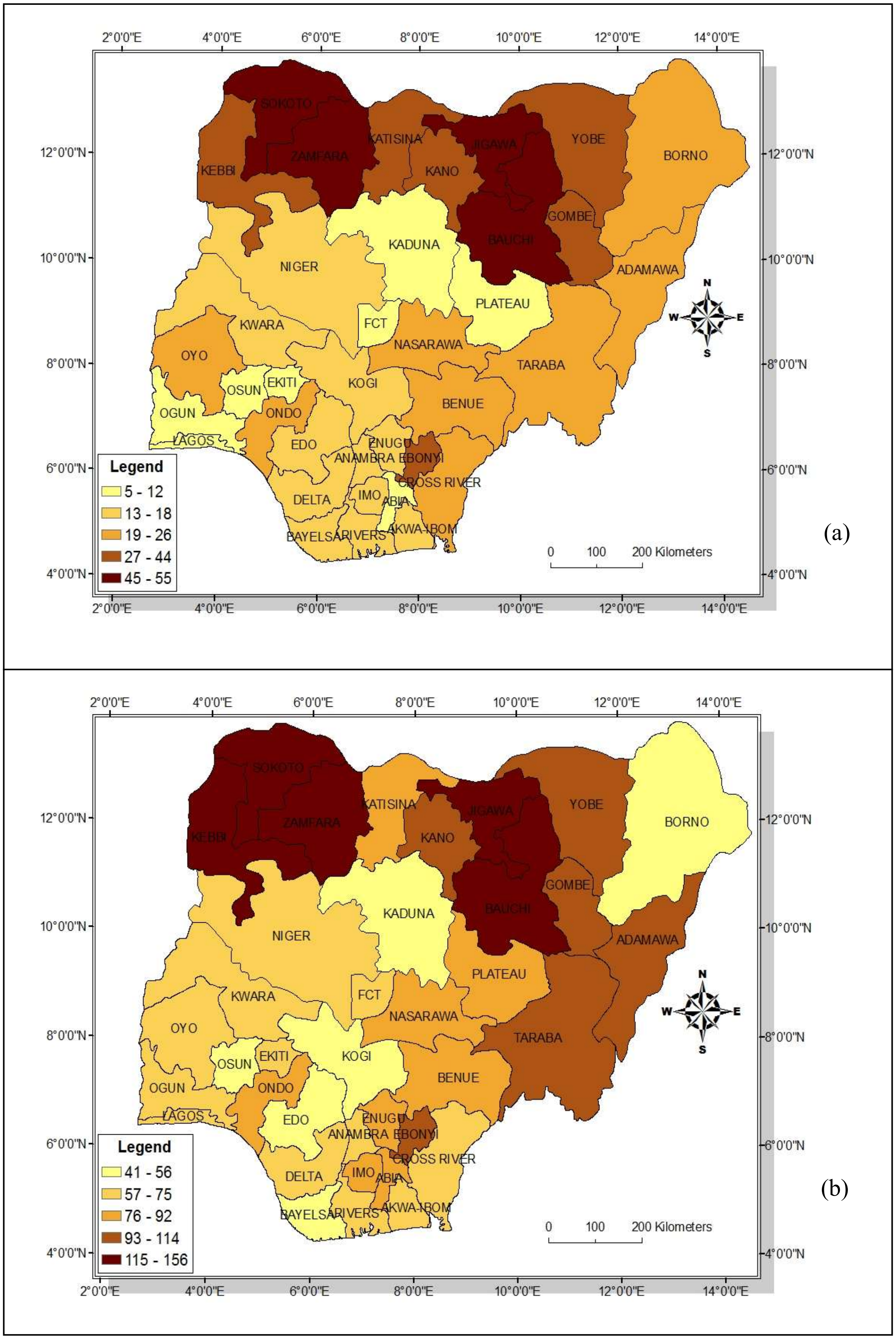


Figure 4.8a and b: The Spatial Distribution of Child and Under 5 Mortality Rates in Nigeria (2013, NDHS)

65 deaths per 1,000 children surviving to the age of one, respectively). However, in urban areas, CMRs among females exceeded CMRs among males (37 and 29 deaths per 1,000 children surviving to the age of one, respectively). CMRs between the sexes also varied within and across regions with male children having the highest CMRs except in the Northeast, Southsouth and Southwest (See Appendix 16a). Table 4.8 shows that across states, CMR among males ranged from 11 deaths per 1,000 children surviving to the age of one in Benue state (with the exception of states that reported no male child deaths) to as high as 200 deaths per 1,000 children surviving to the age of one in Bayelsa state. CMRs among females ranged from 9 deaths per 1,000 children surviving to the age of one in Niger state (with the exception of states that reported no female child deaths) to as high as 161 deaths per 1,000 children surviving to the age of one in Yobe state. The average CMR among females (50 deaths per 1,000 children surviving to the age of one, SD = 45.1) was slightly higher than among males (47 deaths per 1,000 children surviving to the age of one, SD = 48.0). CMRsacross states varied the most among male children (103.2%).

U5MRs were also higher among male children than among female children (147 and 134 deaths per 1,000 live births, respectively). In rural areas, males had a higher U5MR (168 deaths per 1,000 live births) than females (147 deaths per 1,000 live births) while U5MRs were much higher among females (103 deaths per 1,000 live births) than among males (93 deaths per 1,000 live births) in urban areas. Regionally, U5MRs were higher among males except in the Northcentral and Southwestern parts of Nigeria. U5MR among male children ranged from 68 deaths per 1,000 live births in the Southwest to 171 deaths per 1,000 live births in the Northeast while U5MR among female children ranged from 41 deaths per 1,000 live births in the Southeast to 165 deaths per 1,000 live births in the Northeast (See Appendix 17a). At the state level, U5MR ranged from 26 deaths per 1,000 live births in Imo state to 273 deaths per 1,000 live births in Zamfara state among males while U5MR among females ranged from 13 deaths per 1,000 live births in Imo state (with the exception of states with no female deaths reported) to 262 deaths per 1,000 live births in Nasarawa state as shown in Table 4.9. The average U5MR among male and female under 5 children was 132 (SD = 69.4) and 125 (SD = 71.3) deaths per 1,000 live births, respectively. The distribution of U5MRs among males and females varied across states by approximately 53% and 57%, respectively.

In 2008, CMR was slightly higher among male children than among female children (44 and 43 deaths per 1,000 children surviving to the age of one, respectively). The pattern

Table 4.8: CMRs (per 1000 children surviving to age one) by Child's Sex across States in Nigeria

STATE	2003 NDHS		2008 NDHS		2013 NDHS	
	Male	Female	Male	Female	Male	Female
Abia	0	0	53	17	7	14
Abuja	83	143	17	16	10	10
Adamawa	47	53	60	51	22	20
Akwa Ibom	24	36	52	47	24	13
Anambra	0	0	41	49	6	20
Bauchi	83	78	70	53	53	56
Bayelsa	200	0	37	33	18	9
Benue	11	45	25	20	26	26
Borno	62	78	47	43	15	30
Cross River	24	0	22	15	18	26
Delta	0	27	15	33	20	11
Ebonyi	50	46	30	35	31	34
Edo	64	30	20	28	20	11
Ekiti	46	0	26	30	10	11
Enugu	35	0	14	29	8	21
Gombe	58	123	43	61	55	31
Imo	0	14	17	44	8	32
Jigawa	157	99	74	70	51	54
Kaduna	25	61	53	40	12	6
Kano	75	35	74	79	30	43
Katsina	36	46	64	66	57	30
Kebbi	48	64	45	34	47	29
Kogi	42	101	28	33	10	28
Kwara	0	0	10	10	22	10
Lagos	21	12	6	20	8	5
Nasarawa	23	61	27	19	33	14
Niger	120	9	73	72	12	22
Ogun	19	23	9	17	15	8
Ondo	0	67	25	26	12	33
Osun	0	77	12	14	5	0
Oyo	19	22	19	0	24	16
Plateau	39	0	34	18	17	4
Rivers	12	89	35	32	21	12
Sokoto	0	96	89	75	55	50
Taraba	46	13	43	41	27	21
Yobe	119	161	53	55	43	37
Zamfara	137	130	60	47	54	55
Mean	46.5	49.6	38.4	37.1	24.5	23.0
SD	48.0	45.1	21.9	19.8	16.4	14.9
CV (%)	103.2	90.8	56.9	53.4	66.9	65.0
Author's direct estimates & calculations based on 5 years preceding the survey						

Table 4.9: U5MRs (per 1000 live births) by Child's Sex across States in Nigeria

STATE	2003 NDHS		2008 NDHS		2013 NDHS	
	Male	Female	Male	Female	Male	Female
Abia	71	0	132	98	91	83
Abuja	77	143	85	77	67	58
Adamawa	226	156	167	136	96	98
Akwa Ibom	91	91	109	118	84	58
Anambra	38	18	91	95	94	52
Bauchi	188	134	132	141	140	123
Bayelsa	267	143	153	98	60	53
Benue	117	141	137	95	93	90
Borno	166	175	144	115	49	49
Cross River	128	43	79	45	63	59
Delta	130	163	95	116	92	53
Ebonyi	269	160	140	103	118	109
Edo	137	29	102	89	44	41
Ekiti	46	177	69	85	59	62
Enugu	97	61	89	115	89	71
Gombe	132	190	112	108	124	95
Imo	26	13	128	133	66	113
Jigawa	228	226	124	123	147	122
Kaduna	117	164	115	113	54	35
Kano	154	121	177	149	95	108
Katsina	136	93	130	123	111	70
Kebbi	174	97	110	88	140	106
Kogi	71	197	103	65	29	85
Kwara	67	0	37	53	76	59
Lagos	88	44	52	73	76	51
Nasarawa	208	262	101	66	102	61
Niger	200	74	148	144	61	68
Ogun	70	122	67	68	73	54
Ondo	39	222	67	67	77	93
Osun	67	77	56	27	40	37
Oyo	36	22	87	45	60	65
Plateau	93	127	106	91	88	73
Rivers	189	165	88	98	78	69
Sokoto	153	176	184	135	133	119
Taraba	127	215	137	98	103	90
Yobe	185	191	106	110	97	97
Zamfara	273	208	123	112	178	134
Mean	131.8	125.4	110.3	97.6	87.7	77.3
SD	69.4	71.3	34.5	29.9	32.6	26.8
CV (%)	52.7	56.9	31.3	30.6	37.1	34.6
Author's direct estimates & calculations based on 5 years preceding the survey						

was the same in rural areas while in urban areas, CMR was higher among female children than among male children (27 and 24 deaths per 1,000 children surviving to the age of one, respectively). Regionally, CMRs were higher among male children except in the Southern part of the country (See Appendix 16b). Across states, CMR among males ranged from 6 deaths per 1,000 children surviving to the age of one in Lagos state to 89 deaths per 1,000 children surviving to the age of one in Sokoto state. CMR among females ranged from 10 deaths per 1,000 children surviving to the age of one in Kwara state (with the exception of Oyo state that reported no female child deaths) to 79 deaths per 1,000 children surviving to the age of one in Kano state. The average CMR among males (38 deaths per 1,000 children surviving to the age of one, SD = 21.9) was slightly higher than among females (37 deaths per 1,000 children surviving to the age of one, SD = 19.8). However, CMRs among females were more uniformly distributed across states (53.4%) compared to CMRs among males (56.9%).

U5MRs were also higher among male children than among female children (117 and 105 deaths per 1,000 live births, respectively). The pattern was the same in rural areas while U5MRs were much higher among female children than among male children (81 and 79 deaths per 1,000 live births, respectively) in urban areas. Regionally, U5MRs were consistently higher among male children (See Appendix 17b). Significant variations in under 5 mortality are evident across states. Among male children, U5MR ranged from 37 deaths per 1,000 live births in Kwara state to as high as 184 deaths per 1,000 live births in Sokoto state. U5MR among female children ranged from 27 deaths per 1.000 live births in Osun state to as high as 149 deaths per 1,000 live births in Kano state. The average U5MR among male and female under 5 children was 110 (SD = 34.5) and 98 (SD = 29.9) deaths per 1,000 live births, respectively. U5MRs among male and female children varied by 31% across states indicating a uniform distribution.

By the 2013 survey, CMRs were still slightly higher among males (than among females (29 and 28 deaths per 1,000 children surviving to the age of one, respectively). CMRs were higher among male children in rural and urban areas as well as across regions except in the Southeast and Northcentral regions (See Appendix 16c). At the state level, CMRs among males ranged from 5 deaths per 1,000 children surviving to the age of one in Oyo state to 57 deaths per 1,000 children surviving to the age of one in Katsina state. CMR among females ranged from 4 deaths per 1,000 children surviving to the age of one in Plateau state (with the exception of Osun state that reported no female child deaths) to

56 deaths per 1,000 children surviving to the age of one in Bauchi. The average CMR was slightly higher among male children (24 deaths per 1,000 children surviving to the age of one, SD = 16.4) than among female children (23 deaths per 1,000 children surviving to the age of one, SD = 14.9). CMRs among male and female children varied by 67% and 65%, respectively across states indicating a uniform distribution.

U5MRs were also higher among male children than among female children (96 and 84 deaths per 1,000 live births, respectively). U5MRs were significantly higher among male children than female children in rural areas (110 and 98 deaths per 1,000 live births, respectively) and in urban areas (71 and 59 deaths per 1,000 live births, respectively). Regionally, U5MRs were consistently higher among male children. (See Appendix 17c). Across states, U5MR ranged from 29 deaths per 1,000 live births in Kogi state to as high as 178 deaths per 1,000 live births in Zamfara state among male children while U5MR ranged from 35 deaths per 1,000 live births in Kaduna state to as high as 134 deaths per 1,000 live births in Zamfara state among female children. The average U5MR among male and female under 5 children was 88 (SD = 32.6) and 77 (SD = 26.8) deaths per 1,000 live births, respectively. U5MRs among male and female children varied by approximately 37% and 35%, respectively indicating a uniform distribution across states.

4.5.2.2 Spatial variations of child and under 5 mortality by mother's age

With regards to the 2003 survey, CMRs were higher among children with mothers over 34 (65 deaths per 1,000 children surviving to age one) than among children born to very young mothersand mothers aged 20 to 34 (48 and 46 deaths per 1,000 children surviving to age one, respectively). The children born to older women consistently had the highest CMRs regionally (except in the Northwest and Southsouth) as well as in both rural and urban areas (See Appendix 18a). Across states, the mean CMR was highest among children with older mothers (67 deaths per 1,000 children surviving to age one, SD=64.8) CMRs for this group was relatively more uniformly distributed across states (97%) than among children with mothers under 20 (217%) and mothers aged 20 to 34 (930%) as shown in Table 4.10. This suggests a more consistent link between CMRs and mothers over 34 across Nigeria.

U5MRs were higher among children with mothers over 34 (162 deaths per 1,000 live births) than among children born to very young mothers and mothers aged 20 to 34 (150 and 132 deaths per 1,000 live births, respectively). U5MRs were highest among older

Table 4.10: CMRs (per 1000 children surviving to age one) by mother's age group across states in Nigeria

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	15-19	20-34	35-49	15-19	20-34	35-49	15-19	20-34	35-49
Abia	0	0	0	53	30	44	0	5	21.1
Abuja	0	71	200	0	22	0	0	14	0
Adamawa	0	44	33	0	51	85	23	26	13
Akwa Ibom	0	19	93	0	57	42	0	16	29
Anambra	0	0	0	0	43	47	0	13	13
Bauchi	116	65	105	28	59	81	67	57	48
Bayelsa	0	150	0	40	37	27	0	14	34
Benue	0	32	26	54	23	13	0	21	42
Borno	88	66	65	39	37	70	60	21	16
Cross River	0	17	0	0	19	23	0	27	14
Delta	0	20	0	0	25	30	0	12	25
Ebonyi	0	35	77	0	35	31	0	30	42
Edo	0	58	46	0	18	38	0	11	24
Ekiti	0	0	125	111	24	30	0	8	0
Enugu	0	0	46	0	15	35	0	14	28
Gombe	50	73	192	53	47	56	29	43	50
Imo	0	12	39	0	30	23	0	20	22
Jigawa	0	172	83	19	72	82	42	56	50
Kaduna	46	49	31	12	38	80	21	6	14
Kano	61	41	84	21	80	80	59	36	33
Katsina	0	49	20	15	62	89	8	44	53
Kebbi	100	70	22	27	39	54	46	33	46
Kogi	0	39	188	65	29	33	0	19	22
Kwara	0	0	0	0	6.6	25	0	20	9
Lagos	0	15	22	0	12	16	0	5	9
Nasarawa	0	19	125	0	28	12	0	26	19
Niger	0	39	146	16	81	68	13	17	11
Ogun	0	14	46	59	13	5	0	10	18
Ondo	0	0	71	0	6	72	0	12	48
Osun	0	59	0	0	17	0	0	3	9
Oyo	0	26	0	0	10	9	74	15	33
Plateau	0	13	42	0	22	40	111	12	0
Rivers	0	66	0	0	33	38	0	15	24
Sokoto	91	97	77	56	78	100	49	52	55
Taraba	0	16	83	0	41	51	26	24	30
Yobe	71	113	222	20	55	63	44	41	41
Zamfara	250	113	164	22	62	42	37	54	60
Mean	23.6	45.1	66.8	19.2	36.7	44.1	19.1	22.9	27.1
SD	51.3	41.9	64.8	26.3	21.2	27.2	27.9	15.3	16.8
CV (%)	217.4	929.8	96.9	137.1	57.8	61.7	146.1	66.7	61.9
Author's direct estimates and calculations based on 5 years preceding the survey									

women (over 34) in all regions except the Southwest. In both rural and urban areas, children with very young mothershadthe highest U5MRs (158 and 130 deaths per 1,000 live births, respectively) compared to other groups (See Appendix 19a). Across states, the mean U5MR was highest among children with older mothers (146 deaths per 1,000 live births, SD=84.6) (Table 4.11). U5MRs varied more among children with teenage mothers with a CV over 100 (116.3%) indicating a far less uniform distribution across Nigeria.

With regards to the 2008 survey, CMRs in Nigeria were much higher among children with mothers over 34 (52 deaths per 1,000 children surviving to age one) than among children by women aged 20 to 34 and teenage women (42 and 24 deaths per 1,000 children surviving to age one, respectively). The children of women over 34 consistently had the highest CMRs regionally as well as in both rural and urban areas (See Appendix 18b). The mean CMR was highest among children with older mothers (44 deaths per 1,000 children surviving to age one, SD=27.2). CMRs varied more among children with mothers under 20 (CV=137%) across Nigeria.

With regards to under 5 mortality, U5MRs were higher among children by women over 34 (126 deaths per 1,000 live births) than among children born to women aged 20 to 34 and very young mothers (124 and 119 deaths per 1,000 live births, respectively). Similarly, across regions, U5MRs are highest among older women (over 34). Children with mothers over 34 had the highest U5MR in rural areas (139 deaths per 1,000 live births) while children with mothers under 20 had the highest U5MR in urban areas (102 deaths per 1,000 live births) (See Appendix 19b). The mean U5MR was highest among children with older mothers (117 deaths per 1,000 live births, SD=38.8). However, U5MRs among children by teenage mothers varied more across Nigeria (CV= 69.4%) compared to other groups.

With regards to the 2013 survey, CMRs were much higher among children with mothers over 34 (31 deaths per 1,000 children surviving to age one) than among children by women under 20 and women aged 20-34 (29 and 28 deaths per 1,000 children surviving to age one, respectively). The children of women over 34 years had the highest CMRs regionally (except in the Northeast, Southwest and Northcentral regions) as well as in both rural and urban areas (See Appendix 18c). The average CMR was highest among children with older mothers (27 deaths per 1,000 children surviving to age one, SD=16.8) but there were more variations in CMRs among children by teenage mothers (CV = 146.1%) compared to other groups over Nigeria. U5MRs were much higher among

Table 4.11: U5MRs (per 1000 live births) by mother's age group across states in Nigeria

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	15-19	20-34	35-49	15-19	20-34	35-49	15-19	20-34	35-49
Abia	N/A	0	100	52.6	98	173	0	97	69
Abuja	N/A	71	200	0	83	79	0	53	80
Adamawa	500	198	118	135	137	193	106	102	84
Akwa Ibom	0	27	259	94	118	98	57	80	47
Anambra	0	12	77	250	92	89	167	61	112
Bauchi	269	124	220	125	140	133	229	126	115
Bayelsa	0	273	143	143	138	88	67	46	79
Benue	59	140	119	205	110	108	0	97	90
Borno	162	174	160	149	112	173	81	40	70
Cross River	143	67	77	36	61	73	46	62	60
Delta	286	140	143	0	104	122	188	71	70
Ebonyi	N/A	152	333	0	117	136	105	93	162
Edo	0	140	46	0	93	105	0	38	55
Ekiti	N/A	69	222	200	75	77	0	57	57
Enugu	0	53	125	83	85	133	50	76	92
Gombe	50	168	222	163	100	126	150	94	142
Imo	0	24	39	0	129	146	67	92	87
Jigawa	74	260	250	73	116	146	116	137	133
Kaduna	83	124	205	111	100	154	86	39	49
Kano	207	113	170	182	155	180	129	97	107
Katsina	167	124	38	116	122	145	53	79	134
Kebbi	182	145	100	163	99	84	125	114	144
Kogi	0	83	297	94	77	108	36	52	71
Kwara	N/A	0	71	74	39	60	200	77	41
Lagos	0	72	64	111	55	83	0	72	42
Nasarawa	143	243	177	125	93	48	0	96	47
Niger	0	118	180	61	156	143	130	60	67
Ogun	0	110	83	167	69	105	0	55	91
Ondo	0	138	71	0	52	113	87	56	141
Osun	N/A	158	0	91	35	64	0	31	70
Oyo	0	39	0	59	63	78	212	49	79
Plateau	0	122	42	227	96	95	273	79	68
Rivers	286	165	211	0	88	121	63	59	118
Sokoto	91	170	172	107	148	205	183	123	121
Taraba	267	153	189	125	107	146	174	102	64
Yobe	125	167	239	60	106	129	83	94	103
Zamfara	250	240	246	214	124	80	218	155	141
Mean	107.8	123.6	146.1	102.6	99.6	117.3	94.1	78.7	89.2
SD	125.4	69.9	84.6	71.2	30.8	38.8	78.1	29.4	33.5
CV (%)	116.3	56.6	57.9	69.4	30.9	33.1	83.1	37.4	37.6
Author's direct estimates and calculations based on 5 years preceding the survey									

children by teenage women (119 deaths per 1,000 live births) than among children by women aged 20 to 34 and women over 34 (86 and 98 deaths per 1,000 live births, respectively). Children with mothers under 20 had the highest U5MR in rural and urban areas (117 and 129 deaths per 1,000 live births, respectively) (See Appendix 19c). U5MRs were highest among women under 20 across regions except in the Southeast. The mean U5MR was highest among children by women under 20 (94 deaths per 1,000 live births, SD=78.1). The CV indicates more variability in U5MRs among children by teenage mothers (83.1%) compared to other groups which had relatively more uniform distributions of U5MRs (<40%) across Nigeria.

4.5.3 Spatial variations of child and under 5 mortality by socioeconomic characteristics

4.5.3.1 Spatial variations of child and under 5 mortality by mother's educational level

With regards to the 2003 survey, CMRs among children of uneducated mothers (78 deaths per 1,000 children surviving to the age of one) were 4 times higher than CMRs among children by women with secondary education and higher (19 deaths per 1,000 live births). In rural areas, CMRs were 3 times higher among the children of uneducated mothers than among mothers with secondary education and above (80 and 24 deaths per 1,000 children surviving to the age of one, respectively). In urban areas, CMRs were 5 times higher among children with uneducated mothers than among those with educated mothers (64 and 14 deaths per 1,000 children surviving to the age of one, respectively). Across regions, CMRswere higher among children with uneducated mothers except in the Southsouth and Southwest regions where children by women with primary education had the highest CMR (42 and 26 deaths per 1,000 children surviving to the age of one, respectively) (See Appendix 20a). The mean CMR was highest among children by uneducated women (57 deaths per 1,000 children surviving to the age of one, SD=54.3) (Table 4.12). The CV indicates more variability in CMRs among children by mothers with primary education (135.3%) and secondary and higher education (194%) pointing to major variations in CMRs in these groups across Nigeria.

With regards to under 5 mortality, U5MRs were much higher among children by uneducated women (170 deaths per 1,000 live births) than among children by women with secondary and higher education (78 deaths per 1,000 live births). U5MRs were higher among children with uneducated mothers in rural and urban areas (172 and 163 deaths per1,000 live births, respectively). Regionally, children by uneducated women had the

Table 4.12:CMRs (per 1000 children surviving to age one) by mother's educational level across states in Nigeria

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	1	2	3	1	2	3	1	2	3
Abia	0	0	0	0	50	28	0	36	4
Abuja	91	200	0	16	32	17	59	0	0
Adamawa	38	39	48	48	68	73	14	19	32
Akwa Ibom	0	53	26	105	54	43	0	14	18
Anambra	0	0	0	0	57	41	77	0	13
Bauchi	82	74	0	65	64	19	56	62	35
Bayelsa	143	0	154	51	50	23	0	27	15
Benue	31	29	21	30	28	5	32	33	6
Borno	69	71	33	49	36	17	23	45	0
Cross River	167	0	0	24	28	11	32	33	12
Delta	0	43	0	0	22	27	0	21	13
Ebonyi	59	44	0	35	32	20	0	40	31
Edo	0	70	59	57	24	19	53	18	12
Ekiti	0	83	0	0	46	24	0	0	6
Enugu	167	0	0	47	25	14	77	25	9
Gombe	112	83	0	60	35	30	49	46	27
Imo	0	0	10	0	29	30	N/A	15	20
Jigawa	130	63	N/A	69	87	36	54	37	73
Kaduna	68	27	0	59	56	17	10	10	4
Kano	65	91	11	82	72	52	42	32	11
Katsina	50	0	21	66	65	0	46	48	0
Kebbi	66	0	0	36	57	56	37	51	0
Kogi	130	60	0	31	37	29	60	24	0
Kwara	0	0	0	14	0	16	40	12	0
Lagos	0	20	16	21	25	9	39	10	5
Nasarawa	67	0	0	27	25	13	27	41	0
Niger	77	0	0	72	64	68	14	20	23
Ogun	48	0	23	0	20	12	0	14	13
Ondo	0	40	0	30	18	28	0	46	16
Osun	0	0	71	0	28	4	0	10	3
Oyo	59	0	19	0	16	9	55	10	11
Plateau	0	19	0	39	29	18	14	14	5
Rivers	0	34	65	82	49	23	0	23	15
Sokoto	99	0	0	80	116	91	55	47	21
Taraba	28	42	0	54	39	11	34	27	0
Yobe	153	188	0	64	15	0	44	27	0
Zamfara	110	250	0	55	102	0	60	0	13
Mean	56.9	43.8	15.9	39.6	43.1	25.2	30.6	25.3	12.6
SD	54.3	59.3	30.9	28.9	24.8	20.7	24.8	16.1	14.1
CV (%)	95.3	135.3	193.6	73.1	57.6	82.2	80.8	63.4	112.2

Author's direct estimates and calculations based on 5 years preceding the survey
1: No Education; 2: Primary Education; 3: Secondary and Higher Education

highest U5MRs except in the Northeast, Southsouth and Southwest (See Appendix 21a). Table 4.13 shows that across states, the mean U5MR was highest among children born to women with no education (133 deaths per 1,000 live births, SD = 98.2) and primary education (134 deaths per 1,000 SD=75). The CV (111.9%) indicates more variability in state U5MRs among children by women with secondary and higher education in Nigeria

In the succeeding 2008 survey, CMRs were twice as high among children of uneducated women than among children born to women with secondary and higher education (58 and 22 deaths per 1,000 children surviving to the age of one, respectively). CMRs were 2 times higher among the children of uneducated mothers than among mothers with secondary education and above in rural areas (60 and 29 deaths per 1,000 children surviving to the age of one, respectively) and urban areas (47 and 17 deaths per 1,000 children surviving to the age of one, respectively). CMRs also varied across regions (See Appendix.20b). The mean CMR was highest among children by women with primary education (43 deaths per 1,000 children surviving to the age of one, SD=24.8). CV values indicate more variability in CMRs among children by women with primary education and above (73.1% and 82.2%, respectively) suggesting variations in the impact of maternal education on CMRs across states.

With regards to under 5 mortality, U5MRs were much higher among children by uneducated women (132 deaths per 1,000 live births) than among children by women with primary education and above (110 and 80 deaths per 1,000 live births, respectively). In both rural and urban areas, U5MRs were higher among children with uneducated mothers (137 and 107 deaths per 1,000 live births, respectively). A similar pattern was observed regionally (See Appendix 21b). The mean U5MR was significantly higher among children born to women with primary education (112 deaths per 1,000 live births, SD=35.7). U5MRs among children by women with primary education was relatively more uniformly distributed across Nigeria (31.9%) compared to other groups.

By the 2013 survey, CMRs were 3 times higher among children of uneducated women than among children of women with secondary and higher education (41 and 12 deaths per 1,000 children surviving to the age of one, respectively). The same pattern was found in rural and urban areas. Regionally, CMRs were higher among children with uneducated mothers except in the Northcentral and Southsouth (See Appendix 20c). The average CMR was highest among children with uneducated mothers (31 deaths per 1,000

Table 4.13: U5MRs (per 1000 live births) by mother's educational level across states in Nigeria

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	1	2	3	1	2	3	1	2	3
Abia	0	111	0	0	181	88	0	85	90
Abuja	91	200	0	87	91	72	86	65	56
Adamawa	227	103	174	160	148	122	83	78	128
Akwa Ibom	71	100	84	105	142	89	211	55	70
Anambra	0	56	15	0	100	92	74	127	61
Bauchi	169	149	0	130	181	71	143	102	66
Bayelsa	143	167	313	159	126	120	67	66	50
Benue	197	117	41	120	107	119	96	111	63
Borno	194	200	66	135	129	49	44	108	28
Cross River	167	81	96	24	63	68	91	74	48
Delta	0	211	130	118	98	112	60	84	69
Ebonyi	211	185	400	160	96	124	119	148	75
Edo	0	167	59	194	100	74	95	52	34
Ekiti	0	154	95	71	117	62	250	77	54
Enugu	286	51	105	180	121	69	77	81	77
Gombe	139	242	192	127	79	59	118	151	61
Imo	N/A	125	19	0	90	141	N/A	169	77
Jigawa	236	118	0	114	181	36	140	90	150
Kaduna	208	66	40	124	129	76	49	61	33
Kano	153	191	43	179	127	125	118	77	46
Katsina	126	74	115	127	128	67	93	94	47
Kebbi	158	0	0	97	135	132	122	148	83
Kogi	128	170	0	69	106	67	114	76	21
Kwara	0	0	0	48	64	24	83	76	45
Lagos	0	58	66	40	105	56	107	103	52
Nasarawa	372	108	67	89	93	50	91	99	55
Niger	133	156	42	154	141	80	65	46	74
Ogun	91	132	67	82	108	52	49	86	46
Ondo	250	111	143	58	48	83	51	140	63
Osun	0	0	133	77	49	29	0	58	38
Oyo	59	33	19	127	68	34	64	91	46
Plateau	0	136	108	149	87	82	80	62	95
Rivers	250	162	180	82	101	91	39	79	75
Sokoto	164	250	0	160	164	154	132	47	96
Taraba	151	303	0	140	123	33	101	103	83
Yobe	190	188	143	118	56	71	106	53	0
Zamfara	234	283	0	120	154	26	169	78	13
Mean	133.2	133.9	79.8	106.1	111.7	78.3	93.9	89.1	61.3
SD	98.2	75.0	89.3	51.3	35.7	34.1	49.8	31.2	28.9
CV (%)	73.7	56.0	111.9	48.4	31.9	43.6	53.0	35.1	47.3

Author's direct estimates and calculations based on 5 years preceding the survey
1: No Education; 2: Primary Education; 3: Secondary and Higher Education

children surviving to the age of one, SD=24.8). CV values indicate more variability in CMRs among children by women with secondary and higher education (112.2%) suggesting variations in the impact of maternal education on CMRs across states. With regards to under 5 mortality, U5MRs were much higher among children by uneducated women (109 deaths per 1,000 live births) than among children by women with secondary and higher education (60 deaths per 1,000 live births). U5MRs were higher among children with uneducated mothers (115 deaths per 1,000 live births) in rural areas and among children by women with primary education (82 deaths per 1,000 live births) in urban areas. U5MRs also varied regionally (See Appendix 21c). The mean U5MR was higher among children with uneducated mothers (94 deaths per 1,000 live births, SD = 49.8). U5MRs among children by women with primary education (35.1%) was relatively more uniformly distributed across Nigeria compared to other groups.

4.5.3.2 Spatial variations of child and under 5 mortality by wealth index

In 2003, children born into the wealthiest homes (highest wealth group) had the lowest CMR (32 deaths per 1,000 children surviving to the age of one) compared to those in the lowest and middle wealth group (75 and 58 deaths per 1,000 children surviving to the age of one, respectively). CMR was higher among children in the poorest homes in rural areas (77 deaths per 1,000 children surviving to the age of one) and among children in the middle wealth group (62 deaths per 1,000 children surviving to the age of one) in urban areas. Regionally, CMRs were significantly higher among children born into poor homes except in the Southsouth (See Appendix 22a). Table 4.14 shows that children in the middle wealth group had the highest mean CMR (56 deaths per 1,000 children surviving to the age of one, SD=74.2). CMRs varied highly over Nigeria for all with a CV of 95.9%, 132.7% and 168.4% in the low, middle and high wealth group, respectively.

U5MRs were higher among children born into the poorest homes (179 deaths per 1,000 live births) compared to those in the middle and highest wealth group (146 and 89 deaths per 1,000 live births, respectively). U5MR was higher among the poorest children in rural areas (181 deaths per 1,000 live births)and among children in the middle wealth group (175 deaths per 1,000 live births) in urban areas. Regionally, U5MRs were significantly higher among children born into poor homes except in the Southsouth (See Appendix 23a). Table 4.15 shows that children in the lowest wealth group had the highest mean U5MR (169 deaths per 1,000 live births, SD=63.3). U5MRs were also more uniformly distributed in this group compared to others (CV = 37.4%) indicating a

Table 4.14: CMRs (per 1000 children surviving to age one) by Wealth Index across states in Nigeria

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	Poor	Middle	Rich	Poor	Middle	Rich	Poor	Middle	Rich
Abia	0	0	0	0	22	39	33	31	5
Abuja	N/A	0	56	0	48	17	0	31	7
Adamawa	56	67	0	54	69	38	24	26	12
Akwa Ibom	40	49	0	70	40	46	16	30	8
Anambra	0	0	0	115	97	32	44	20	10
Bauchi	80	92	43	67	62	20	63	31	26
Bayelsa	56	0	333	22	31	40	0	18	13
Benue	31	20	29	24	16	26	32	13	9
Borno	105	52	43	52	34	25	18	42	14
Cross River	0	0	35	18	26	12	30	26	12
Delta	0	105	0	17	36	21	0	24	14
Ebonyi	59	0	N/A	31	46	23	42	27	23
Edo	64	333	0	54	0	21	26	18	14
Ekiti	0	N/A	50	54	28	20	0	0	6
Enugu	48	0	0	17	31	14	23	22	12
Gombe	106	103	0	56	54	27	63	12	10
Imo	0	167	10	35	30	25	0	20	22
Jigawa	130	67	0	71	100	39	60	29	0
Kaduna	41	75	26	67	52	17	5.5	11	11
Kano	87	63	35	101	43	47	46	24	19
Katsina	36	35	44	72	50	33	54	13	11
Kebbi	54	222	0	44	31	33	46	17	0
Kogi	42	0	123	30	39	29	23	33	9
Kwara	0	0	0	11	17	12	56	33	7
Lagos	N/A	0	17	46	36	11	N/A	59	5
Nasarawa	70	0	0	16	29	26	27	19	29
Niger	87	59	16	72	94	47	16	19	16
Ogun	35	0	16	7	8	15	0	13	12
Ondo	67	0	0	17	42	23	50	9	21
Osun	0	0	44	13	15	12	0	0	6
Oyo	0	0	29	13	14	8	9	55	17
Plateau	19	0	0	31	37	0	14	0	12
Rivers	0	129	47	33	46	30	47	14	13
Sokoto	84	158	125	82	104	58	57	42	32
Taraba	17	52	0	40	70	15	27	35	0
Yobe	203	80	99	59	58	15	48	0	0
Zamfara	145	86	148	58	55	41	63	23	0
Mean	50.3	55.9	37.9	42.4	43.5	25.9	29.4	22.6	11.8
SD	48.3	74.2	63.9	27.9	25.3	12.9	21.6	13.7	7.9
CV (%)	95.9	132.7	168.4	65.9	58.2	49.8	73.3	60.6	67.3

Author's direct estimates and calculations based on 5 years preceding the survey consistent link between poverty and U5MRs across Nigeria. In 2008, CMRs were higher among children born into homes in the lowest wealth group (58 deaths per 1,000 children surviving to the age of one) compared to those in the middle and highest wealth group (44 and 24 deaths per 1,000 children surviving to the age of one, respectively). CMR was higher among children in the poorest homes in rural and urban areas (58 and 49 deaths per 1,000 children surviving to the age of one, respectively). Regionally, CMRs were much higher among children in the poorest homes in the Northeast, Northwest and Southsouth while CMRs were highest among children in the middle wealth group in the Northcentral, Southeast and Southwest region (See Appendix 22b). The mean CMR was highest among children in the middle wealth group (43 deaths per 1,000 children surviving to the age of one, SD=25.3). CV values indicate some uniformity in CMRs among children in all wealth groups across states especially in the highest wealth group (49.8%). This suggests a consistent link between wealth and child health/survival over Nigeria.

U5MRs were also significantly higher among the poorest children (133 deaths per 1,000 live births) compared to those in the middle and highest wealth group (116 and 79 deaths per 1,000 live births, respectively). U5MR was highest among children in the poorest homes in rural and urban areas (133 and 135 deaths per 1,000 live births, respectively). Regionally, U5MRs were consistently higher among children born into the poorest homes except in the Southeast (See Appendix 23b). The mean U5MR was highest among children in the poorest homes (114 deaths per 1,000 live births, SD=38.4). U5MRs among children in the middle wealth group was more uniformly distributed across Nigeria (28%) compared to the lowest and highest wealth groups (34% and 33%, respectively).

With respect to the 2013 survey, CMRs were higher among children born into homes in the lowest wealth group (44 deaths per 1,000 children surviving to the age of one) compared to those in the middle and highest wealth group (22 and 12 deaths per 1,000 children surviving to the age of one, respectively). Children in the poorest homes had the highest CMRs in rural and urban areas (45 and 34 deaths per 1,000 children surviving to the age of one, respectively). Similarly, CMRs were much higher among children born into the poorest homes in all regions except in the Southwest (See Appendix 22c). The mean CMR was also higher among the poorest children (29 deaths per 1,000 children surviving to the age of one, SD=21.6). CV values indicate a more uniform distribution of CMRs across Nigeria especially among children in the middle wealth group therefore suggesting a consistent link between wealth and CMRs across states.

Table 4.15: U5MRs (per 1000 live births) by Wealth Index across states in Nigeria

STATE	2003 NDHS			2008 NDHS			2013 NDHS		
	Poor	Middle	Rich	Poor	Middle	Rich	Poor	Middle	Rich
Abia	167	0	0	105	111.1	116	65	100	86
Abuja	N/A	0	56	36	91	86	0	114	57
Adamawa	218	125	71	166	134	94	120	78	72
Akwa Ibom	155	71	0	149	106	100	101	79	62
Anambra	250	53	23	148	137	81	122	140	63
Bauchi	146	263	100	138	165	77	151	67	51
Bayelsa	105	0	500	143	114	124	0	52	55
Benue	170	58	81	125	88	106	104	78	71
Borno	198	167	143	145	113	72	37	62	57
Cross River	125	42	67	65	75	48	76	46	77
Delta	265	261	85	121	101	101	159	105	53
Ebonyi	233	111	N/A	125	134	96	148	119	45
Edo	64	250	143	134	112	81	73	51	40
Ekiti	111	N/A	100	137	42	58	0	65	55
Enugu	167	111	32	103	118	81	65	87	79
Gombe	183	167	53	122	93	77	124	90	81
Imo	167	167	10	97	115	144	170	57	84
Jigawa	241	125	500	122	143	108	142	118	49
Kaduna	205	171	90	151	111	73	36	76	28
Kano	184	112	123	186	179	97	124	74	63
Katsina	125	104	120	134	115	91	103	50	53
Kebbi	137	333	59	105	86	84	129	109	85
Kogi	233	44	147	67	86	91	46	78	45
Kwara	N/A	0	0	28	94	40	56	83	63
Lagos	N/A	0	68	46	70	64	N/A	158	61
Nasarawa	241	125	240	89	83	73	83	84	82
Niger	143	200	47	157	159	103	65	63	66
Ogun	97	375	60	120	80	68	48	66	64
Ondo	177	0	167	33	124	62	95	100	72
Osun	0	0	120	85	81	24	63	19	43
Oyo	50	0	29	95	79	56	13	104	69
Plateau	136	91	83	112	97	38	85	67	79
Rivers	177	400	103	94	122	84	116	46	78
Sokoto	156	238	125	165	157	126	139	80	89
Taraba	199	83	200	127	149	31	109	67	84
Yobe	254	185	131	120	80	58	113	23	10
Zamfara	272	185	148	128	71	69	170	86	66
Mean	169.0	128.2	111.7	114.1	108.4	80.6	90.2	79.4	63.1
SD	63.3	109.8	110.6	38.4	30.4	26.9	48.2	29.3	17.4
CV (%)	37.4	85.7	98.9	33.6	28.0	33.3	53.4	36.9	27.6
Author's direct estimates and calculations based on 5 years preceding the survey									

U5MRs were also significantly higher among the poorest children (117 deaths per 1,000 live births) compared to those in the middle and highest wealth group (78 and 62 deaths per 1,000 live births, respectively). Children in the poorest homes had the highest U5MR in rural and urban areas (117 and 113 deaths per 1,000 live births, respectively). Regionally, U5MRs were consistently higher among children born into the poorest homes except in the Southwest (See Appendix 23c). Across states, children in the lowest wealth category had the highest mean U5MR (90 deaths per 1,000 live births, SD=48.2). U5MRs for children in the highest wealth group was more uniformly distributed across Nigeria (27.6%) compared to the lowest and middle wealth group (53.5% and 36.9%, respectively) indicating the impact of wealth index on U5MRs across states.

4.6 Spatial pattern analysis of child and under 5 mortality rates in Nigeria

4.6.1 Test of hypothesis 1b**:** There is no significant clustering of child and under 5 mortality in Nigeria

4.6.1.1 Global Moran's I analysis

The Global Moran's I shows a significant positive spatial autocorrelation of CMRs in Nigeria for 2003 (MI = 0.40, p = 0.00), 2008 (MI = 0.56, p = 0.00) and 2013 (MI = 0.53, p = 0.00). The positive z score (4.02, 5.46 and 5.28, respectively) further indicates a clustered pattern. The Global Moran's I also shows a significant positive spatial autocorrelation of U5MRs in Nigeria for 2003 (MI= 0.28, p=0.004), 2008 (MI= 0.41, p=0.00) and 2013(MI= 0.37, p=0.00). The positive z score (2.86, 4.13 and 3.80, respectively) further indicates a clustered pattern (See Appendix 24). The null hypothesis which states that child and under 5 mortality rates are not significantly clustered (i.e not spatially correlated) is therefore rejected since there is significant evidence of spatial dependence/correlation. The higher the Global Moran's I value, the stronger the spatial autocorrelation/dependence. Hence results suggest that spatial autocorrelation was strongest in 2004-2008 for both mortality rates in Nigeria.

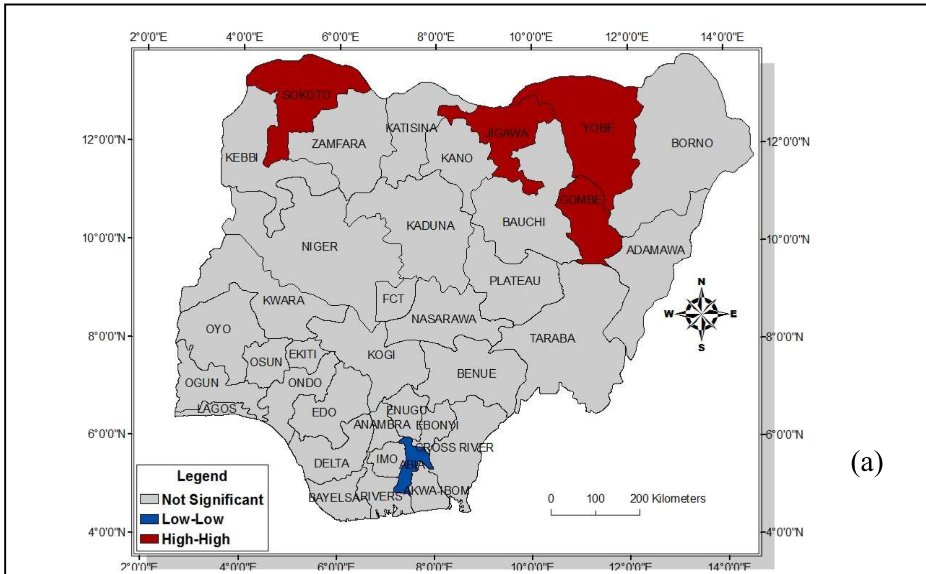
4.6.1.2 Local Moran's I analysis

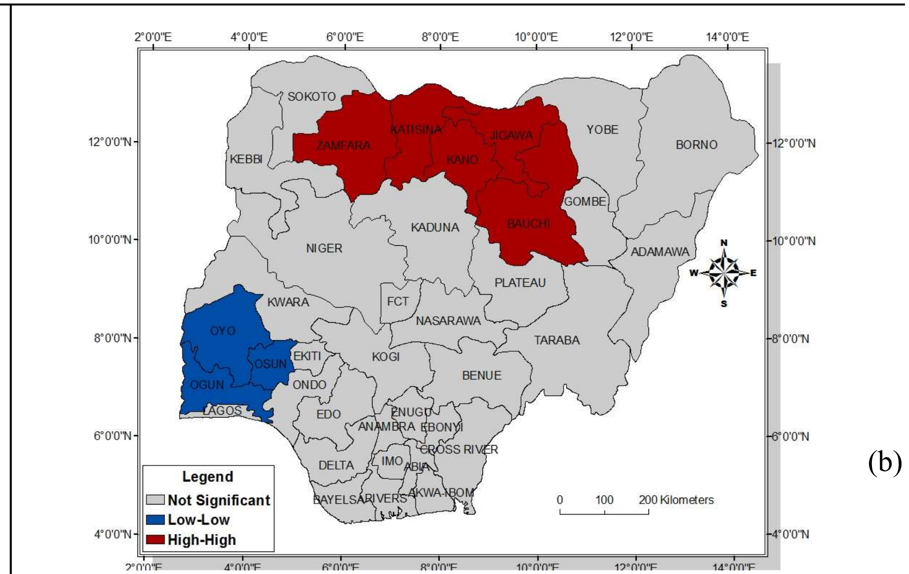
States with significant local spatial autocorrelation (p<0.05) in CMRs were identified for the 2003, 2008 and 2013 survey (See Appendix 25). Two significant clusters were identified in 2003: High-High and Low-Low. Yobe (Index=2.84, p=0.00), Jigawa (Index=1.71, p=0.00), Sokoto (Index=1.64, p=0.01) and Gombe state (Index=0.80,p=0.04) are significant clusters of high values. In other words, they not only had relatively high CMRs but were also surrounded by states with high CMRs as well (High-High cluster). The concentration of CMRs in major states in the Northeastern and Northwestern region suggests that these neighbouring states most likely have similar underlying determinants of child mortality. Abia state with a significant index of 0.82 ($p=0.01$) indicates that the state not only had a relatively low CMR but was also surrounded by states with relatively low CMRs (Low-Low cluster) as shown in Figure 4.9a.

States with significant local spatial autocorrelation ($p<0.05$) in U5MRs were identified based on the three surveys (See Appendix 26). Based on the 2003 survey, two significant clusters were identified: low-low and High-Low. Oyo (Index=1.38, $p=0.01$), Kwara (Index=0.79, $p=0.05$), Imo (Index=1.31, $p=0.02$) and Anambra state (Index=0.80, $p=0.01$) are significant clusters of low values. In other words, they not only had relatively low U5MRs but were also surrounded by states with low U5MRs as well (Low-Low cluster). Ebonyi State (Index= -1.03, $p=0.03$) is a High-Low cluster. The negative sign indicates dissimilar values. In other words, Ebonyi had a high U5MR but was surrounded by states with much lower values (Figure 4.10a). This suggests that the key factors responsible for a high U5MR in Ebonyi are most likely state-specific.

The Local Moran's I identified two significant clusters of CMRs (high-high and low-low) with respect to the 2008 survey. Five states in the Northwest and Northeast: Zamfara, Katsina, Kano, Jigawa and Bauchi are significant clusters of high values. In other words, they not only had relatively high CMRs but were also surrounded by states with high CMRs (High-High cluster). The concentration of CMR in this region suggests that these states most likely share common underlying determinants of child mortality. Oyo (Index=1.79, $p=0.001$), Ogun (Index=1.44, $p=0.002$) and Osun state (Index=1.25, $p=0.002$) are significant clusters of low values (Figure 4.9b). Two significant clusters of U5MRs were identified: High-High and Low-Low (Figure 4.10b). Kano state with a significant Index of 1.36 ($p=0.003$) is a High-High cluster. All the Southwestern states (except for Lagos) and Kwara state in the Northcentral region are significant clusters of low U5MRs (Low-Low clusters). This suggests that states in these region share characteristics that may explain the concentration of significantly lower U5MRs.

The Local Moran's I identified 9 states in the Northwest and Northeast as significant High-High clusters of CMRs with respect to the 2013 survey. The clustered pattern of CMRs suggest states in these regions most likely share key factors responsible for the





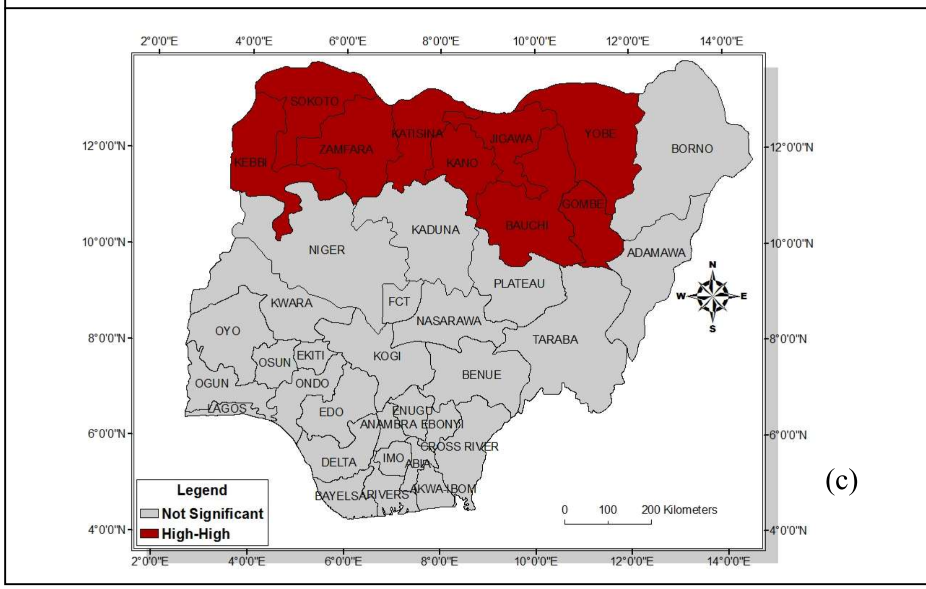
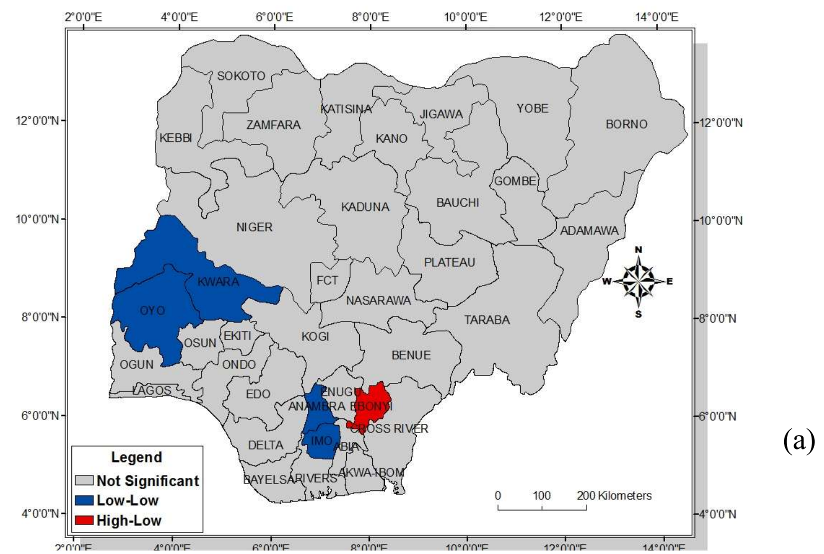
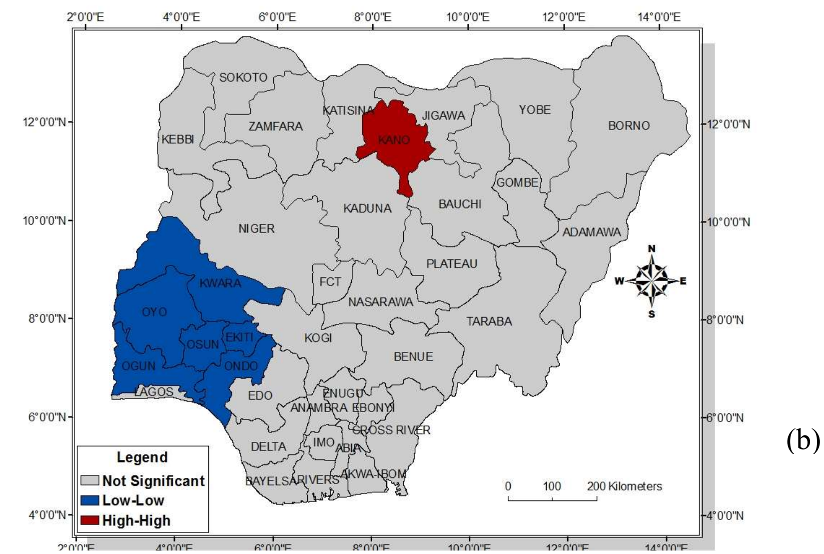


Figure 4.9a-c: LISA cluster maps for CMRs in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively





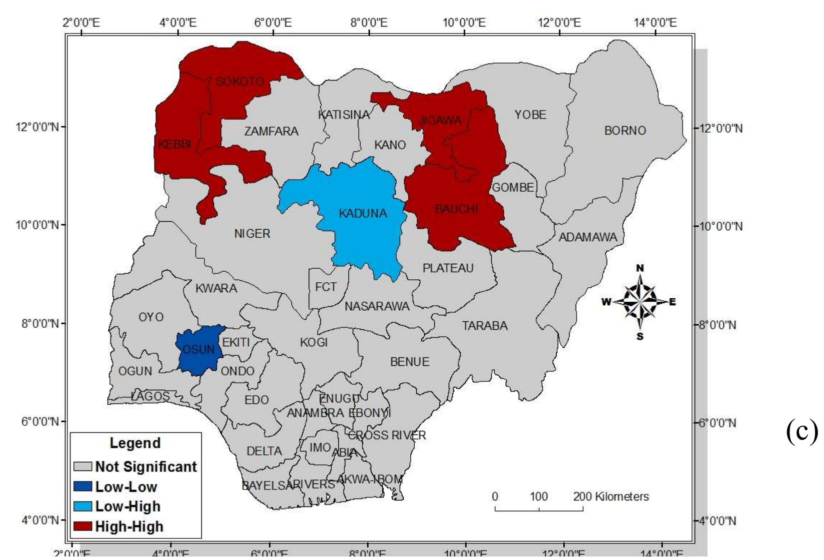


Figure 4.10a-c: LISA cluster maps for U5MRs in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

concentration of relatively high CMRs (Figure 4.9c). Three significant clusters of U5MRs were identified: High-High, Low-Low and Low-High (Figure 4.10c). Osun state with a statistically significant Index of 0.83 (p=0.04) is a significant cluster of low values (Low-Low cluster) which indicates that Osun state as well as surrounding states had significantly low U5MRs. Kebbi, Sokoto, Jigawa and Bauchi are significant clusters of high values (High-High cluster) which indicates that they not only had relatively high U5MRs but were also surrounded by states with high U5MRs as well. Kaduna State (Index= -0.66, p=0.04) is an outlier state (Low-High cluster) indicating that U5MRs in Kaduna state were significantly lower than U5MRs in neighbouring states. This suggests that key factors responsible for a much lower U5MR in Kaduna state compared to its neighbours are most likely peculiar to Kaduna state itself.

4.6.1.3 Hot spot analysis (Getis-Ord Gi* Statistic)

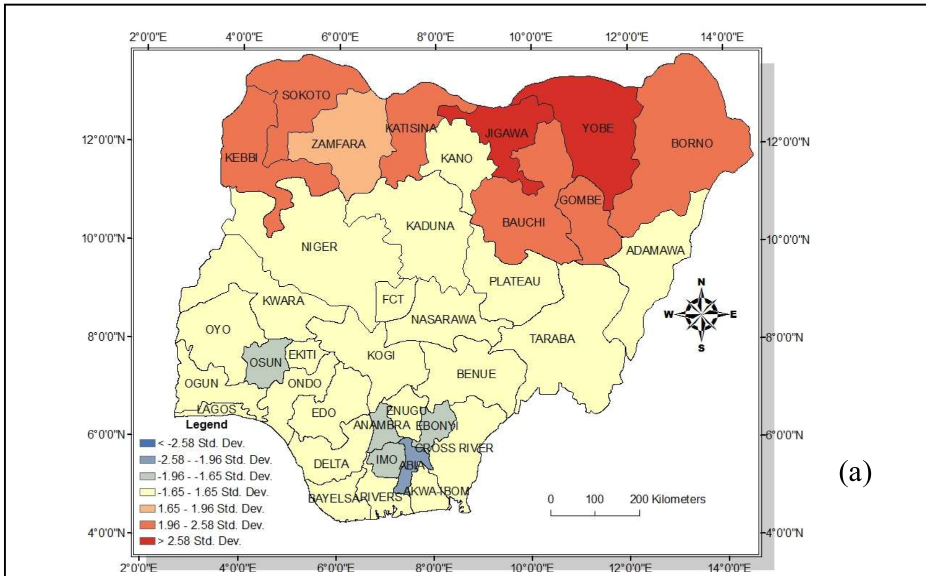
Figure 4.11a and Appendix 27a show the degree of clustering of CMRs in Nigeria based on the 2003 survey. Abia state (p=0.02) is a statistically significant cold spot at a 95% confidence level signifying the maximum spatial clustering of low CMRs. Osun, Anambra, Imo and Ebonyi states are cold spots at a 90% confidence level. Seven states in the Northwest and Northeast regions are significant hot spots with the maximum spatial clustering of high values at a 99% confidence level in Jigawa (p=0.01) and Yobe states (p=0.00). Figure 4.12a and Appendix 27b show the degree of clustering of U5MRs in Nigeria. Oyo (p=0.03), Osun (p=0.04), Anambra (p=0.04) and Imo state (p=0.03) are significant cold spots at a 95% confidence level signifying the maximum spatial clustering of low U5MRs. Cold spots are also in Kwara, Kogi and Abia state at a 90% confidence level. Yobe State (p=0.04) is a significant hot spot at a 95% confidence level signifying the maximum spatial clustering of high U5MRs. Hot spots are also in Katsina, Bauchi, Gombe, Borno and Bayelsa state at a 90% confidence level.

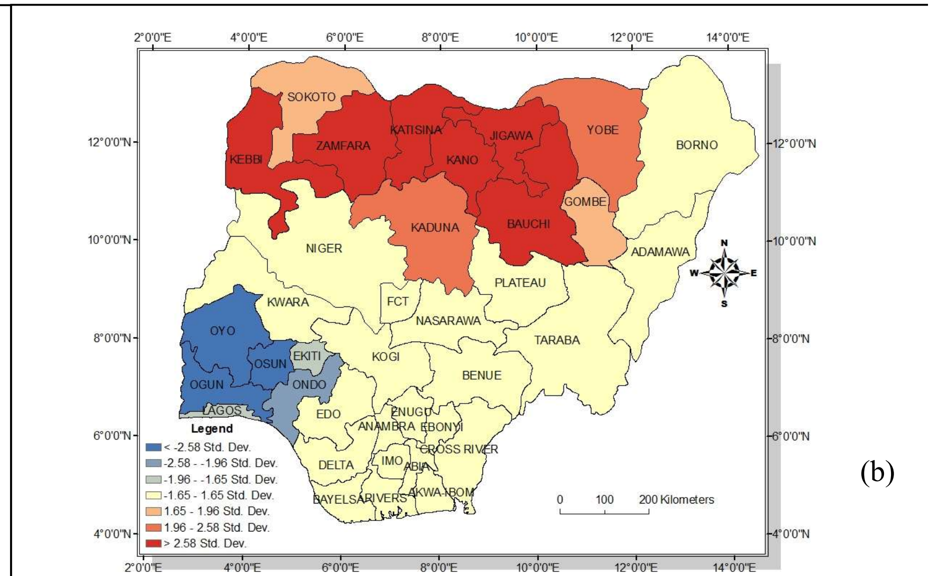
Figure 4.11b and Appendix 28a show the degree of clustering of CMRs in Nigeria based on the 2008 survey. Oyo (p=0.01), Ogun (p=0.01) and Osun (p=0.01) are significant cold spots at a 99% confidence level signifying the maximum spatial clustering of low CMRs. Significant cold spots are also in Ondo, Lagos and Ekiti state. Six states in the Northwest and extreme Northeast are significant hotspots at a 99% confidence level. Hot spots are also in Kaduna, Yobe, Gombe and Sokoto states. With respect to under 5 mortality, Oyo (p=0.001), Ogun (p=0.001) Osun (p=0.00) and Ekiti State (p=0.00) are significant cold spots at a 99% confidence level signifying the maximum spatial clustering of low U5MRs (Figure 4.12b). Significant cold spots are also in Kwara and Ondo state at a 95% confidence level and in Kogi state at a 90% confidence level. Four states in the Northwest are significant hotspots of under 5 mortality at a 95% confidence level. Hot spots are also in Kebbi, Bauchi and Gombe state at a 90% confidence level (See Appendix 28b).

Figure 4.11c and Appendix 29a show the degree of clustering of CMRs in Nigeria based on the 2013 survey. Ondo state (p=0.04) is a significant cold spot at a 95% confidence level indicating the maximum spatial clustering of low CMRs in Nigeria. Kwara, Ogun, Osun, Ekiti, Kogi, Anambra and Rivers states are also cold spots at a 90% confidence level. Sokoto (p=0.003), Jigawa (p=0.00) and Yobe state (p=0.002) are significant hot spot at a 99% confidence level. Significant hot spots are also in 6 states in the Northwest and extreme Northeast at a 95% confidence level. With regards to under 5 mortality, Kwara (p=0.02) and Ondo state (p=0.02) are significant cold spots at a 95% confidence level indicating the maximum spatial clustering of low U5MRs in Nigeria (See Appendix 29b). Six states including the Federal Capital Territory are also cold spots at a 90% confidence level. Sokoto (p=0.00) and Kebbi state (p=0.01) are significant hotspots of under 5 mortality at a 99% confidence level indicating the maximum spatial clustering of high U5MRs in Nigeria. Jigawa, Zamfara, Katsina, Bauchi, Yobe and Taraba states are also significant hot spots (Figure 4.12c).

4.7 Summary

This first section has examined the spatial distribution and pattern of infant, child and under 5 mortality rates in Nigeria. Findings indicate significant spatial variations in infant, child and under 5 mortality rates in Nigeria by location (region, state and rural-urban areas) and by demographic and socioeconomic characteristics over time. In 2003 there were distinct spatial variations in IMRs with higher rates found in the Northeast (Adamawa and Taraba), Northwest (Zamfara and Jigawa) and Southsouth (Delta and Rivers) and lower rates in the Southwest (Oyo and Osun) and Southeast (Imo and Anambra). The spatial pattern changed slightly in 2008. While high IMRs were still found in the Northeast and lowest rates in the Southwest, IMRs increased in the Southeast (particularly in Imo and Ebonyi states), Northwest (Kano), Northcentral (Benue) and Southsouth (Bayelsa). In 2013, however, higher IMRs were in the Northwest (Zamfara, Kebbi and Jigawa) and Northeast (Bauchi, Adamawa, Taraba), while lower IMRs were in the Southwest (Oyo and Osun) and Southsouth (Bayelsa, Edo and Crossriver).





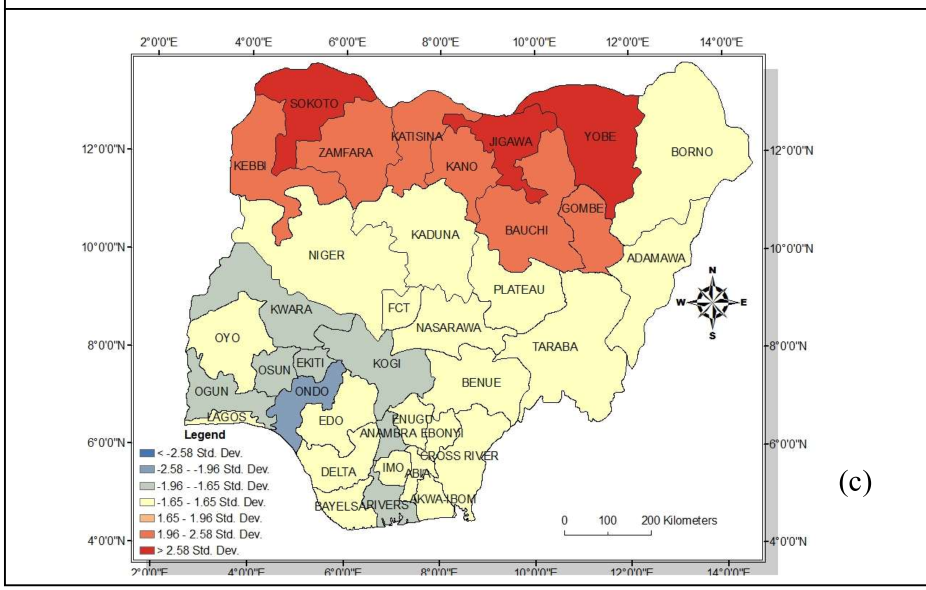
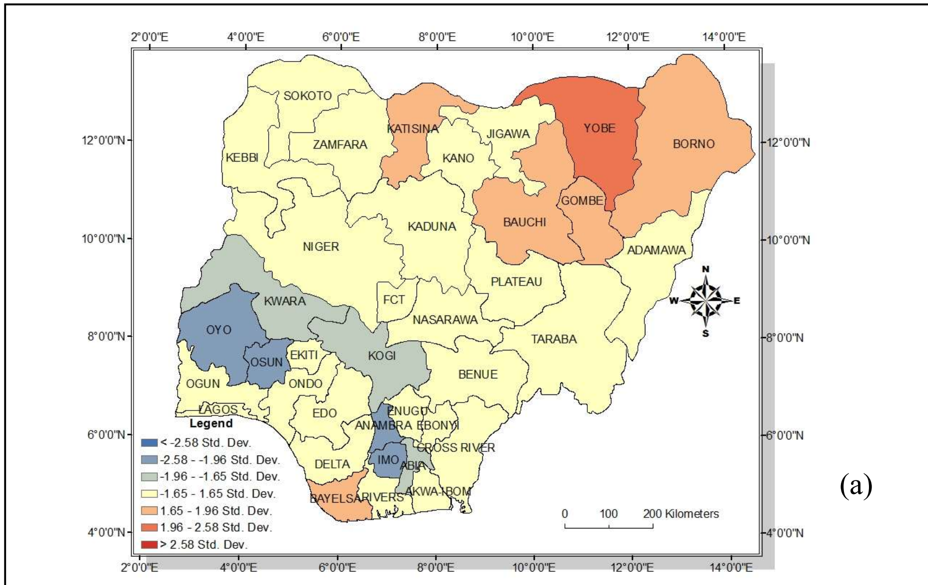
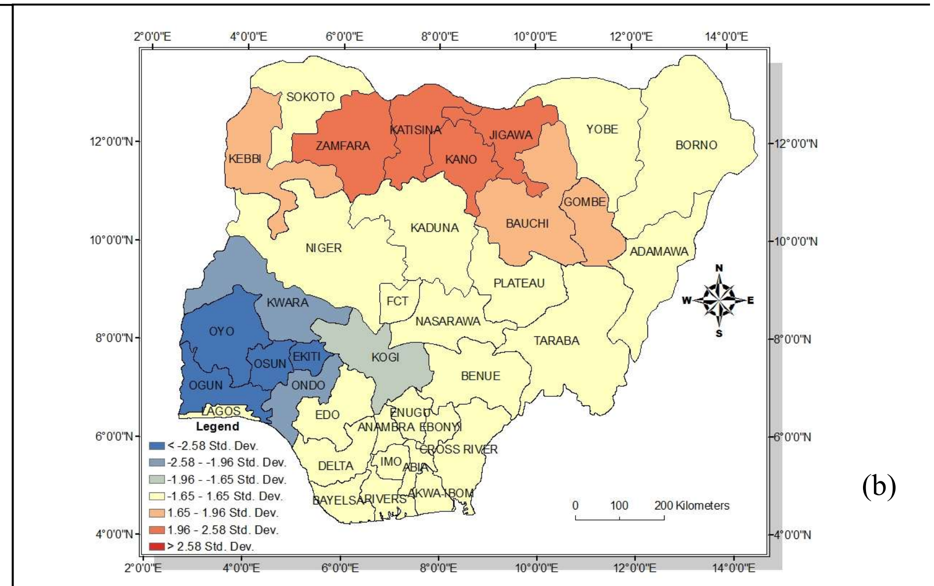


Figure 4.11a-c: Gi* statistic (Hot spot) maps for CMRs in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively





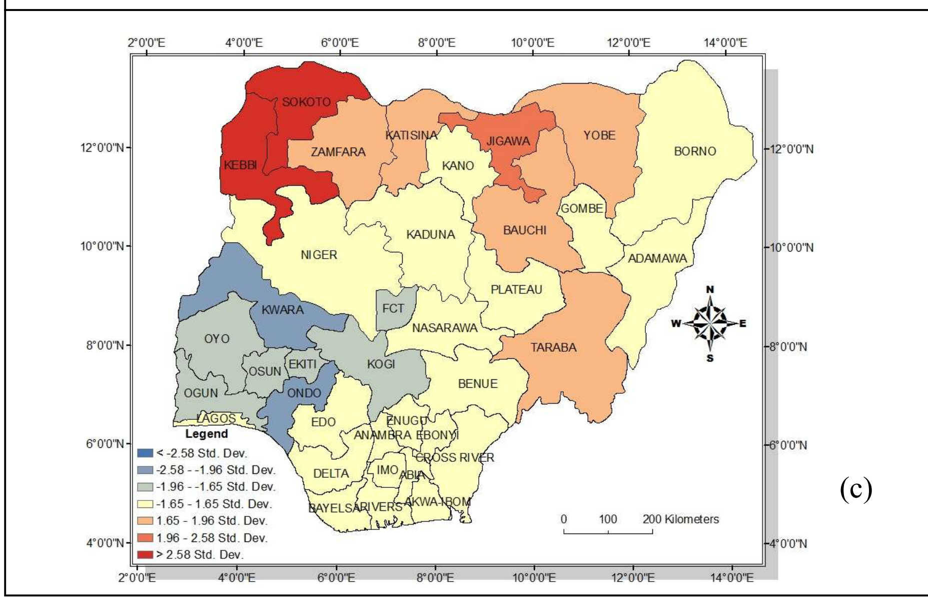


Figure 4.12a-c: Gi* statistic (Hot spot) maps for U5MRs in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

Evidence of spatial autocorrelation was observed throughout the period of study. The Global Moran's Index identified an overall clustered pattern of IMRs in Nigeria throughout the survey years though not at a 95% confidence level but at a 90% confidence level. However, the Local Moran's Index revealed the presence of significant local clusters. In 2003, the results showed a High-High cluster in the Northeast (Taraba), Low-Low clusters in the Northcentral (Kwara) and Southwest (Oyo) and a Low-High outlier (Abuja). The 2008 survey is similar to the 2003 survey. Results showed a Low-High outlier (Cross River) and Low-Low clusters in the Southwest (though centered mainly in Osun and Ekiti state) but Oyo state was no longer identified as a Low-Low cluster indicating variations in IMR between Oyo state and its neigbours since the 2003 survey. According to the 2013 survey, High-High clusters were in the Northwest centered in Sokoto and Kebbi state.

In 2003, the hot spot analysis results showed cold spots in the Southwest (Oyo and Osun) and Northcentral region (Taraba) and hot spots in the Northcentral (Plateau and Benue) and Northeast (Taraba and Adamawa) not detected by the Local Moran's I. In 2008, there were no hot spots. However, the same cold spots detected in 2003 were observed in addition to new cold spots that emerged in Ekiti, Ogun and Ondo states. This suggests that IMRs declined in these states as well as in neighbouring states intensifying the clustering of low values in the Southwest. All the cold spots detected in 2008 were also identified as cold spots in2013 (with the exception of Osun and Ogun state) while the Federal Capital Territory emerged as a new cold spot. Surprisingly, hot spots detected in the Northeast and Northcentral region in 2003 were no longer identified as hot spots in 2013 with the exception of Taraba state, while new hot spots were detected in the Northwest (Kebbi and Sokoto) indicating a shift in the clustering of statistically significant high IMRs.

Findings on CMRs, showed significant spatial variations in 2003, with higher rates concentrated mainly in the Northwest specifically in Zamfara and Jigawa state, and in a few states in the Northeast (Yobe), and Southsouth (Bayelsa) and lower rates concentrated in the Southeast (Imo, Anambra and Abia) and Northcentral region (Kwara). The spatial pattern changed slightly in 2008 with high CMRs in the Northwest (Sokoto, Kano and Jigawa) and the lowest rates in the Southwest but this low rate extends to Kwara state in the Northcentral region. By 2013, high CMRs were still spatially concentrated in the Northwest (Zamfara and Jigawa) and the lowest rates in the Southwest specifically in Osun, Ekiti and Lagos state. However, new areas of high and low CMRs had emerged.These were in the Northeast and Northcentral regions. The Global Moran's Index confirmed spatial autocorrelation with an overall clustered pattern of CMRs observed at a 95% confidence level. The Local Moran's Index revealed the presence of significant local clusters of CMR. In 2003, results showed a High-High cluster in the Northeast (Yobe) and Northwest (Jigawa and Sokoto) and a Low-Low cluster in the Southeast (Abia). The results of the 2008 survey, show High-High clusters in the same regions (though centered in Zamfara, Katsina, Kano, Jigawa and Bauchi state). However, Low-Low clusters were detected in a different region (Southwest) centered mainly in Oyo, Ogun and Osun state. Interestingly, only High-High clusters in 9 states located in the Northwest and Northeast was observed.

In 2003, the hot spot analysis results showed cold spots in the Southeast (Abia, Anambra, Imo and Ebonyi) and Southwest (Osun) while hot spots were identified in the Northwestern and Northeastern parts of Nigeria not detected by the Local Moran's I. Unlike the previous survey, the hot spot analysis for the 2008 survey, detected cold spots in the entire Southwestern region centered in Oyo, Ogun and Osun state and detected hot spots in the entire Northwest extending to Gombe, Yobe and Bauchi state in the Northeast. All the cold spots detected in 2008 were also identified as cold spots in the 2013 survey (with the exception of Oyo and Lagos state). It should be noted that new cold spots emerged in the Northcentral (Kwara and Kogi), and Southsouth (Rivers) region as well as the Southeast (Anambra) re-emerging since the 2003 survey as a cold spot. Similarly, all the hot spots detected in 2008 were still identified as hot spots in 2013.

Findings on U5MRs, showed significant spatial variations in 2003. The highest rates were in the Northwest specifically in Zamfara, Yobe and Jigawa state, and in a few states such as in the Southsouth (Bayelsa) while lower rates were in the Southwest (Oyo) extending to the Northcentral region (Kwara), Southeast (Imo and Anambra) and Southsouth (CrossRiver). By 2008, the spatial pattern had changed with higher U5MRs mainly in the Northwest (Kano and Sokoto) and Northeast (Adamawa) and the lowest rates in the South (Osun and CrossRiver) and Northcentral region (Kwara). By 2013, high U5MRs were mainly in the Northwest (Zamfara and Jigawa) and the lowest rates in the Southwest specifically in Osun and Edo state. However, new areas of relatively low U5MRs emerged in the Northeast and Northcentral region.

The Global Moran's Index confirmed spatial autocorrelation with an overall clustered pattern of U5MRs throughout the survey years at a 95% confidence level. The Local

Moran's Index also detected the presence of significant local clusters. The 2003 survey, showed a Low-Low cluster in the Southeast centered in Imo and Anambra state as well as in the Southwest (Oyo) extending to the Northcentral region (Kwara). A High-Low outlier was also identified in Ebonyi state. The results of the 2008 survey, showed High-High clusters in the Northwest (Kano) while Low-Low clusters were detected in all the Southwestern region (except for Lagos state) extending to Kwara state in the Northcentral region. The results of the 2013 survey, showed High-High clusters in the Northwest centered in Kebbi, Sokoto and Jigawa which extended to Bauchi in the Northeast. Low-Low clusters were detected in Osun state while a Low-High outlier was detected in Kaduna state where U5MRs were significantly lower than that of neighbouring states.

The results of the hot spot analysis for 2003, showed cold spots in the Southeast (Imo, Abia and Anambra), Southwest (Oyo and Osun) and Northcentral region (Kwara and Kogi). Hot spots not detected by the Local Moran's Index were found in the Northeastern parts of Nigeria as well as in Katsina in the Northwest and Bayelsa in the Southsouth. Unlike in 2003, the hot spot analysis for 2008, detected cold spots in the entire Southwestern region centered in Oyo, Ogun, Osun and Ekiti state (with the exception of Lagos state) extending to Kogi and Kwara in the Northcentral region. Hot spots were detected in Bauchi and Gombe in the Northeast and in the Northwest (with the exception of Kaduna and Sokoto). All the cold spots detected in 2008 were similarly identified as cold spots in 2013 in addition to the Federal Capital Territory in the NorthCentral region. In the same vein, all the hot spots detected in 2008 (with the exception of Gombe state) were still identified as hot spots. In addition, hot spots emerged in the Northeast (Yobe and Taraba) leading to the further clustering of significantly high U5MRs in this region.

Findings therefore indicate that infant, child and under 5 mortality rates in Nigeria vary significantly over space. In addition, the strong evidence of spatial autocorrelation shows that infant, child and under 5 mortality rates in individual states are significantly related to mortality rates in contiguous states. This suggests that there are geographical influences on infant, child and under 5 mortality in Nigeria.

4.8Temporal patterns and trends in infant, child and under 5 mortality in Nigeria

This section examines the temporal patterns and trends in infant, child and under 5 mortality in Nigeria in three major ways: (1) by comparing changes in mortality rates based on the 2003, 2008 and 2013 NDHS surveys using descriptive statistics; (2) by examining mortality data from the World Bank using descriptive and statistical techniques; and (3) by assessing whether relative decrease (or increase) in infant, child and under 5 mortality rates are randomly distributed or concentrated in particular areas using the Moran's Index.

4.9 Temporal patterns and trends of infant mortality rates in Nigeria

4.9.1 Descriptive analysis of trends in infant mortality rates in Nigeria

Table 4.16 shows the percent change in IMRs in Nigeria based on the 2003, 2008 and 2013 NDHS which covers a 15 year period (1999-2013). Nationally, IMRs declined by 20% between 2003 and 2008 and then by 10% between 2008 and 2013 - an overall decline of 28% between the 2003 and 2013 surveys. IMRs fell by 29% and 25% in rural and urban Nigeria, respectively between 2003 and 2013. IMRs also declined in all regions except in the Southeast where IMRs increased significantly by 51% between 2003 and 2008 and then fell slightly by 10% between 2008 and 2013- an overall increase of 36% between the 2003 and 2013 surveys.

Among the 36 states and Federal Capital Territory, 24 states experienced some decline in IMRs between 2003 and 2008. IMR declined in 25 states between 2008 and 2013 as well as between 2003 and 2013. Borno and Nasarawa state experienced the largest decline in infant mortality (75% and 68%, respectively) between the 2003 and 2013 surveys. Bauchi state experienced the least decline (9%) in infant mortality in the same period. IMRs increased in 10 states specifically in Imo, Oyo and Anambra states over the same period although IMRs were still relatively lower in these states compared to others.

With regards to the World Bank IMR figures for Nigeria (1990-2015), IMRs steadily declined over the years, falling by 45% from 126 deaths per 1,000 live births in 1990 to 69 deaths per 1,000 live births in 2015 (Figure 4.13).

Table 4.16: Percentage Change in IMR per 1,000 live births in Nigeria

Location		2003 NDHS	2008 NDHS	2013 NDHS	% Change (2003-2008)	% Change (2008-2013)	% Change (2003-2013)
Residence	Urban	68	56	51	-18	-9	-25
	Rural	99	78	70	-21	-10	-29
Regions	Northcentral	90	71	57	-21	-20	-37
	Northeast	100	80	64	-20	-20	-36
	Northwest	95	75	72	-21	-4	-24
	Southeast	53	80	72	51	-10	36
	Southsouth	99	69	50	-30	-28	-49
	Southwest	55	52	51	-5	-2	-7
States	Abia	44	83	78	89	-6	77
	Abuja	0	62	53	-	-15	-
	Adamawa	145	101	79	-30	-22	-46
	Akwa Ibom	67	67	56	0	-16	-16
	Anambra	28	50	62	79	24	121
	Bauchi	89	80	81	-10	1	-9
	Bayelsa	100	98	43	-2	-56	-57
	Benue	104	94	69	-10	-27	-34
	Borno	108	88	27	-19	-69	-75
	Cross River	65	45	42	-31	-7	-35
	Delta	135	83	60	-39	-28	-56
	Ebonyi	177	93	84	-47	-10	-53
	Edo	58	74	30	28	-59	-48
	Ekiti	77	50	51	-35	2	-34
	Enugu	63	82	63	30	-23	0
	Gombe	78	62	68	-21	10	-13
	Imo	9	106	72	1078	-32	700
	Jigawa	119	55	86	-54	56	-28
	Kaduna	102	71	37	-30	-48	-64
	Kano	87	93	68	7	-27	-22
	Katsina	78	66	49	-15	-26	-37
	Kebbi	86	62	88	-28	42	2
	Kogi	63	55	38	-13	-31	-40
	Kwara	0	33	53	-	61	-
	Lagos	52	51	57	-2	12	10
	Nasarawa	190	61	60	-68	-2	-68
	Niger	76	79	49	4	-38	-36
	Ogun	84	70	54	-17	-23	-36
	Ondo	89	43	64	-52	49	-28
	Osun	36	30	36	-17	20	0
	Oyo	10	57	42	470	-26	320
	Plateau	94	74	70	-21	-5	-26
	Rivers	126	62	58	-51	-6	-54
	Sokoto	77	83	78	8	-6	1
	Taraba	137	79	74	-42	-6	-46
	Yobe	57	57	58	0	2	2
	Zamfara	123	67	108	-46	61	-12
	National	89	71	64	-20	-10	-28

Author's Calculations (Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time).

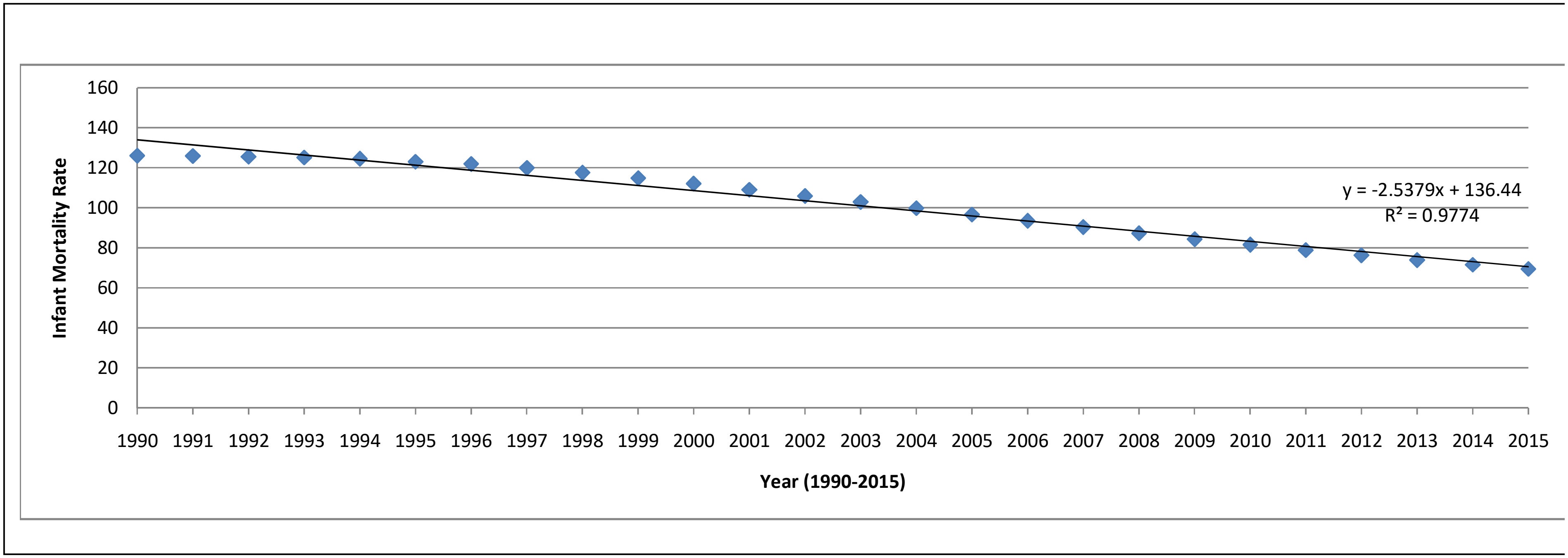


Figure 4.13: Trends in Infant Mortality Rate in Nigeria (World Bank, 1990-2015)

4.9.2 Test of hypothesis 2a: There are no significant variations in infant mortality over time across states in Nigeria

4.9.2.1 Analysis of Variance (ANOVA) of infant mortality rates in Nigeria over time

A one- way ANOVA was carried out to determine whether there are statistically significant differences in IMRs across states over time in Nigeria. IMRsdiffered significantly over time at the 0.05 level for F (2, 108) = 4.819, P = 0.010 (See Appendix 30a-d). The difference in mean IMR between groups is fairly moderate as indicated by the effect size (0.082). Hence, hypothesis 2a which states that there are no significant variations in IMRs in Nigeria over time (1999-2013) is rejected. To identify which specific pairs of means are significantly different, a post hoc test was carried out. Post hoc comparisons using the Tukey HSD test indicated that the mean IMR for 2003 (Mean=81.92, SD=44.565) is significantly different from 2013 (Mean=60.57, SD=17.792) although there was no significant difference in mean IMR between the 2003 and 2008 surveys and between the 2008 and 2013 surveys.

Variations in IMR according to four key variables: wealth index, mother’s age, mother’s education and child’s sex was also examined statistically for the 2003, 2008 and 2013 surveys. Significant differences in IMRs were found between male and female children at the 0.05 level for F (1, 72) = 6.720, P= 0.012 based on the 2008 survey. There were also significant differences in IMRs between wealth groups at the 0.05 level for F (2,108) = 5.244, P = 0.007. Post hoc comparisons using the Tukey HSD test indicated that the mean IMR for the lowest wealth group (poorest) (Mean=74.243, SD=28.808) is significantly different from the mean IMR for the highest wealth group (Richest) (Mean=56.068, SD=20.307). There were no significant differences in IMR by other variables especially in 2003 and 2013 (See Appendix 31).

4.9.3 Test of hypothesis 3a: There is no significant decline in the trend of infant mortality in Nigeria

4.9.3.1 Statistical analysis of trends in infant mortality rates in Nigeria

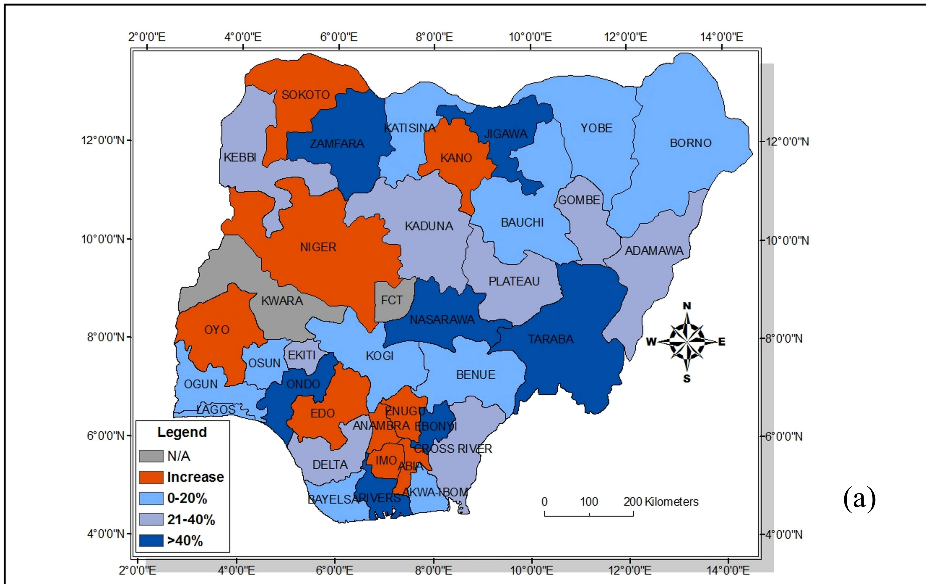
Runs test of randomness (Z) was carried out to indicate the presence or absence of trends in infant mortality in Nigeria based on World Bank IMR figures. The series was not random (Z= -4.604 which lies outside of -1.96 and +1.96). Consequently, this indicates that there is a significant trend in IMRs in Nigeria. A correlation and regression analysis was therefore carried out. Correlation results r = -0.989 (p=0.000) indicates a very high negative correlation at the 0.01 level while Regression results R^2=0.977 indicates that time accounts for 98% of the change/decline in annual IMRs in Nigeria (See Appendix 32).

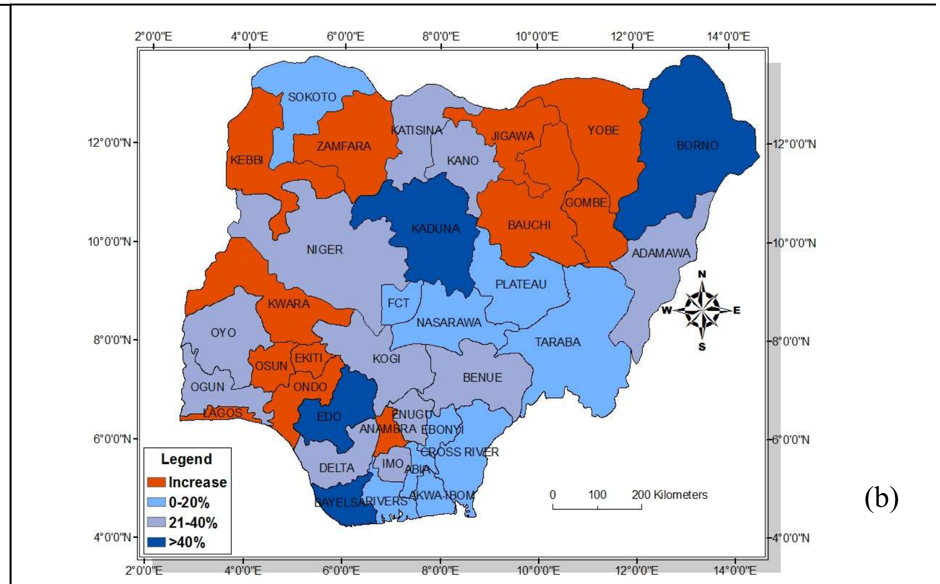
4.9.3.2 Temporal pattern of changes in IMR in Nigeria

Since the presence of trend had been descriptively and statistically established, the Global and Local Moran's I was therefore used to identify the pattern of change in IMRs in Nigeria. Figure 4.14a shows significant variations in the percent change of IMRs across states between 2003 and 2008. Overall areas that experienced relatively large declines in IMR were beside areas with small reductions or even an increase in IMR suggesting an overall random pattern. The pattern was confirmed by calculating a Global Moran's Index (MI = 0.03, p = 0.32) which indicates that reductions in IMR among states during this period was neither clustered nor dispersed (See Appendix 33).In addition, no statistically significant local clusters were identified by the Local Moran's Index.

Figure 4.14b shows variations in the percent change of IMR across states between 2008 and 2013 with some states especially in the Northwest and Southwest experiencing some increase in IMR during this period. Nevertheless, the Global Moran's Index (MI = -0.10, p = 0.51) indicates that changes in IMR among states during this period was neither clustered nor dispersed. Also, no significant local clusters were identified by the Local Moran's Index. This indicates that reductions (or increases) in IMRs across states was random and probably due to a combination of programmes/strategies adopted by the Nigerian government.

Figure 4.14c shows significant variations in the percent change of IMRs across states between 2003 and 2013 with relatively large reductions in the Northeast, Northcentral and Southsouth regions. The Global Moran's I (MI= 0.09, p=0.09) indicates a significant clustered pattern in the percent change of IMRs during this period but not at the 95% confidence level. The Local Moran's I identified High-High clusters in the Southeast centered on Imo state (Index=1.53, p=0.00) (See Appendix 34). This indicates that Imo state not only had a relatively high percentage change value in IMR (increase) between 2003 and 2013 but was surrounded by states specifically Abia and Anambra with a relatively high percentage change value in IMRs which suggests that conditions in individual and neighbouring states played a major role in determining changes in IMR in this region.





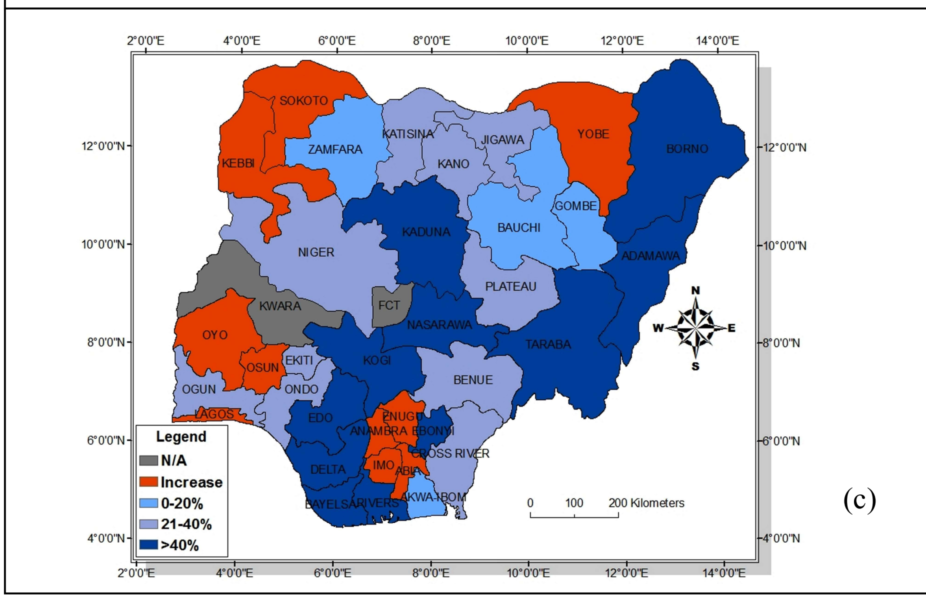


Figure 4.14a-c: Spatial Pattern of percentage change in IMRs in Nigeria for (a) 2003-2008, (b) 2008-2013 and (c) 2003-2013, respectively

4.10Temporal pattern of child and under 5 mortality rates in Nigeria

4.10.1 Descriptive analysis of trends in child and under 5 mortality rates in Nigeria

Table 4.17 shows the percent change in CMRs in Nigeria based on the 2003, 2008 and 2013 NDHS. CMRs in Nigeria declined by 22% between 2003 and 2008 and then by 33% between 2008 and 2013 - an overall decline of 47% between the 2003 and 2013 surveys. CMRs fell by 45% and 55% in rural and urban Nigeria, respectively between 2003 and 2013. CMRs also declined in all regions except in the Southeast where CMRs increased significantly by 67% between 2003 and 2013. At the state level, most states experienced some decline in CMRs. Twenty states experienced some decline in CMRs between 2003 and 2008 while CMR declined in 29 states between 2008 and 2013 and between 2003 and 2013. Bayelsa and Osun state experienced the largest decline in child mortality (87% and 86%, respectively) between the 2003 and 2013 surveys. Ondo state experienced the smallest decline with a 4% decrease in CMR in the same period. CMR increased in 4 states – Cross River, Delta, Imo, Katsina - and remained unchanged in Oyo state over the same period.

Table 4.18 shows that U5MRs in Nigeria declined by 21% between 2003 and 2008 and then by 18% between 2008 and 2013- an overall decline of 35% between the 2003 and 2013 surveys. U5MRs fell by 34% in both rural and urban Nigeria between the 2003 and 2013 surveys. U5MRs also declined regionally except in the Southeast where U5MRs increased significantly by 41% between 2003 and 2013. Most states experienced some decline in U5MRs. Between 2003 and 2008, 25 states experienced some decline in U5MRs. U5MR also declined in 29 states between 2008 and 2013 and in 30 states between 2003 and 2013. Bayelsa and Borno state experienced the largest decline in under 5 mortality (76% and 71%, respectively) between 2003 and 2013. Lagos state experienced the least decline (6%) in the same period. U5MRs increased in the Federal Capital Territory as well as in Abia, Anambra, Enugu, Imo, Kwara and Oyo States over the same period.

With respect to the World Bank U5MR figures (1990-2015), Figure 4.15 shows that U5MRs in Nigeria steadily declined over the years, falling by 49% from 213 deaths per 1,000 live births in 1990 to 109 deaths per 1,000 live births in 2015.

Table 4.17: Percentage Change in CMR per 1,000 children survivng to age one in Nigeria

Location		2003 NDHS	2008 NDHS	2013 NDHS	% Change (2003-2008)	% Change (2008-2013)	% Change (2003-2013)
Residence	Urban	32	26	15	-19	-42	-53
	Rural	66	51	36	-23	-29	-45
Regions	Northcentral	43	35	18	-19	-49	-58
	Northeast	76	53	36	-30	-32	-53
	Northwest	71	65	40	-8	-38	-44
	Southeast	12	34	20	183	-41	67
	Southsouth	36	30	17	-17	-43	-53
	Southwest	21	15	13	-29	-13	-38
States	Abia	0	34	10	-	-71	-
	Abuja	53	21	10	-60	-52	-81
	Adamawa	40	55	21	38	-62	-48
	Akwa Ibom	30	48	16	60	-67	-47
	Anambra	0	45	13	-	-71	-
	Bauchi	78	62	55	-21	-11	-29
	Bayelsa	111	32	14	-71	-56	-87
	Benue	28	22	25	-21	14	-11
	Borno	69	44	22	-36	-50	-68
	Cross River	11	19	22	73	16	100
	Delta	14	24	15	71	-38	7
	Ebonyi	48	30	32	-38	7	-33
	Edo	49	22	15	-55	-32	-69
	Ekiti	28	28	5	0	-82	-82
	Enugu	17	22	15	29	-32	-12
	Gombe	92	52	44	-43	-15	-52
	Imo	9	29	18	222	-38	100
	Jigawa	123	72	53	-41	-26	-57
	Kaduna	42	47	9	12	-81	-79
	Kano	55	77	36	40	-53	-35
	Katsina	41	65	43	59	-34	5
	Kebbi	56	40	37	-29	-8	-34
	Kogi	67	33	18	-51	-45	-73
	Kwara	0	12	16	-	33	-
	Lagos	16	13	7	-19	-46	-56
	Nasarawa	39	23	26	-41	13	-33
	Niger	58	72	17	24	-76	-71
	Ogun	20	12	12	-40	0	-40
	Ondo	24	27	23	13	-15	-4
	Osun	37	13	5	-65	-62	-86
	Oyo	20	10	20	-50	100	0
	Plateau	19	26	11	37	-58	-42
	Rivers	53	33	16	-38	-52	-70
	Sokoto	93	82	52	-12	-37	-44
	Taraba	33	42	26	27	-38	-21
	Yobe	133	54	40	-59	-26	-70
	Zamfara	132	54	54	-59	0	-59
	National	55	43	29	-22	-33	-47

Author's Calculations (Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time).

Table 4.18: Percentage Change in U5MR per 1,000 live births in Nigeria

Location		2003 NDHS	2008 NDHS	2013 NDHS	% Change (2003-2008)	% Change (2008-2013)	% Change (2003-2013)
Residence	Urban	98	80	65	-18	-19	-34
	Rural	158	125	104	-21	-17	-34
Regions	Northcentral	129	104	74	-19	-29	-43
	Northeast	168	128	98	-24	-23	-42
	Northwest	159	135	110	-15	-19	-31
	Southeast	64	111	90	73	-19	41
	Southsouth	132	97	66	-27	-32	-50
	Southwest	74	66	63	-11	-5	-15
States	Abia	44	114	87	159	-24	98
	Abuja	53	81	63	53	-22	19
	Adamawa	188	151	98	-20	-35	-48
	Akwa Ibom	96	113	73	18	-35	-24
	Anambra	28	93	74	232	-20	164
	Bauchi	161	136	131	-16	-4	-19
	Bayelsa	233	126	56	-46	-56	-76
	Benue	129	114	92	-12	-19	-29
	Borno	170	129	49	-24	-62	-71
	Cross River	86	63	61	-27	-3	-29
	Delta	147	105	74	-29	-30	-50
	Ebonyi	216	120	114	-44	-5	-47
	Edo	93	95	45	2	-53	-52
	Ekiti	103	76	61	-26	-20	-41
	Enugu	78	102	80	31	-22	3
	Gombe	162	110	111	-32	1	-31
	Imo	18	130	90	622	-31	400
	Jigawa	227	123	135	-46	10	-41
	Kaduna	140	114	45	-19	-61	-68
	Kano	137	163	101	19	-38	-26
	Katsina	116	126	90	9	-29	-22
	Kebbi	137	100	123	-27	23	-10
	Kogi	126	84	56	-33	-33	-56
	Kwara	25	43	68	72	58	172
	Lagos	68	63	64	-7	2	-6
	Nasarawa	221	83	84	-62	1	-62
	Niger	130	146	65	12	-55	-50
	Ogun	94	81	65	-14	-20	-31
	Ondo	133	67	85	-50	27	-36
	Osun	107	43	41	-60	-5	-62
	Oyo	30	66	61	120	-8	103
	Plateau	103	99	80	-4	-19	-22
	Rivers	178	93	75	-48	-19	-58
	Sokoto	163	160	127	-2	-21	-22
	Taraba	165	118	97	-28	-18	-41
	Yobe	183	108	96	-41	-11	-48
	Zamfara	239	118	156	-51	32	-35
	National	141	111	91	-21	-18	-35

Author's Calculations (Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time).

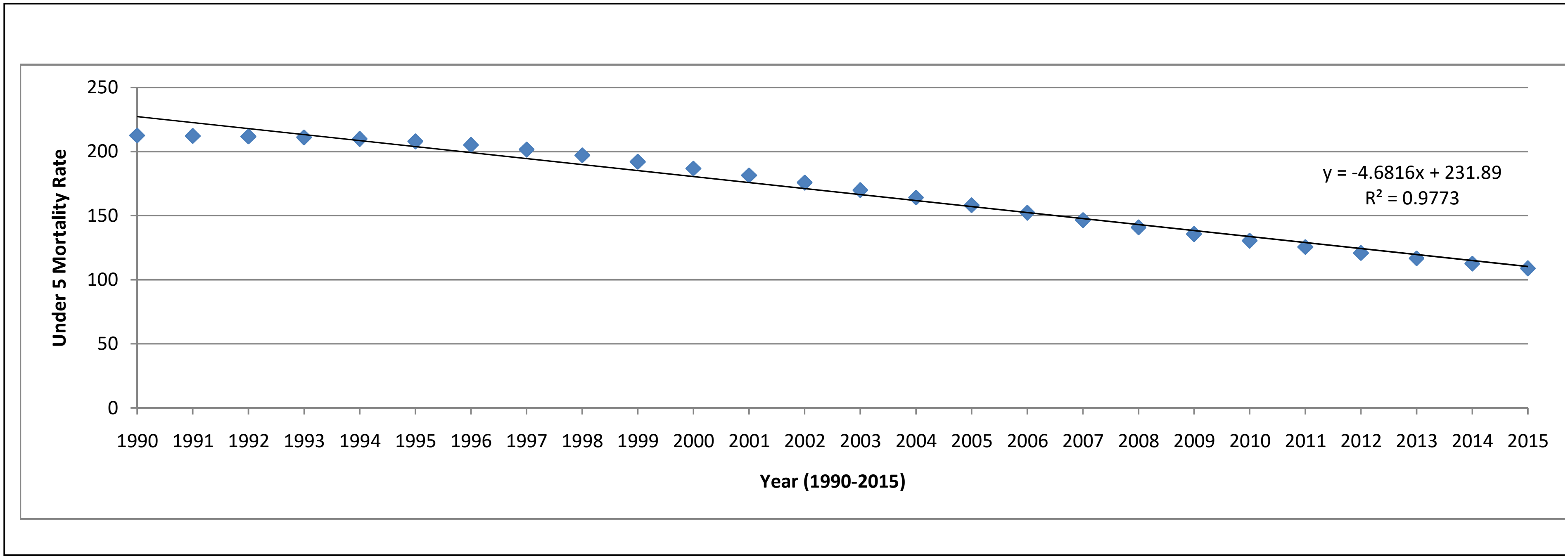


Figure 4.15: Trends in Under 5 Mortality Rate in Nigeria (World Bank, 1990-2015)

4.10.2 Test of Hypothesis 2b**:** There are no significant variations in child and under 5 mortality over time across states in Nigeria.

4.10.2.1 Analysis of Variance (ANOVA) of child mortality rates in Nigeria

A one- way ANOVA was carried out to determine whether there are statistically significant differences in both child and under 5 mortality rates across states over time in Nigeria. CMRs were significantly different over time at the 0.05 level for F (2, 108) = 8.009, P = 0.001. The difference in mean CMR between groups is fairly large as indicated by the effect size (0.129). Hence, hypothesis 2b which states that there are no significant variations in CMRs in Nigeria over time (2003-2013) is rejected. Post hoc comparisons using the Tukey HSD test indicated significant differences between the mean CMR for 2003 and 2013 and for 2008 and 2013 but there was no statistically significant difference in mean CMR between 2003 and 2008 (See Appendix 35).

Significant differences were found in CMRs by wealth, mother's education and age(See Appendix 36). With regards to the 2008 and 2013 survey, there are significant differences in CMRs between wealth groups at the 0.05 level for F (2,108) = 6.780, P = 0.002 and F (2,108) = 11.218, P = 0.000, respectively. The Tukey HSD test indicated significant differences in 2008 between the mean CMR of the wealth groups except between the lowest (Mean=42.37, SD=27.951) and the middle wealth group (Mean=43.48, SD=25.290). Similarly, results indicated significant differences in 2013 between the mean CMR of the wealth groups except between the lowest (Mean=28.67, SD=21.834) and the middle wealth group (Mean=22.60, SD=13.691). This suggests no significant increase in child survival between the lowest and middle wealth groups. Results also suggest that child health/survival significantly inmproves only with a substantial increase in wealth.

Significant differences in CMRs by mother's educational level were also identified across surveys. In 2003, there were significant differences in CMRs by education groups at the 0.05 level for F (2,108) = 6.720, P = 0.002. Post hoc comparisons indicated significant differences in mean CMR between maternal education groups except between children with uneducated mothers (Mean=56.94, SD=54.248) and mothers with primary education (Mean=43.81, SD=59.290). This suggests that child health/survival did not significantly increase when mothers had primary education but only when they had secondary and higher education.

With respect to the 2008 survey, there are significant differences in CMRs by education groups at the 0.05 level for F (2,108) = 5.317, P = 0.006. Post hoc comparisons indicated significant differences in mean CMR between maternal education groups except between uneducated mothers (Mean=39.60, SD=28.928) and mothers with primary education (Mean=43.14, SD=24.827) This suggests that CMRs did not differ significantly between both groups and highlights the importance of secondary and higher education among mothers to child health/survival. There were also significant differences in CMRs by education groups at the 0.05 level for F (2,108) = 8.252, P = 0.000 in 2013. Post hoc comparisons indicated significant differences in mean CMR between maternal education groups except between uneducated mothers (Mean=29.80, SD=24.929) and mothers with primary education (Mean=25.31, SD=16.050) indicating that CMRs did not differ significantly between both groups.

Significant differences in CMRs by mother's age were also identified in 2003 and 2008. For the 2003 survey, there are significant differences in CMRs by mother's age at the 0.05 level for F (2, 108) = 6.029, P=0.003. Post hoc comparisons indicated significant differences in mean CMR between children with teenage mothers (under 20) (Mean=23.61, SD=51.322) and mothers over 34 (Mean=66.81, SD=64.778). For the 2008 survey, results showed significant differences in CMRs by mother's age at the 0.05 level for F (2,108) = 9.671, P = 0.000. Post hoc comparisons indicated significant differences in mean CMR between children with teenage mothers (Mean=19.18, SD=26.295) and mothers over 34 (Mean=44.13, SD=27.234). In addition, significant differences were found between the mean CMR for teenage mothers (Mean=19.18, SD=26.295) and mothers aged 20-34 (Mean=36.68, SD=21.209) unlike the previous surveys while no significant difference was identified in 2013.

4.10.2.2 Analysis of Variance (ANOVA) of under 5 mortality rates in Nigeria

U5MRs differed significantly over time at the 0.05 level for F (2, 108) = 10.308, P = 0.000. The difference in mean U5MR between groups is large as indicated by the effect size (0.160). Hence, hypothesis 2b which states that there are no significant variations in U5MRs in Nigeria over time (2003-2013) is rejected. Post hoc comparisons using the Tukey HSD test showed significant differences in mean U5MR between 2003 and 2013 and between 2003 and 2008 but no statistically significant difference in mean U5MR between 2008 and 2013 (See Appendix 37).

U5MRs were significantly different by wealth, Mother's education and age (See Appendix 38). Results show significant differences in U5MRs between wealth groups at the 0.05 level for $F(2, 108) = 11.459$, $P = 0.000$ and $F(2, 108) = 4.797$, $p=0.010$ based on the 2008 and 2013 surveys, respectively. Post hoc comparisons indicated that in 2008, mean U5MR was significantly different between wealth groups except between the lowest (Mean=114.08, SD=38.352) and middle wealth group (Mean=108.44, SD=30.411). Similarly, mean U5MR was significantly different between wealth groups in 2013 except between the lowest (Mean=87.74, SD=49.812) and middle wealth group (Mean=79.45, SD=29.276)indicating no significant difference in under 5 deaths between both groups between 2008 and 2013.

U5MRs were significantly different between education groups at the 0.05 level for $F(2, 108) = 4.274$, $p = 0.016$, $F(2, 108) = 7.007$, $p=0.001$ and $F(2, 108) = 7.014$, $p=0.001$ for 2003, 2008 and 2013, respectively. Post hoc comparisons indicated significant differences in U5MR by mother's educational level across survey years except between children with uneducated mothers and mothers with primary education. This suggests that child health/survival significantly iimproved when mothers had at least secondary education. U5MRs were also significantly different between maternal age groups at the 0.05 level for $F(2,108) = 3.262$ in 2003. Post hoc comparisons indicated significant differences in the U5MR between the children of teenage mothers (Mean=90.35, SD=121.382) and mothers over 34 (Mean=146.13, SD=84.625).

4.10.3 Test of hypothesis 3b:There is no significant decline in the trend of child and under 5 mortality in Nigeria.

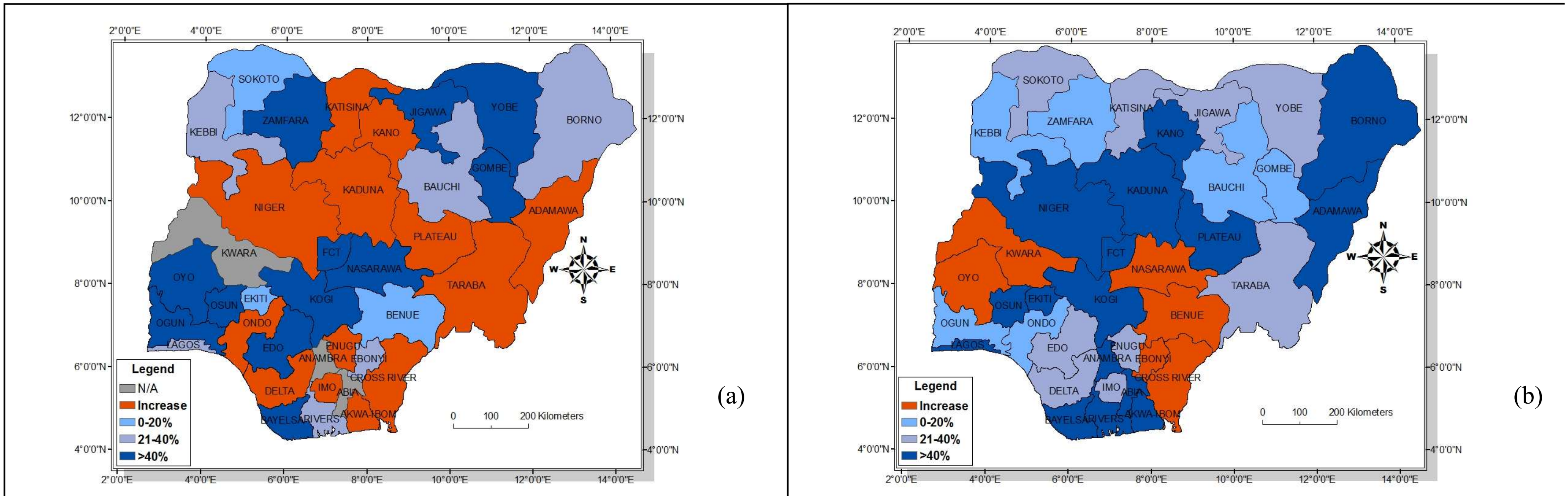
4.10.3.1 Statistical analysis of trends in under 5 mortality rates in Nigeria

Runs test of randomness (Z) was carried out to indicate the presence or absence of trends in under 5 mortality in Nigeria based on World Bank U5MR figures. Results showed that the series was not random ($Z= -4.604$ which lies outside of -1.96 and +1.96). This indicates a significant trend in U5MRs in Nigeria over time (1990-2015). Correlation results, $r = -0.989$ ($p=0.000$) indicates a very high negative correlation at the 0.01 level while regression results $R^2=0.977$ indicates that time accounts for 98% of the change/decline in U5MR in Nigeria (See Appendix 39).

4.10.3.2 Temporal pattern of changes in child and under 5 mortality in Nigeria

Figure 4.16a-c shows variations in the percent change of CMRs across states between surveys. The Global Moran's I results (MI = -0.02, p = 0.93) indicates that changes in CMR among states between 2003 and 2008 was random (See Appendix 40). Also, no significant local clusters were identified by the Local Moran's Index. This suggests that reductions (or increases) in CMR was likely due to a combination of factors or programmes/strategies adopted by the Nigerian government. The Global Moran's I result (MI = 0.06, p = 0.37) indicates that changes in CMR across states between 2008 and 2013 was random. However, the Local Moran's I identified High-High and Low-High clusters in Oyo (Index=1.83, p=0.00) and Osun state (Index=-0.85, p=0.04), respectively (See Appendix 41 and Figure 4.17a). This indicates that Oyo state not only had a relatively high percent change value (decrease) in CMR between 2008 and 2013 but was bordered mainly by states with a relatively high percent change value in CMR (i.e. percent change values statistically similar to those of neighbouring states) while Osun state had a relatively lower percent change value compared to most neighbouring states. In the same way, the Global Moran's I (MI = 0.07, p = 0.32) indicates that changes in CMR among states between 2003 and 2013 was random while the Local Moran's Index identified a High-High cluster in Abia state (Index=0.76, p=0.02) (Figure 4.17b). This indicates a relatively high percent change in values in this region compared to others.

Figure 4.18 shows significant variations in the percent change of U5MR across states between surveys. The Global Moran's I result (MI = 0.21, p = 0.001) indicates that changes in U5MR across Nigeria between 2003 and 2008 was clustered at the 99% confidence level (See Appendix 42). The Local Moran's I identified High–High clusters (Anambra, Imo and Abia) and Low-high clusters (Rivers) in the percent change in U5MR during this period as shown in Figure 4.19a. The Global Moran's I (MI = -0.08, p = -0.03) indicates that changes in U5MR across states between 2008 and 2013 was random. The Local Moran's I identified a High-Low and Low-High cluster in Zamfara (Index=-0.85, p=0.04) and Niger state (Index=-0.94, p=0.013), respectively indicating dissimilar values in the percent change in U5MR between these states and their neighbours (See Appendix 43 and Figure 4.19b). The Global Moran's I (MI = 0.19, p = -0.03) indicates that changes in U5MR over Nigeria between 2003 and 2013 was clustered at the 95% confidence level. High–High clusters were detected in the same areas identified between 2003 and 2008 (Figure 4.19c).



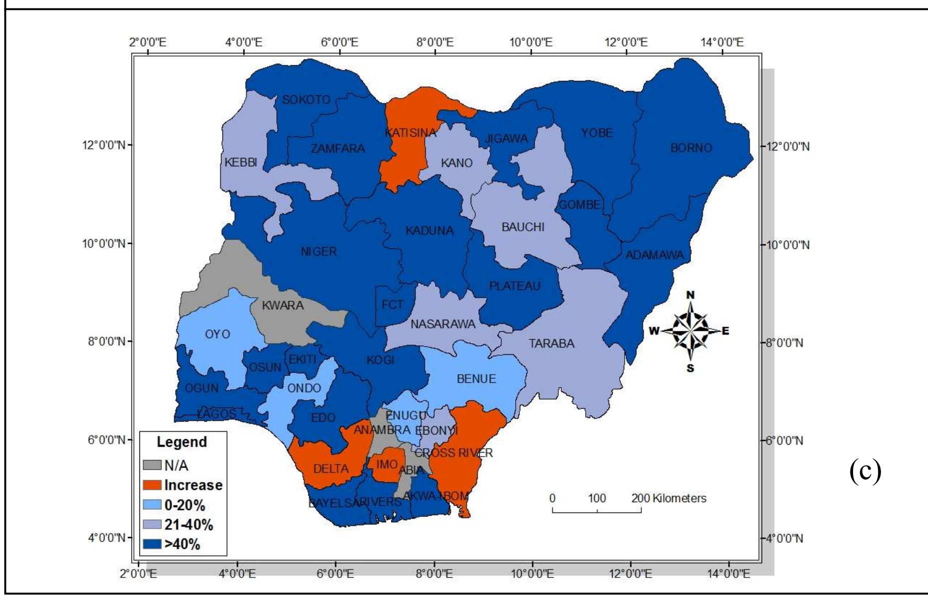
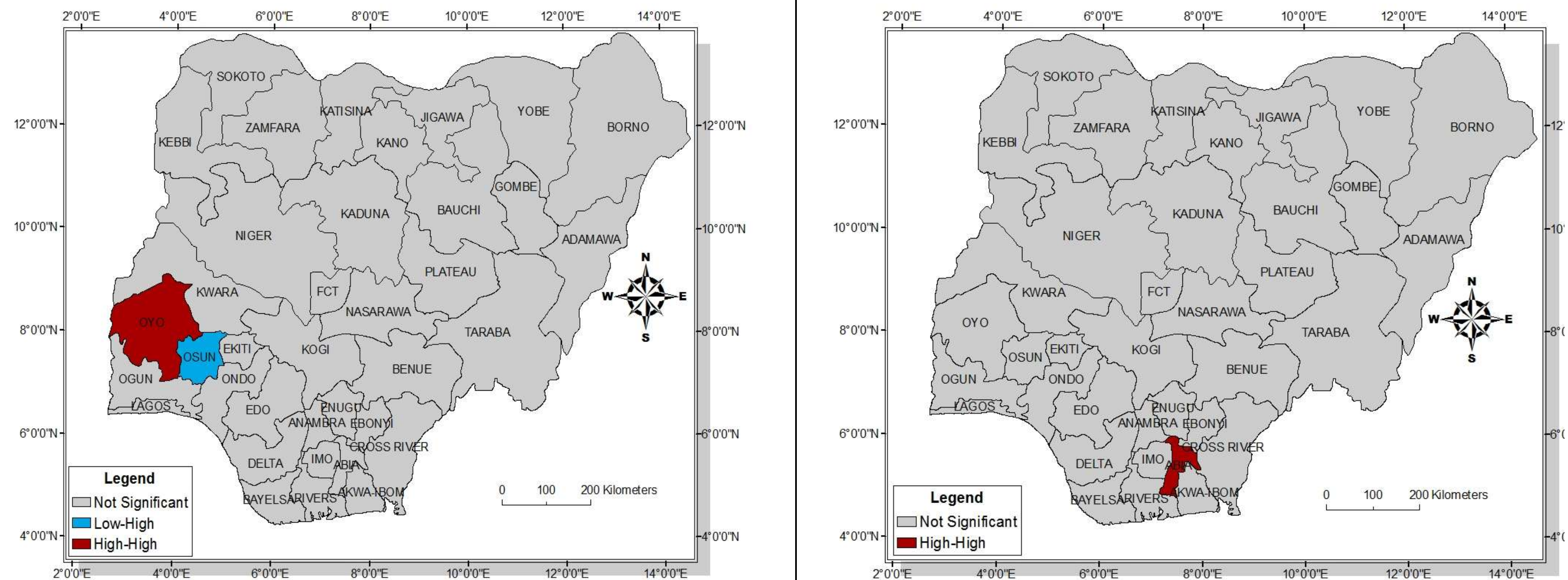
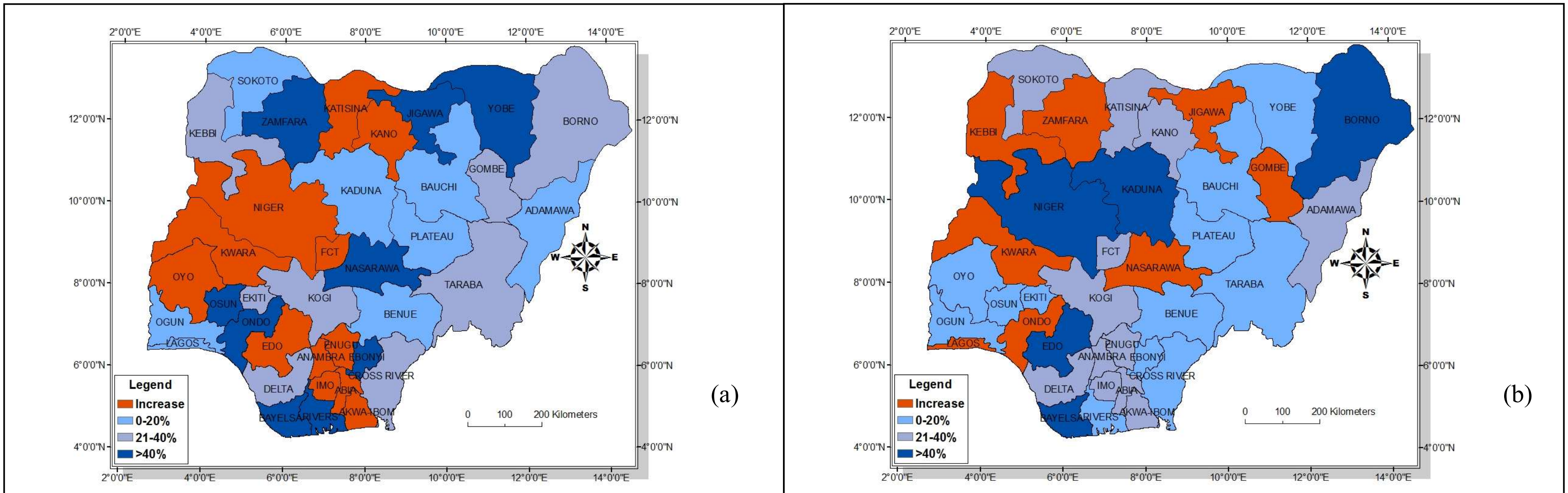


Figure 4.16a-c: Spatial Pattern of percentage change in CMRs in Nigeri for (a) 2003-2008, (b) 2008-2013 and (c) 2003-2013, respectively



(a) (b)

Figure 4.17a and b: Local Moran's I Map for percentage change in CMRs in Nigeria (2008-2013 and 2003-2013, respectively)



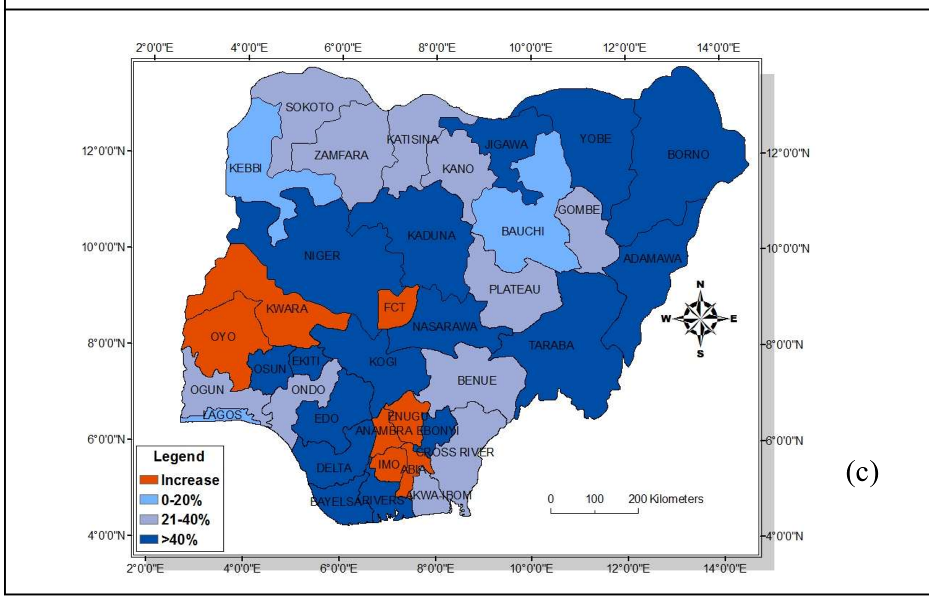
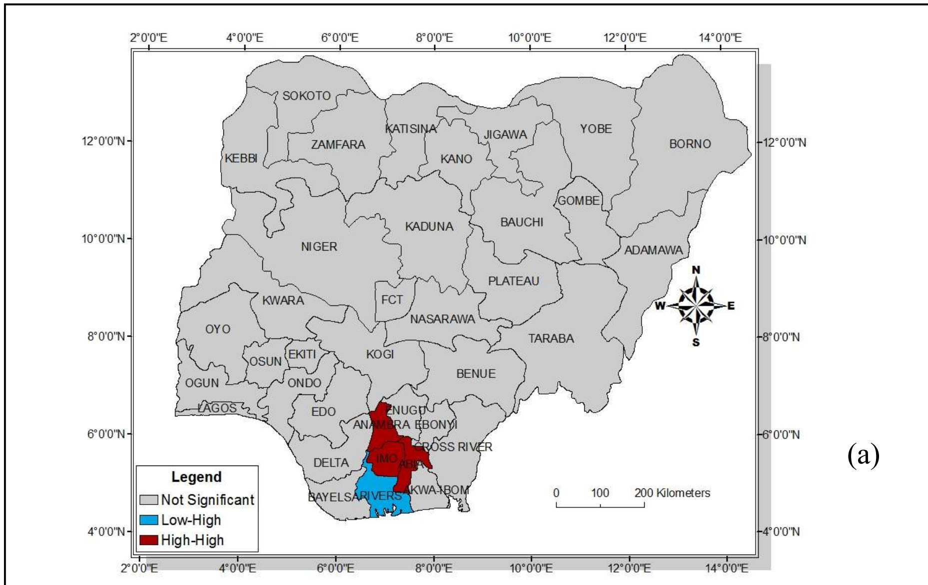
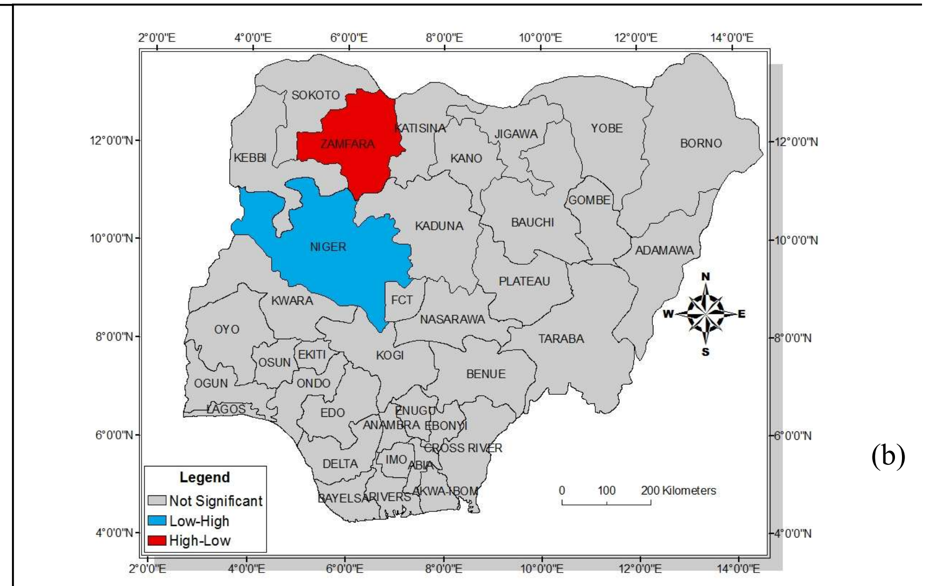


Figure 4.18a-c: Spatial Pattern of percentage change in U5MRs in Nige
for (a) 2003-2008, (b) 2008-2013 and (c) 2003-2013, respectively





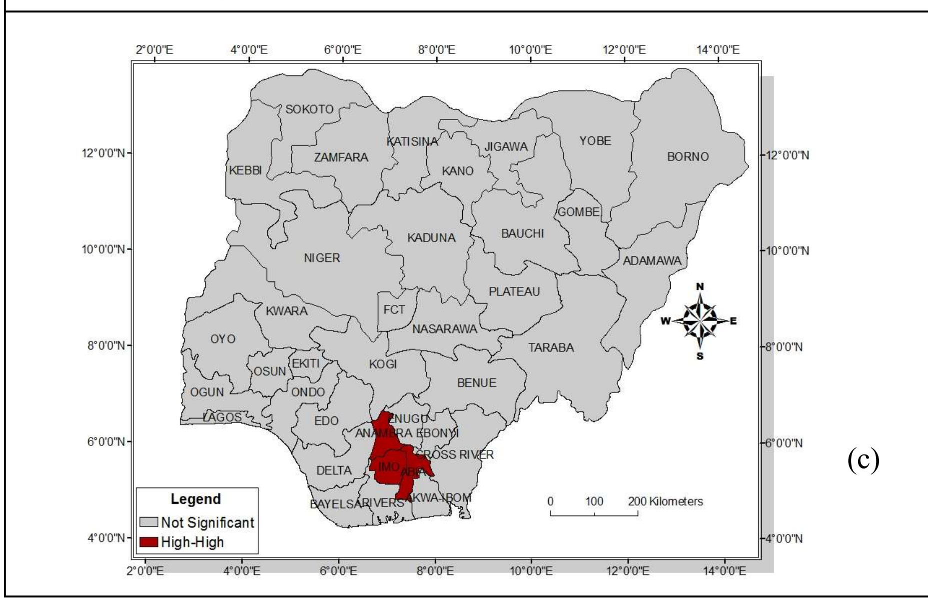


Figure 4.19a-c: Local Moran's I map for percentage change in U5MRs i
Nigeria for (a) 2003-2008, (b) 2008-2013 and (c) 2003-2013, respective

4.11 Summary

This second section has examined changes in the pattern of infant, child and under 5 mortality in Nigeria over time. The temporal analysis of mortality among children under 5 has revealed significant reductions and variations in all three mortality indicators. Infant, child and under 5 mortality fell by 28%, 47% and 35%, respectively between 2003 and 2013. Mortality rates also fell in rural and urban areas, across regions (except in the Southeast) and among most states during the same period. Analysis based on data from the World Bank also indicate a significant decline in annual infantand under 5 mortality rates in Nigeria. Among states, the largest reduction in IMRs between 2003 and 2013 surprisingly occurred in Borno (75%) and Nasarawa state (69%) while the largest reduction in CMR during the same period occurred in Bayelsa (88%) and Osun state (87%). The largest reduction in overall under 5 mortality during this period occurred in Bayelsa (76%) and Borno state (71%).

In general, findings show that the largest reductions in all three mortality indicators over time were primarily concentrated in the Northern part of the country and the Southsouth region, though these areas still had relatively higher mortality rates compared to other regions. All three mortality rates increased mainly in parts of the Southeast as well as in a few states in the Southwestern and Northcentral region, though most of these areas continued to have relatively lower mortality rates compared to other regions.Statistical analysis also showed significant differences in infant, child and under 5 mortality over time and across some variables. This suggests that Nigeria generally managed to reduce mortality rates among children under 5 particularly in the areas with very high U5MRs. However, some of that progress might have been offset by the increase in mortality in other areas.

Results indicated that the pattern of relative change in IMR over Nigeria was random except between 2003 and 2013 where a clustered pattern was identified though at a 90% confidence level. The Local Moran's I revealed a High-High cluster in the Southeast suggesting that states in this region most likely shared conditions that played a major role in determining changes in IMR. With regards to CMRs, results indicated an overall random pattern in the percent change in CMRs in Nigeria. However, the Local Moran's I identified areas that did not follow the overall random pattern. A High-High cluster and Low-High outlier was identified in the Southwest between 2008 and 2013 while a High-High cluster was identified in the Southeast between 2003 and 2013. This suggests that both state specific and neighbouring conditions played a part in the temporal pattern of CMRs in these regions. Results showed a clustered pattern in the percent change of U5MRs in Nigeria except between 2008 and 2013 where the pattern was found to be neither clustered nor dispersed. The Local Moran's I detected High-High and Low-High clusters in the Southeast between 2003 and 2008, High-Low and Low-High outliers in the North between 2008 and 2013 and High-High clusters in the Southeast between 2003 and 2013. This suggests that the temporal pattern of mortality rates among states in Nigeria was largely due to a combination of conditions/characteristics in individual states as well as conditions shared with neighbouring states.

4.12 Determinants of infant, child and under 5 mortality in Nigeria

This section aims to explain the spatial and temporal patterns of infant, child and under 5 mortality in Nigeria identified in preceding sections. This is done by statistically investigating and identifying the key determinants that explain the spatial patterns of infant, child and under 5 mortality rates across states (based on the 2003, 2008 and 2013 NDHS) as well as the temporal variations in annual infant and under 5 mortality rates (based on World Bank datasets, 1990-2014).

4.13 Test of hypothesis 4: There is no significant relationship between infant, child and under 5 mortality and selected variables in Nigeria

4.13.1 Bivariate correlation analysis for infant, child and under 5 mortality (NDHS)

4.13.1.1 Bivariate correlation analysis for 2003

A Pearson Product Moment Correlation Coefficient was computed to assess the relationship between variables in order to evaluate hypothesis 4. The correlation matrix (See Appendix 44a and b) shows that 11 out of 21 variables were statistically significant with IMRs. The 3 most highly correlated determinants are % poor ($r = .642$; $r^2 = .412$, $p < .01$), breastfeeding 6 months or more ($r = -.601$; $r^2 = .361$, $p < .01$) and health care delivery ($r = -.508$; $r^2 = .258$, $p < .01$). The correlation matrix shows that 15 variables were statistically significant with CMRs. The 5 most highly correlated determinants are health care delivery ($r = -.726$; $r^2 = .527$, $p < .01$), 4 or more antenatal care visits ($r = -.735$; $r^2 = .540$, $p < .01$), PAB ($r = -.691$; $r^2 = .477$, $p < .01$), fully immunized ($r = -.640$; $r^2 = .410$, $p < .01$) and age at first birth less than 20 ($r = .621$; $r^2 = .386$, $p < .01$). The correlation matrix indicates that 13 variables were statistically significant with U5MRs. The 5 most highly correlated determinants are health care delivery ($r = -.729$; $r^2 = .531$, $p < .01$), % poor ($r = .696$; $r^2 = .484$, p<.01), 4 or more antenatal care visits (r = -.658; r^2=.433, p<.01), breastfeeding 6 months or more (r = -.641; r^2=.411, p<.01) and mothers with complete secondary education and more (r = -.633; r^2=.401, p<.01). Results also showed that both birth interval (less than 24 months) and age at first birth (34 or older) were not correlated with any other determinant.

4.13.1.2 Bivariate correlation analysis for 2008

Out of the 21 variables, only 5 were statistically significant with IMRs (See Appendix 45a and b). The 2 most highly correlated determinants are breastfeeding 6 months or more (r = -.540; r^2=.292, p<.01) and birth interval less than 24 months (r =.523; r^2=.274, p<.01). The correlation matrix indicates that 15 variables were statistically significant with CMRs. The 3 most highly correlated determinants are PAB (r = -.736; r^2=.542, p<.01), age at first birth less than 20 (r = .718; r^2=.516, p<.01) and health care delivery (r = -.711; r^2=.506, p<.01). The correlation matrix indicates that 13 variables were statistically significant with U5MRs. Four or more antenatal care visits (r = -.648; r^2=.420, p<.01) was the most highly correlated determinant followed by Fully immunized (r = -.646; r^2=.417, p<.01) and health care delivery (r = -.595; r^2=.354, p<.01). Results also indicated that 2 variables (% male and % that did not sleep under ITNs) were not correlated with any other determinant.

4.13.1.3 Bivariate correlation analysis for 2013

Out of the 21 variables, 8 were statistically significant with IMRs (See Appendix 46a and b). The 2 most highly correlated determinants are % poor (r =.556; r^2=.309, p<.01) and access to improved water sources (r = -.422; r^2=.178, p<.01). The correlation matrix shows that 16 variables were statistically significant with CMRs. The 6 most highly correlated determinants are % poor (r =.853; r^2=.728, p<.01), age at first birth less than 20 (r = .799; r^2=.638, p<.01), mother's with complete secondary education and more (r = -.789; r^2=.623, p<.01), fully immunized (r = -.768; r^2=.590, p<.01), health care delivery (r = -.746; r^2=.557, p<.01) and PAB (r = -.737; r^2=.543, p<.01). The correlation matrix shows that 15 variables were statistically significant with U5MRs. The 3 most highly correlated determinants are % poor (r =.761; r^2=.579, p<.01), mothers with complete secondary education and more (r = -.606; r^2=.367, p<.01) and age at first birth less than 20 (r =.600; r^2=.036, p<.01). Results also indicated that the variable '% male' was not statistically correlated with any other determinant.

4.13.2 Bivariate correlation analysis (World Bank, 1990-2014)

With respect to the World Bank datasets, the correlation matrix (Table 4.19) shows that 6 out of 9 variables were statistically significant with IMRs over time in Nigeria. There was a positive relationship between IMRs and 2 determinants: access to improved sanitation ($r = .980$; $r^2 = .960$, $p < .01$) and Inflation ($r = .508$; $r^2 = .258$, $p < .01$). There was a negative relationship between IMRs and 4 determinants: access to improved water sources ($r = -.985$; $r^2 = .970$, $p < .01$), PAB ($r = -.811$; $r^2 = .658$, $p < .01$), urban population ($r = -.997$; $r^2 = .994$, $p < .01$) and DPT ($r = -.503$; $r^2 = .253$, $p < .05$).

Out of the 9 variables, 6 were statistically significant with U5MRs over time in Nigeria. There was a positive relationship between U5MRs and 2 determinants: access to improved sanitation ($r = .980$; $r^2 = .960$, $p < .01$) and Inflation ($r = .510$; $r^2 = .260$, $p < .01$). There was a negative relationship between U5MRs and 4 determinants: access to improved water sources ($r = -.985$; $r^2 = .970$, $p < .01$), PAB ($r = -.812$; $r^2 = .659$, $p < .01$), urban population ($r = -.997$; $r^2 = .994$, $p < .01$) and DPT vaccination ($r = -.504$; $r^2 = .254$, $p < .05$). Both household final consumption expenditure and GDP per capita were not correlated with any other variable. In general, the results suggest that improvements in access to improved water sources (97%) and an increase in the urban population (99%) are the determinants most associated with declines in infant and under 5 mortality rates in Nigeria from 1990 to 2014.

4.13.3 Stepwise muitiple regression results (NDHS 2003, 2008 and 2013)

A multiple stepwise regression was carried out to identify the determinants that most explain the spatial pattern of infant, child and under 5 mortality rates across states in Nigeria. In 2003, poverty and breastfeeding 6 months or more were significant predictors of IMRs although they accounted for only 54% of the variance in IMR across states in Nigeria (Table 4.20). Both models were significant ($F = 24.497$, $p < .001$ and $F = 19.830$, $p < .001$, respectively) indicating that poverty and breastfeeding 6 months or more are significantly associated with variations in IMRs across states (Beta= .468 and -.396, respectively). In 2008, breastfeeding 6 months or more and 4 or more antenatal care visits during pregnancy were significant predictors of IMR although they accounted for only 46% of the variance in IMR across Nigeria. Both models were significant ($F = 14.376$, $p < .001$ and $F = 14.663$, $p < .001$, respectively) indicating that both variables are significantly associated with variations in IMRs across states (Beta= -.583 and -.417, respectively).

Table 4.19: Correlation Matrix (WorldBank)

		1	2	3	4	5	6	7	8	9	10	11
1	IMR	1										
2	U5MR	1.000**	1									
3	Access to Improved Water Sources (%)	-.985**	-.985**	1								
4	Access to Improved Sanitation services (%)	.980**	.980**	-.999**	1							
5	Inflation (CPI-%)	.508**	.510**	-.507**	.510**	1						
6	Household Consumption Expenditure (%)	.027	.027	-.039	.038	-.053	1					
7	PAB (%)	-.811**	-.812**	.872**	-.885**	-.536**	.031	1				
8	GDP Per Capita (Annual %)	-.232	-.234	.232	-.233	-.295	.120	.331	1			
9	Urban Population (% of Total Population)	-.997**	-.997**	.991**	-.986**	-.483*	-.038	.811**	.211	1		
10	Vaccinated against measles (%)	-.338	-.339	.216	-.193	-.101	-.035	.013	-.025	.308	1	
11	DPT (%)	-.503*	-.504*	.387	-.366	-.154	.025	.170	.088	.468*	.872**	1

Note: N = 25, *p < .05; **p< .01 (Calculated by Author)

Table 4.20: Stepwise Regression Results for IMR in Nigeria

2003 NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.412	.412	24.497			
(Constant)				36.837	10.743	
% Poor				1.111	.224	.642
Model 2	.538	.127	9.332			
(Constant)				373.867	110.749	
% Poor				.811	.224	.468
Breastfeeding (6 months or more)				-4.006	1.311	-.396
2008 NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.291	.291	14.376			
(Constant)				456.982	102.259	
Breastfeeding (6 months or more)				-4.704	1.241	-.540
Model 2	.463	.172	10.889			
(Constant)				503.881	91.407	
Breastfeeding (6 months or more)				-5.085	1.102	-.583
4 or more ANC visits				-.317	.096	-.417
2013 NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.309	.309	15.662			
(Constant)				48.791	3.865	
% Poor				.334	.084	.556
Model 2	.441	.132	8.046			
(Constant)				119.791	25.146	
% Poor				.482	.093	.802
Breastfeeding (6 months or more)				-1.185	.418	-.439
Model 3	.515	.074	5.007			
(Constant)				89.832	27.211	
% Poor				.723	.139	1.204
Breastfeeding (6 months or more)				-1.169	.395	-.433
4 or more ANC visits				.337	.151	.488
Model 4	.571	.056	4.213			
(Constant)				93.688	26.044	
% Poor				.934	.168	1.556
Breastfeeding (6 months or more)				-1.322	.384	-.490
4 or more ANC visits				.441	.153	.638
Prevalence of Diarrhea in Under 5				-.825	.402	-.322
Model 5	.639	.068	5.852			
(Constant)				52.000	29.764	
% Poor				.912	.157	1.519
Breastfeeding (6 months or more)				-.984	.384	-.365
4 or more ANC visits				.474	.143	.685
Prevalence of Diarrhea in Under 5				-1.001	.382	-.391
Birth Interval (Less than 24 Months)				.904	.374	.293
Calculated by Author						

In 2013, 5 variables: poverty, breastfeeding 6 months or more, 4 or more antenatal care visits, prevalence of diarrhea and birth interval less than 24 months were significant predictors of IMRs accounting for 64% of the variance in IMR across states in Nigeria. All 5 models were significant ($p<.001$) indicating that poverty (Beta= 1.519, $p<.001$), breastfeeding 6 months or more (Beta= -.365, $p<.001$), 4 or more antenatal care visits (Beta= .685, $p<.001$), prevalence of diarrhea (Beta= -.391, $p<.001$) and birth interval less than 24 months (Beta= .293, $p<.001$) were significantly associated with spatial patterns of IMRs across states.

With regards to CMRs, results indicated that 4 or more antenatal care visits was a significant predictor accounting for 54% of the variance in CMRs across states in Nigeria in 2003 (Table 4.21). The model was significant ($F = 41.154$, $p<.001$) indicating that at least 4 antenatal care visits during pregnancy is significantly associated with variations in CMRs across states (Beta= -.735, $p<.001$). In 2008, the proportion of children protected at birth from neonatal tetanus (PAB) and birth intervals less than 24 months were significant predictors of CMRs accounting for 66% of the variance in CMR across states. Both models were significant ($F=41.457$, $p<.001$ and $F=32.958$, $p<.001$, respectively) suggesting that both factors are significantly associated with patterns of CMRs across states (Beta= -.732 and .343 respectively). In 2013, the stepwise regression analysis identified wealth (% poor) as the significant predictor accounting for 73% of the variance in CMRs across Nigeria. The overall model was significant, $F = 93.516$, $p<.001$ indicating that the level of poverty was significantly associated with variations in CMRs across states (Beta= .853, $p<.001$).

With regards to U5MRs, results indicated that health care delivery, breastfeeding 6 months or more and full knowledge of MTCT of HIV/AIDS were significant predictors of U5MRs accounting for 76% of the variance in U5MR across Nigeria in 2003 (Table 4.22). All 3 models were significant ($p<.001$) indicating that health care delivery (Beta= -.595, $p<.001$), breastfeeding 6 months or more (Beta= -.444, $p<.001$) and full knowledge of MTCT of HIV/AIDS (Beta = -.184, $p<.001$) are significantly associated with the spatial pattern of U5MRs across Nigeria. In 2008, 4 variables: 4 or more antenatal care visits, breastfeeding 6 months or more, access to improved sanitation services and use of solid fuels in cooking were significant predictors of U5MRs accounting for 73% of the variance in U5MR across states in Nigeria. All 4 models were significant ($p<.001$) indicating that 4 or more antenatal care visits (Beta= -.480, $p<.001$), breastfeeding 6 months or more

Table 4.21: Stepwise Regression Results for CMR in Nigeria

2003 NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.540	.540	41.154			
(Constant)				101.075	9.370	
4 or more ANC visits				-.963	.150	-.735
2008 NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.542	.542	41.157			
(Constant)				70.154	5.522	
PAB				-.544	-.085	-.736
Model 2	.660	.117	11.739			
(Constant)				47.851	8.106	
PAB				-.541	.074	-.732
Birth Interval (Less than 24 Months)				.967	.282	.343
2013 NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.728	.728	93.516			
(Constant)				8.758	1.994	
% Poor				.421	.044	.853
Calculated by Author						

Table 4.22: Stepwise Regression Results for U5MR in Nigeria

Key Predictors	R^2	R^2 Change	F Change	B	SE	β
2003, NDHS						
Model 1	.531	.531	39.678			
(Constant)				191.770	12.341	
Health Care Delivery				-1.435	.228	-.729
Model 2	.721	.190	23.109			
(Constant)				695.072	105.144	
Health Care Delivery				-1.153	.188	-.586
Breastfeeding (6 months or more)				-6.362	1.323	-.458
Model 3	.755	.034	4.532			
(Constant)				694.727	100.075	
Health Care Delivery				-1.172	.179	-.595
Breastfeeding (6 months or more)				-6.167	1.263	-.444
Full Knowledge of MTCT				-3.180	1.494	-.184
2008, NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.419	.419	25.273			
(Constant)				142.705	8.548	
4 or more ANC visits				-.789	.157	-.648
Model 2	.626	.207	18.786			
(Constant)				671.532	122.210	
4 or more ANC visits				-.848	.129	-.695
Breastfeeding (6 months or more)				-.6.383	1.473	-.457
Model 3	.680	.054	5.586			
(Constant)				662.279	114.785	
4 or more ANC visits				-.900	.123	-.738
Breastfeeding (6 months or more)				-6.441	1.383	-.461
Access to improved Sanitation services				.347	.147	.237
Model 4	.734	.054	6.534			
(Constant)				646.069	106.412	
4 or more ANC visits				-.585	.167	-.480
Breastfeeding (6 months or more)				-7.020	1.299	-.503
Access to improved Sanitation services				.464	.143	.316
Use of solid fuels in cooking				.529	.207	.372
2013, NDHS						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1	.580	.580	48.256			
(Constant)				57.879	4.680	
% Poor				.709	.102	.761

Model 2						
(Constant)				30.118	11.514	
% Poor	.649	.070	6.774	.668	.096	.717
Birth Interval (Less than 24 months)				1.284	.493	.268
Model 3						
(Constant)				-4.315	19.446	
% Poor				.956	.162	1.026
Birth Interval (Less than 24 months)	.692	.043	4.591	1.307	.469	.273
4 or more ANC visits				.399	.186	.372
Model 4						
(Constant)				-17.198	19.226	
% Poor				1.211	.191	1.299
Birth Interval (Less than 24 months)	.734	.042	5.053	1.561	.457	.326
4 or more ANC visits				.544	.187	.506
Prevalence of Diarrhea				-1.120	.498	-.281
Model 5						
(Constant)				-8.391	18.322	
% Poor				1.196	.178	1.283
Birth Interval (Less than 24 months)	.776	.041	5.720	1.777	.436	.371
4 or more ANC visits				.590	.176	.549
Prevalence of Diarrhea				-1.233	.467	-.310
Access to improved Sanitation services				-.302	.126	-.218
Calculated by Author						

(Beta= -.503, p<.001), access to improved sanitation services (Beta= .316, p<.001), and use of solid fuels (Beta= .372, p<.001) were significantly associated with the spatial pattern of U5MRs across states.

In 2013, 5 variables: % poor, birth interval less than 24 months, 4 or more antenatal care visits, prevalence of diarrhea and access to improved sanitation services were significant predictors of U5MR accounting for 78% of the variance in U5MR across states in Nigeria. All 5 models were significant (p<.001) therefore showing that % poor (Beta= .1.283, p<.001), birth interval less than 24 months (Beta= .371, p<.001), 4 or more antenatal care visits (Beta= .549, p<.001), prevalence of diarrhea (Beta= -.310, p<.001) and access to improved sanitation services (Beta= -.218, p<.001) were significantly associated with the spatial pattern of U5MR across states.

4.13.4 Residual mapping

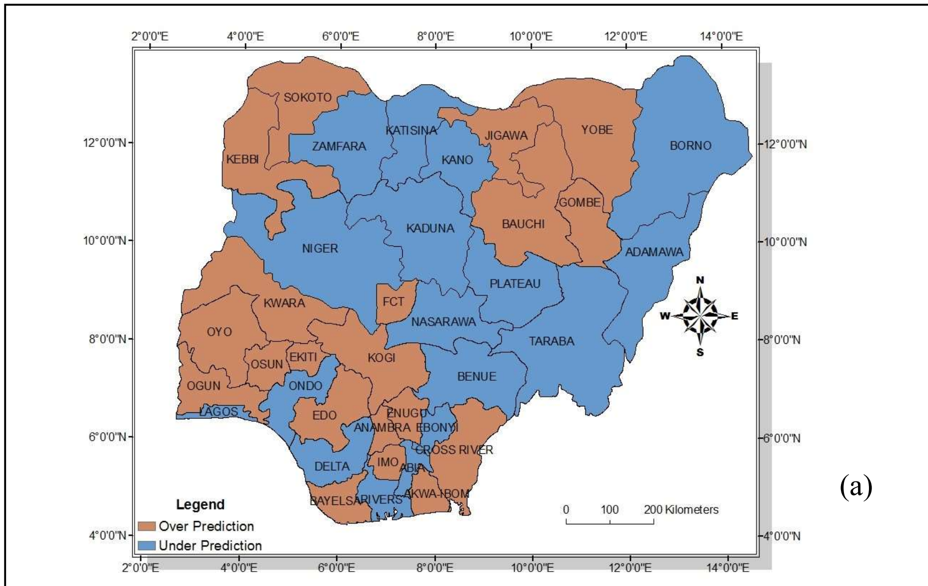
Maps were generated in ArcGIS based on residuals derived from the regression analysis. Residual maps show areas of over and under prediction in infant, child and under 5 mortality rates across states in Nigeria based on the regression explanatory variables. Negative residuals are areas where actual mortality rates are smaller than the model estimated values (over prediction) while positive residuals are areas where actual mortality rates are larger than the model estimated values (under prediction) (See Appendix 47). Model estimated IMRs for 2003 were higher than actual values in some states particularly in Sokoto and Kebbi state while model estimated IMRs were lower than actual values in others particularly in Nasarawa, Delta and Rivers state in the Southsouth and Benue and Plateau in the Northcentral region (Figure 4.20a).

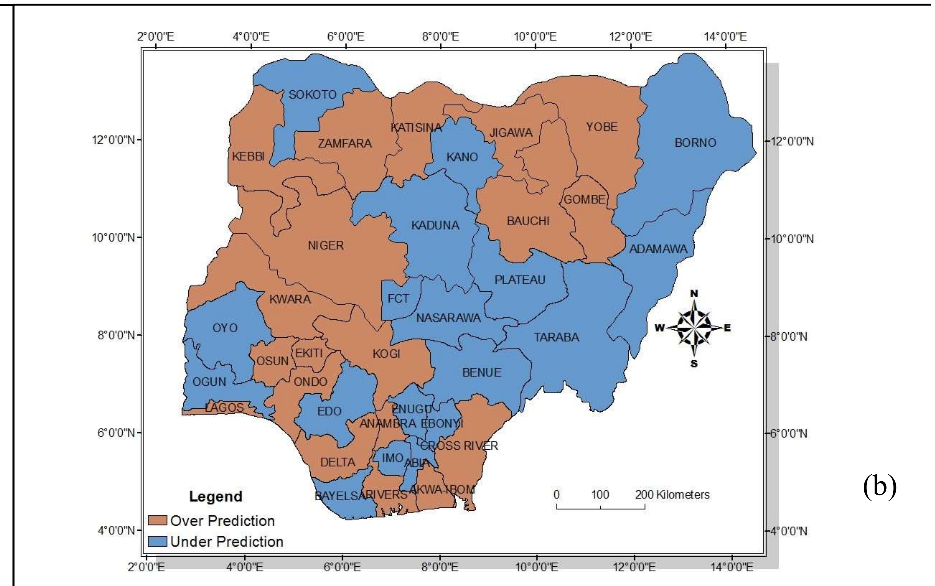
Figure 4.20b indicates that model estimated IMRs for 2008 were higher than actual values in some areas especially in Kwara, Anambra and Cross River state while model estimated IMRs were lower than actual values in some states including the Federal Capital

Territory. Figure 4.20c shows a tendency towards over prediction in IMRs in 2013 with model estimated IMRs being higher than actual values in some states particularly in Borno, Katsina and Edo state and a tendency towards under prediction in Kebbi, Zamfara and Kwara state among others. Spatial autocorrelation analysis (Global Moran's I) was carried out to assess whether residuals had a tendency to cluster spatially. A clustered pattern of regression residuals would indicate that factors identified only explain mortality for some areas and not others. In other words, it would indicate that key variables aremissing from the model. Results showed that residuals are randomly distributed that is neither clustered nor dispersed (See Appendix 48). This suggests that regression models on IMRs are generally reliable.

Figure 4.21a shows a tendency towards over prediction in CMRs in 2003 in some states particularly in Taraba state in the Northeast and Anambra state in the Southeast and a tendency towards under prediction in some states including the Federal Capital Territory. Figure 4.21b indicates a tendency towards over prediction in CMRs in 2008 in some states particularly in Borno and Kebbi state in the North and Oyo and Ogun state in the Southwest and a tendency towards under prediction in Niger, Sokoto and Kano state among others. Figure 4.21c indicates a tendency towards over prediction in CMRs in 2013 in some states particularly in Plateau, Kaduna and Taraba state in the North and a tendency towards under prediction in Bauchi, Sokoto and Zamfara state among others (See Appendix 49). The Global Moran's I showed that residuals are neither clustered nor dispersed. This suggests that regression models on CMRs are generally reliable.

In 2003, there was a tendency towards over prediction in U5MRs in some states particularly in Kebbi state in the Northwest, Cross River in the Southsouth and Oyo, Ogun and Lagos state in the Southwest. There was a tendency towards under prediction in Rivers, Yobe and Jigawa state among others (Figure 4.22a). Figure 4.22b indicates a tendency towards over prediction in U5MRs in 2008 in some states particularly in Yobe, Kwara and Cross River state and a tendency towards under prediction in some states particularly in the Federal Capital Territory. Figure 4.22c shows a tendency towards over prediction in U5MRs in 2013 in some states particularly in Borno, Katsina and Plateau state in the North and a tendency towards under prediction in Kwara, Sokoto and Kebbi state among others (See Appendix 50). Results of the Global Moran's I showed that residuals are neither clustered nor dispersed. This suggests that regression models on U5MRs are generally reliable.





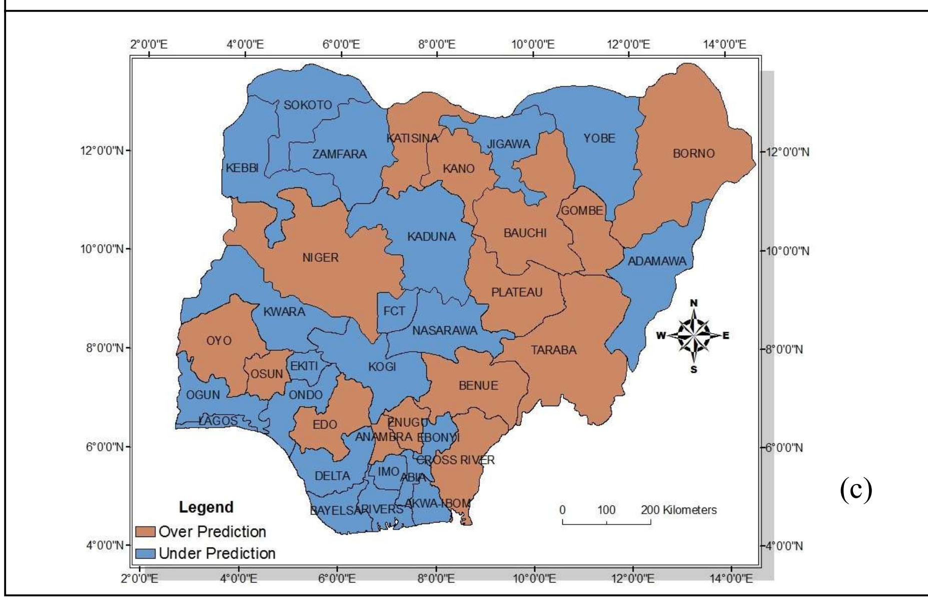
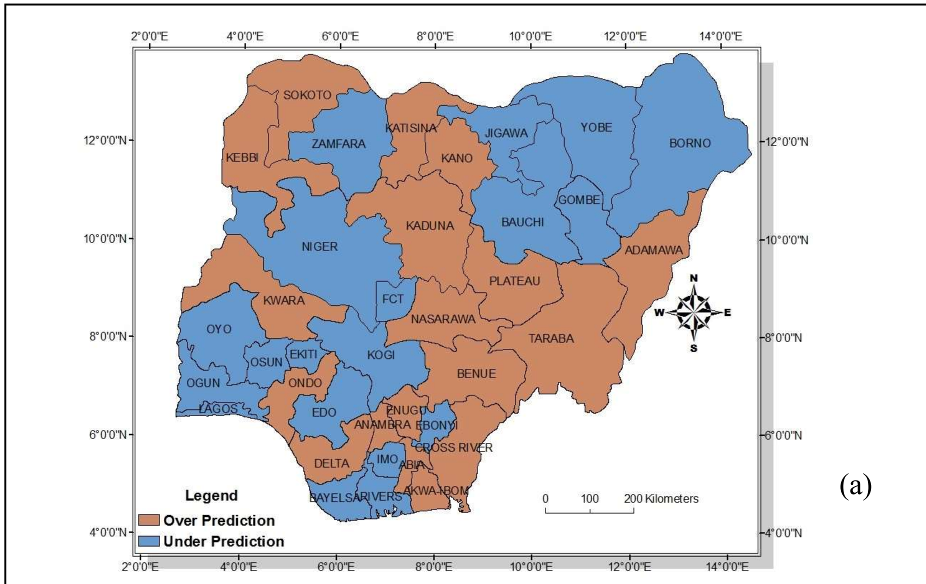
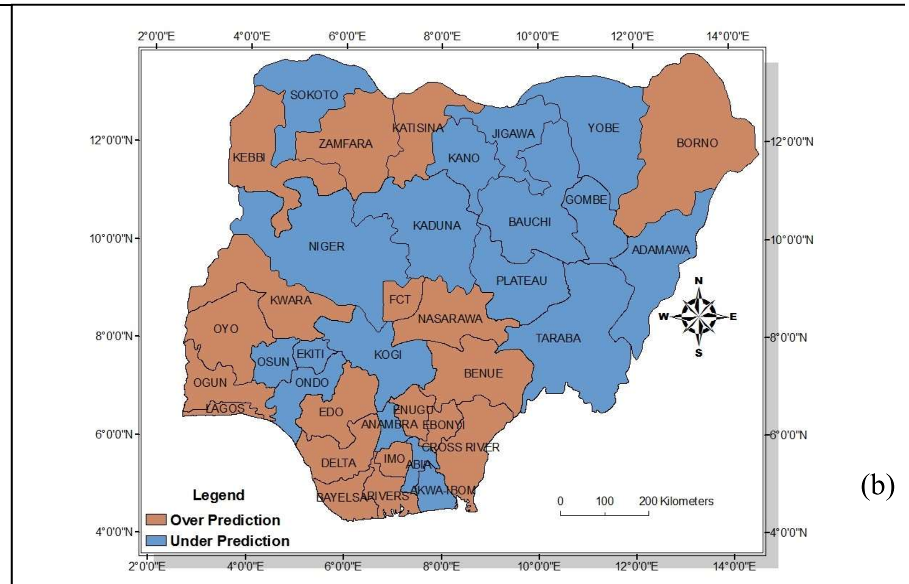


Figure 4.20a-c: IMR Residual Maps for (a) 2003, (b) 2008 and (c) 2013, respectively





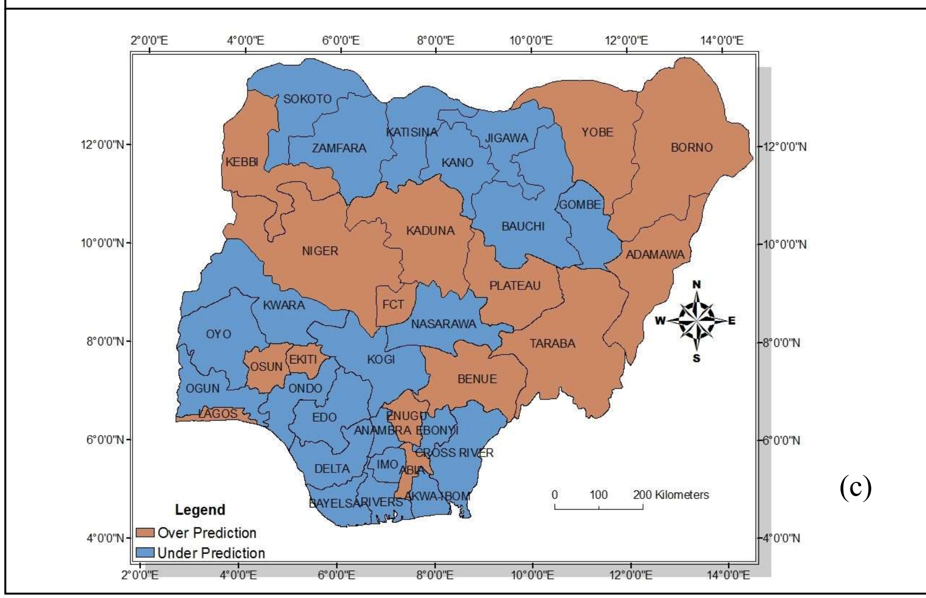
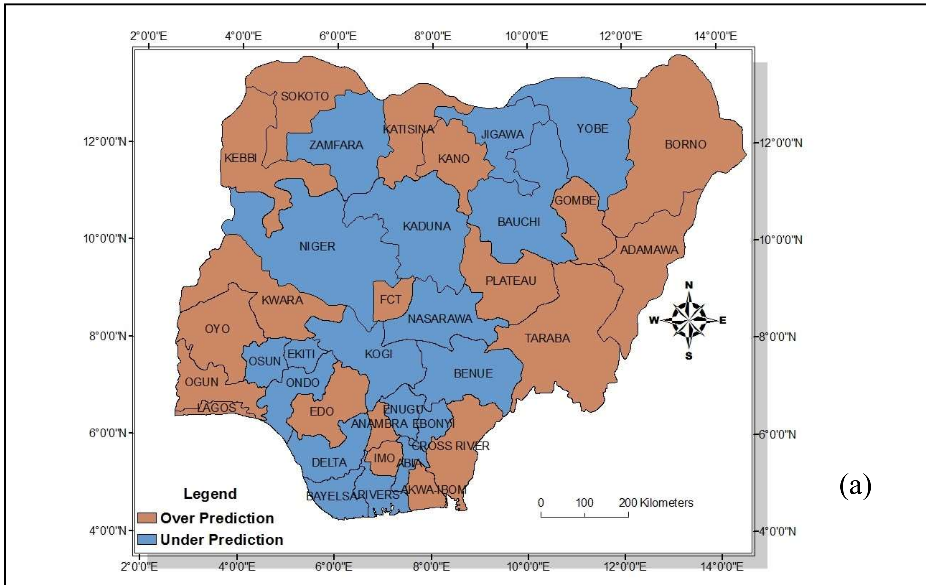
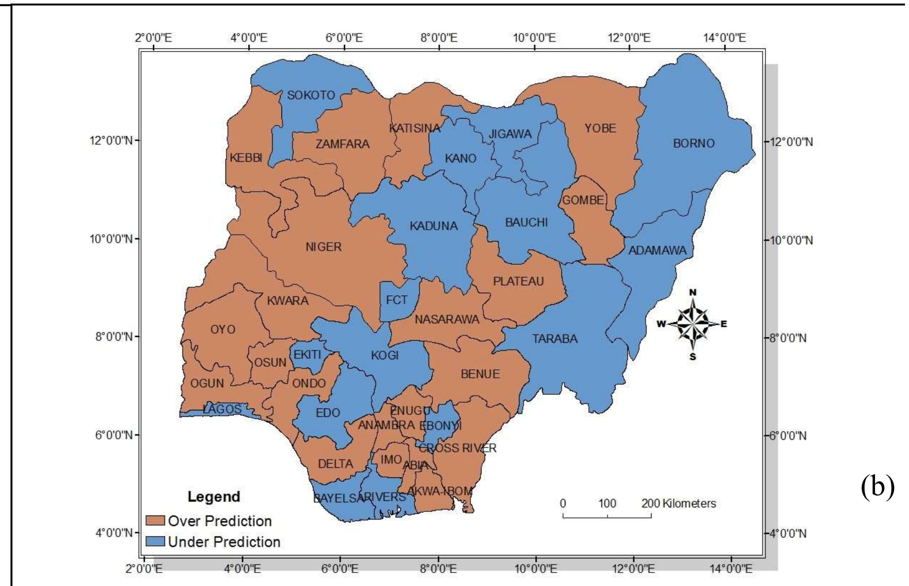


Figure 4.21a-c: CMR Residual Maps for (a) 2003, (b) 2008 and (c) 2013, respectively





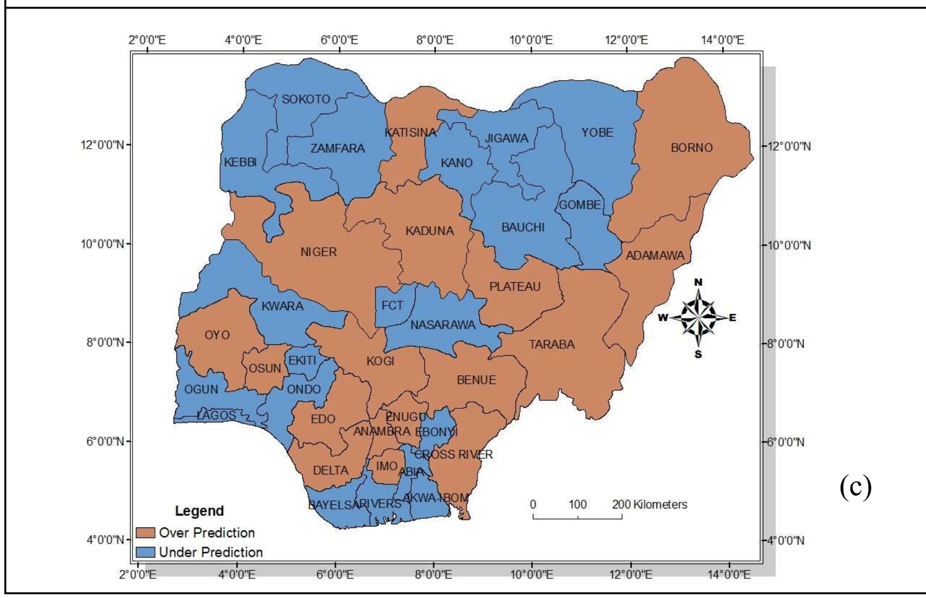


Figure 4.22a-c: U5MR Residual Maps for (a) 2003, (b) 2008 and (c) 2013, respectively

4.13.5 Stepwise regression results (World Bank, 1990-2014)

A multiple stepwise regression was carried out to identify the determinants that most explain the temporal variations/trends in infant and under 5 mortality rates in Nigeria. Results indicated that 3 variables: urban population, DPT vaccination and inflation were significant predictors of IMRs accounting for 99.7% of the variance in IMR (Table 4.23). All 3 models were significant ($p<.001$). Results suggest that IMR decreased as the urban population (Beta= -.995, $p<.001$) and proportion receiving DPT vaccinations (Beta= -.050, $p<.001$) increased and as inflation fell (Beta= .039, $p<.001$). With regards to under 5 mortality, results identified the same 3 variables as significant predictors of infant mortality rate accounting for 99.7% of the variance in U5MR. All 3 models were significant ($p<.001$). Results suggest that U5MR decreased with the increase in urban population (Beta= -.952, $p<.001$) and proportion receiving DPT vaccinations (Beta= -.052, $p<.001$) and decrease in inflation (Beta= .043, $p<.001$).

The R^2 change showed that the urban population variable accounted for a significant proportion of the variance in IMR: Shared $(-.997)^2$=99.4%; Part $(-.744)^2$= 55.4%. Also, the urban population variable accounted for a significant proportion of the variance in U5MR: Shared $(-.997)^2$=99.4%; Part $(-.742)^2$= 55.1%. An examination of the bivariate correlation matrix showed that the 'urban population' variable' and 'access to improved water sources' variable are highly correlated ($r= .991$, $p=.000$). This suggested that the urban population variable may have unduly influenced the regression results. This was investigated by conducting the analysis again without this variable. Results indicated that 4 variables: access to improved water sources, access to improved sanitation services, DPT vaccination and inflation were significant determinants accounting for 99.6% of the variance in both infant and under 5 mortality (Table 4.24). The results therefore suggest that the 'urban population' variable was indeed concealing the impact of the 'access to improved water sources' variable on both infant and under 5 mortality which is a more relevant determinant of mortality. On one hand, an increase in urban population suggests better access to improved water sources and health care which could explain the increase in access to improved water sources and DPT vaccinations as well as the decline in infant and under 5 mortality over time. On the other hand, overcrowding due to the increase in urban population might explain why access to improved sanitation services fell over time and why it is negatively though highly associated with the decline in both infant and under 5 mortality rates over time.

Table 4.23

Stepwise Regression Results for IMR in Nigeria (World Bank)						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1						
(Constant)	.994	.994	3995.004	232.582	2.063	
Urban Pop				-3.461	.055	-.997
Model 2						
(Constant)	.996	.002	9.336	232.865	1.770	
Urban Pop				-3.385	.053	-.975
DPT				-.080	.026	-.047
Model 3						
(Constant)	.997	.001	8.767	229.641	1.871	
Urban Pop				-3.313	.052	-.955
DPT				-.086	.023	-.050
Inflation (CPI)				.041	.014	.039
Stepwise Regression Results for U5MR in Nigeria (World Bank)						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1						
(Constant)	.994	.994	3656.091	409.461	3.982	
Urban Pop				-6.392	.106	-.997
Model 2						
(Constant)	.996	.002	8.699	409.994	3.452	
Urban Pop				-6.249	.104	-.975
DPT				-.151	.051	-.048
Model 3						
(Constant)	.997	.001	9.499	403.528	3.605	
Urban Pop				-6.104	.100	-.952
DPT				-.164	.044	-.052
Inflation (CPI)				.081	.026	.043
Calculated by Author						

Table 4.24

Stepwise Regression Results for IMR (World Bank)*						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1						
(Constant)	.971	.971	774.413	221.096	4.277	
Water				-2.174	.078	-.985
Model 2						
(Constant)	.994	.023	80.765	1743.390	169.401	
Water				-11.707	1.061	-5.307
Sanitation				-30.107	3.350	-4.324
Model 3						
(Constant)	.996	.003	14.344	1344.133	170.220	
Water				-9.139	1.078	-4.143
Sanitation				-22.183	3.371	-3.186
DPT				-.119	.031	.069
Model 4						
(Constant)	.997	.001	4.696	1377.599	157.725	
Water				-9.330	.998	-4.230
Sanitation				-22.894	3.126	-3.288
DPT				-.117	.029	-.068
Inflation (CPI)				.032	.015	.031
Stepwise Regression Results for U5MR (World Bank)*						
Key Predictors	R^2	R^2 Change	F Change	B	SE	β
Model 1						
(Constant)	.971	.971	775.509	388.314	7.893	
Water				-4.015	.144	-.985
Model 2						
(Constant)	.993	.022	72.918	3166.243	325.339	
Water				-21.412	2.038	-5.255
Sanitation				-54.941	6.434	-4.272
Model 3						
(Constant)	.996	.003	14.552	2396.190	325.955	
Water				-16.458	2.063	-4.039
Sanitation				-39.657	6.455	-3.084
DPT				-.229	.060	.072
Model 4						
(Constant)	.997	.001	5.383	2463.869	297.910	
Water				-16.846	1.884	-4.134
Sanitation				-41.095	5.904	-3.196
DPT				-.226	.055	-.071
Inflation (CPI)				.064	.028	.034

*Without Urban Population Variable
Calculated by Author

4.14 Summary

This third section has examined the impact of selected determinants on the spatial and temporal pattern of infant, child and under 5 mortality rates in Nigeria over time. Findings showthat in 2003, poverty (Partial=28%; Part=18%) and the proportion breastfed for 6 months or more (Partial=22%; Part=13%) explained 54% of the spatial pattern of IMRs across Nigeria. In addition, results showed a fairly high positive correlation between poverty and IMR (r=.642) and a fairly high negative correlation between breastfeeding and IMR (r= -.601). This indicates that a decline in poverty and an increase in the proportion of children breastfed 6 months or more would significantly reduce IMR across states.

In 2008, breastfeeding (Partial=39%; Part=34%) as well as 4 or more antenatal care visits (Partial=24%; Part=17%) were key predictors of infant mortality, explaining 46% of the spatial variations in IMRover Nigeria. Breastfeeding and birth interval were also found to be negatively and positively correlated with IMR, respectively. In 2013, five variables accounted for 64% of the disparities in IMR across states. However, in terms of individual contribution, poverty accounted for 39.3% of the variance in IMR, followed by at least 4 antenatal care visits (12.8%), breastfeeding for 6 months or more (8%), diarrhea prevalence (8%) and birth intervals less than 24 months (7%). Overall, poverty and duration of breastfeeding exerted the most influence on the pattern of IMR across states in Nigeria during the 15 year period covered by the NDHS surveys.

With respect to child mortality, findings indicate that in 2003, antenatal care visits of 4 or more explained 54% of the spatial pattern of CMRs across states in Nigeria. In addition, results showed a high negative correlation between the number of antenatal care visits and CMR (r= -.735) which suggests that CMRs would reduce as more women receive antenatal care at least 4 times during their pregnancy. In 2008, the proportion of births protected from neonatal tetanus (Partial=61.2%; Part=54%) and birth interval (Partial=26%; Part=12%) explained 66% of the spatial pattern of CMRs across states in Nigeria. PAB in particular had a high negative correlation with CMR (r = -.736) while birth interval had a positive correlation with CMR (r=.351).Hence findings indicate that encouraging women to receive the tetanus toxoid injection during pregnancy and increasing intervals between births would potentially have reduced CMRs. In 2013, poverty accounted for 73% of the pattern of child deaths across states in Nigeria.In addition, results showed a very high negative correlation between poverty and CMR (r = -

.853) which indicates that lowering levels of poverty would lead to significant improvements in the rate of child survival.

With regards to under 5 mortality, findings show that in 2003, health care delivery (Partial=56.6%; Part=31.9%), breastfeeding (Partial=42%; Part=18%) and knowledge of MTCT of HIV/AIDS (Partial=12%; Part=3.4%) explained 76% of the spatial variations of U5MRs across states in Nigeria. In addition, these health care determinants had a negative correlation with U5MRs across states in Nigeria. In 2008, four variables accounted for 73% of the spatial variations in U5MRs across states.However, in terms of individual contribution, breastfeeding for 6 months or more accounted for 24% of the variance in U5MR, followed by antenatal care visits of 4 or more (10%), access to improved sanitation services (9%) and the use of solid fuels in cooking (5.4%).In 2013, five variables accounted for 78% of the spatial variations in U5MR across states.In terms of individual contribution, poverty accounted for 33% of the variance in U5MR, followed by birth intervals less than 24 months (12%), antenatal care visits of 4 or more (8%), prevalence of diarrhea (5%) and the access to improved sanitation services (4%). In general, findings indicate that breastfeeding, antenatal care, birth interval and poverty were the most important factors influencing infant, child and under 5 mortality rates across statesduring the 15 year period covered by the three surveys. Residual maps also indicated that variables examined explained infant, child and under 5 mortality patterns in Nigeria well. However, there might be other factors not examined here that also had significant influence on mortality rates in Nigeria during this period such as political factors.

Overall, findings indicate that encouraging long term breastfeeding, regular antenatal care during pregnancy, educating women on the spacing of births and improving the socioeconomic status of women would significantly reduce mortality rates across states in Nigeria. In addition, analysis based on the World Bank datasets, indicate that increase in urban population, increase in the proportion of children receiving DPT vaccinations and a decrease in inflation played a significant role in the reduction of infant and under 5 mortality rates observed nationally over time. Hence, encouraging child vaccinations, improving living conditions in urban areas and improvements in the macro economy would also significantly reduce mortality rates in Nigeria.

4.15 Socioeconomic inequality in infant, child and under 5 mortality in Nigeria

This fourth section examines the problem of socioeconomic inequalities (or disparities) in infant, child and under 5 mortality in Nigeria over space and time. However, socioeconomic inequality is an ethical concept in the sense that it involves arguments as to whether observable differences in health outcomes are due to unfair/unjust circumstances. As a result, they can only be assessed or evaluated indirectly by measuring socioeconomic inequalities (i.e. disparities/inequalities in health outcomes linked to differences in socioeconomic status). Socioeconomic inequalities in infant, child and under 5 mortality are therefore examined here using a combination of simple pair wise measures (rate ratio and rate difference) and more complex/composite measures (SII, CI and PAF). Findings from these measures are discussed and compared to determine whether inequalities (both absolute and relative) in all three mortality rates by key socioeconomic status indicators (wealth, child's sex, mother's education, mother's age and religion) have increased, decreased or remained stable (unchanged) over space and time in Nigeria.

Table 4.25 presents guidelines for interpretation of relative and absolute inequality measures. It is also important to note that Low and Low (2004); Houweling et al (2007) and Mackenbach (2015) have shown mathematically that absolute inequalities usually decrease when overall mortality rates fall over time across groups while relative inequalities tend to increase when one group has a larger proportional reduction (or increase) in mortality compared to other groups over time. Both relative and absolute inequalities tend to increase when one group has a larger proportional and absolute reduction (or increase) in mortality compared to the other groups over time.

4.16 Relative and absolute inequalities in infant mortality rate in Nigeria

4.16.1 Wealth-based relative inequalities in IMR (rate ratio)

Table 4.26 shows the Rate Ratio (RR) and Rate Difference (RD) indicating inequalities in IMRs by wealth groups in Nigeria. In 2003, the RR indicates that two times (1.91) more infants died in the most disadvantaged or poorest homes compared to the most advantaged or richest homes. In both rural and urban areas, IMR was twice as high (1.66 and 1.97, respectively) among infants in the poorest homes. Regionally, poor/rich inequality in IMR was highest in the Southeast where 12 times more infants died in the poorest homes compared to the richest or better off homes. Fourteen states had poor/rich RRs greater than one indicating inequalities in favour of better off groups. The highest

Table 4.25: Interpretation of Inequality Measures and Reference Groups

	Inequality Measures	Reference Group/Description	Interpretation
1	Range Measures (Rate Ratio and Rate Difference)	Wealth Index (Rich), Child's Sex (Female), Mother's Education (Secondary and Higher) Mother's Age (>34 years) Religion(Christian)	RR>1(Mortality rate higher in non-reference group, hence distribution favours the reference group) RR<1(Mortality rate higher in reference group, hence distribution favours the non-reference group) RR=1(Mortality rate about the same in both groups) RD>0(Gap in Mortality rate between both groups favours the reference group) RD<0(Gap in Mortality rate between both groups favours the non-reference group) RD=0(No gap in Mortality rate between both groups)
2	PAF and PAF (%)	Reference group is the group with lowest observed mortality rate.	The difference between the general rate (e.g. state rate) and the lowest observed group rate expressed as a percentage of the general rate. The higher the PAF the more pronounced the level of inequality.
	PAF(absolute)		PAF (%) multiplied by the general rate such as the state rate.
	Avoidable death count (i.e. deaths attributable to SES)		PAF (%) multiplied by the number of deaths.
3	Concentration Index and curve	Derived by plotting the cumulative proportion of mortality against the cumulative proportion of live births ranked by SES indicator	Negative CI (mortality concentrated among disadvantaged or worse off groups); positive CI (mortality concentrated among advantaged or better off groups) and CI=0 (burden of mortality distribution proportionate amongst groups)
4	Slope Index of Inequality (SII)	Derived by regressing mortality rate on the cumulative proportion of live births ranked by SES indicator using a weighted least square method	Value indicates the absolute change in mortality of moving from the most disadvantaged to the least disadvantaged SES group. Negative value indicates mortality is more prevalent among the most disadvantaged group

inequality was inAnambra state where about eleven times (10.73) more infants died in the poorest homes than in the richest homes. In contrast, 7 states had a poor/rich RR of about one indicating little or no inequality in IMR between infants in the poorest and richest homes while Ondo (0.37), Jigawa (0.24) and Bayelsa (0.21) had a poor/rich RR less than one indicating inequalities in favour of the poorest group.

In 2008, infant mortality was about the same in its distribution by wealth with a poor/rich ratio of 1.41 indicating some inequality between infants in the poorest and richest homes. In urban areas, two times (1.82) more infants died in the poorest homes while in rural areas there was relatively less inequality or disparity (1.18) between wealth groups. Regionally, two times more infants died in the poorest homes except in the Northwest, Southeast and Southsouth. Across states, 17 states had poor/rich RRs greater than one indicating inequalities in favour of the rich. The highest inequality was in Osun state where about six times (6.15) more infants died in the poorest homes than in the richest homes. In contrast, 16 states had a poor/rich RRof about one while 4 states including the Federal Capital Territory had a poor/rich RR less than one.

In 2013, two times (1.51) more infants died in the poorest homes compared to the richest homes. In urban areas, two times (1.73) more infants died in the poorest homes while in rural areas there was much smaller disparity (1.29) between wealth groups. Regionally, two times more infants died in the poorest homes except in the Southwest (0.56) and Northcentral region (1.21). Fifteen states had poor/rich RRs greater than one. The highest inequality was in Yobe state where about seven times (7.07) more infants died in the poorest homes. In contrast, 16 states had a poor/rich RR of about one while 5 states including the Federal Capital Territory had a poor/rich RR less than one.

4.16.2 Wealth-based absolute inequalities in IMR (rate difference)

In 2003, the difference in IMR between infants in the poorest and richest homes nationally was 53 deaths per 1,000 live births. The poor-rich RD in IMR in rural and urban areas was 45 and 52 deaths per 1,000 live births, respectively in favour of the rich. Regionally, the poor-rich gap was highest in the Southeast (145 deaths per 1,000 live births). At the state level, 27 states had a positive RD indicating that the difference in IMR by wealth was in favour of the better off. The highest poor-rich gap was in Anambra state (227 deaths per 1,000 live births). In contrast, 8 states had a negative RD indicating thatthe difference in IMR was in favour of the poor with the highest poor-rich gap in Jigawa

Table 4.26: Rate Ratio and Rate Difference indicating Wealth based Relative and Absolute Inequality in IMR in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	1.97	1.82	1.73	51.9	41.3	34.9
	Rural	1.66	1.18	1.29	45	12	16.9
Regions	Northcentral	2.26	1.5	1.21	69.4	27.5	10.7
	Northeast	1.54	1.88	1.54	36.7	40.5	25.6
	Northwest	1.46	1.39	1.92	35	21.5	38.8
	Southeast	12.01	1.16	1.73	145.3	12.3	43
	Southsouth	1.81	1.24	1.45	53.3	15.1	22.3
	Southwest	1.72	1.48	0.56	33.2	22.2	-22.9
States	Abia	N/A	1.31	0.76	166.7	25.2	-19.3
	Abuja	N/A	0.51	0	0	-33.8	-50.6
	Adamawa	2.41	1.98	1.62	101	57.4	37.7
	Akwa Ibom	N/A	1.38	1.73	117.6	21.7	36.8
	Anambra	10.73	0.71	1.53	226.7	-15.2	28.2
	Bauchi	1.2	1.58	2.94	11.8	28	61.6
	Bayelsa	0.21	1.41	0	-197.4	36.2	-48.5
	Benue	1.75	1.46	1.17	60.5	32.5	10.6
	Borno	0.99	2.07	0.44	-1	51.4	-24.4
	Cross River	3.75	1.43	0.73	91.7	15.6	-17.8
	Delta	3.12	1.29	3.3	179.8	24	97.2
	Ebonyi	N/A	1.3	4.88	N/A	22.3	87.2
	Edo	0	1.59	1.83	-142.9	36.3	22.1
	Ekiti	2.33	2.27	0	63.5	49.4	-48.5
	Enugu	3.87	1.19	0.79	92.7	12.9	-14.1
	Gombe	1.63	1.35	0.89	33.4	17.8	-7.7
	Imo	N/A	0.28	2.69	166.7	-86.9	106.5
	Jigawa	0.24	0.65	1.79	-379	-28.8	38.4
	Kaduna	2.56	1.67	1.89	102.6	36.3	15.2
	Kano	1.12	1.9	1.78	11.4	45.2	35.3
	Katsina	1.14	1.07	1.1	10.9	4.5	4.7
	Kebbi	1.48	1.21	1.03	28.2	11.2	2.8
	Kogi	7.49	0.75	0.64	173.3	-15.7	-12.9
	Kwara	N/A	0.77	1	0	-6.7	-0.2
	Lagos	0	0	N/A	-52.4	-53.5	N/A
	Nasarawa	0.79	1.51	1.07	-51.3	24.7	3.8
	Niger	1.96	1.55	1.02	29.9	32.7	1
	Ogun	2.09	2.01	0.91	49	54.3	-4.5
	Ondo	0.37	0.42	1.05	-104.2	-23	2.5
	Osun	0	6.15	1.66	-41.7	61.3	24.9
	Oyo	N/A	1.76	0.09	47.6	36	-47.2
	Plateau	1.81	2.23	1.07	46.3	46.3	4.5
	Rivers	3.4	1.12	1.13	124.6	6.8	8.6
	Sokoto	N/A	1.23	1.66	77.8	16.5	34.4
	Taraba	N/A	5.76	1	178.1	72.4	-0.3
	Yobe	1.35	1.51	7.07	16.4	22	58.3
	Zamfara	N/A	1.9	1.75	144.3	35.2	49.2
National		1.91	1.41	1.51	53.4	23.4	25.7

Note: RR is unit less; RD retains the same unit as infant mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

state (379 deaths per 1,000 live births). In 2008, the difference in IMR between infants in the poorest and richest homes nationally was 23 deaths per 1,000 live births. The poor-rich RD was significantly higher in urban than in rural areas (41 and 12 deaths per 1,000 live births, respectively) in favour of the rich. Regionally, the poor-rich gap was highest in the Northeast and smallest in the Southeast (41 and 12 deaths per 1,000 live births, respectively). At the state level, 29 states had a positive RD with the highest gap in Taraba state (72 deaths per 1,000 live births) as shown in Table 4.26. In contrast, 8 states had a negative RD with the highest gap in favour of the poor in Imo state (87 deaths per 1,000 live births).

In 2013, the difference in IMR between the poor and rich nationally was 26 deaths per 1,000 live births. The poor-rich RD was twice as high in urban areas than in rural areas (35and 17 deaths per 1,000 live births, respectively) in favour of the rich. Regionally, the poor-rich gap was highest in the Northwest and smallest in the Northcentral region (39 and 11 deaths per 1,000 live births, respectively). At the state level, 23 states had a positive RD with the highest gap in favour of the rich in Imo state (107 deaths per 1,000 live births). In contrast, 14 states had a negative RD with the highest gap in favour of the poor in Lagos state (56 deaths per 1,000 live births).

4.16.3 Relative inequalities in IMR by child's sex (rate ratio)

Table 4.27 shows the RR and RD indicating inequalities in IMRs by child's sex in Nigeria. In 2003, IMR was about the same in its distribution by sex between male and female infants nationally with a male/female ratio of 1.19 indicating little inequality in IMR by sex. Regionally, two times more boys died before the age of one compared to girls in the Southeast (2.62) and Southsouth (1.51). Twelve states had a male/female ratio greater than one indicating inequalities in favour of female children. The highest inequality in IMR by sex was in Cross River state where about five times (4.90) more male infants died. In contrast, 14 states had a male/female ratio of about one indicating little to no inequality in IMR irrespective of sex while 6 states had a RR less than one indicating inequalities in favour of male children.

In 2008, there was little inequality or disparity in IMRs between male and female infants nationally (1.18) as well as across regions (ranging from 1.11 in the Southsouth to 1.24 in the Northcentral region). At the state level, there was little to no inequality in IMRs regardless of sex except in 10 states. The highest inequality was in Osun state where three

Table 4.27: Rate Ratio and Rate Difference indicating Sex based Relative and Absolute Inequality in IMR in Nigeria.

Location		Rate Ratio (RR)			Rate Difference (RD)		
		2003	2008	2013	2003	2008	2013
Residence	Urban	0.98	1.02	1.28	-1.6	1.3	12.7
	Rural	1.25	1.23	1.16	22.1	15.9	10.2
Regions	Northcentral	0.83	1.24	1.01	-16.3	15.1	0.8
	Northeast	1.21	1.13	1.14	18.7	9.7	8.41.2
	Northwest	1.2	1.22	1.27	17.5	14.5	17.4
	Southeast	2.62	1.14	1.27	49.3	10.6	17
	Southsouth	1.51	1.11	1.21	40	7	9.4
	Southwest	0.84	1.21	1.1	-9.9	10	4.9
States	Abia	N/A	1.06	1.2	71.4	4.6	14.2
	Abuja	N/A	1.13	1.19	0	7.7	9.2
	Adamawa	1.72	1.29	0.92	79.3	25.7	-6.3
	Akwa Ibom	1.4	0.8	1.34	22.5	-14.9	16.8
	Anambra	2.07	1	2.46	19.5	0.1	52.1
	Bauchi	1.93	0.72	1.3	56.9	-26.1	20.9
	Bayelsa	0.44	1.86	0.97	-80.4	57.9	-1.2
	Benue	1.06	1.49	1.04	5.8	37.7	2.6
	Borno	1.05	1.36	1.62	5.1	26.9	12.4
	Cross River	4.9	1.94	1.47	84.7	28.2	15.5
	Delta	0.93	0.95	1.59	-9.6	-3.9	27.2
	Ebonyi	2.16	1.62	1.12	139.3	43.6	9.7
	Edo	2.67	1.27	0.96	49	17.8	-1.3
	Ekiti	0	0.78	0.95	-176.5	-12.2	-2.6
	Enugu	1.06	0.85	1.53	3.9	-12.9	27
	Gombe	1.21	1.44	1.11	16.2	22	7.3
	Imo	0	1.21	0.7	-13.3	19.5	-25.4
	Jigawa	0.57	0.95	1.41	-66.9	-2.6	29.6
	Kaduna	0.87	0.85	1.41	-14.1	-11.7	12.5
	Kano	0.96	1.45	1	-3.4	34.6	-0.2
	Katsina	2.08	1.14	1.38	53.6	8.5	15.6
	Kebbi	3.73	1.18	1.25	96.8	9.9	19.6
	Kogi	0.29	2.68	0.33	-73.3	46.5	-38.6
	Kwara	N/A	0.61	1.13	0	-15.3	6.5
	Lagos	2.06	0.84	1.49	35.3	-9.2	22.5
	Nasarawa	0.79	1.58	1.47	-44.5	27.6	22.6
	Niger	1.36	1.04	1.04	23.5	2.9	1.8
	Ogun	0.52	1.71	1.36	-49.4	36.8	16.5
	Ondo	0.23	1.05	1.06	-128.2	2.1	3.6
	Osun	N/A	3.38	0.97	66.7	31.6	-1
	Oyo	N/A	1.56	0.69	18.2	24.9	-15.3
	Plateau	0.44	1.02	1.05	-71.4	1.2	3.2
	Rivers	2.47	0.84	1.02	107.6	-11.2	1
	Sokoto	0.86	1.69	1.12	-12.3	42.8	9
	Taraba	0.48	1.76	1.1	-101.1	42.1	7.3
	Yobe	2.15	0.97	0.87	41.2	-1.8	-8.4
	Zamfara	1.63	1	1.57	60.9	-0.2	47.5
National		1.19	1.18	1.19	15.9	11.7	11

Note: RR is unit less; RD retains the same unit as infant mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

times (3.38) more male infants died. In 2013, little disparity in IMRs by sex was observed nationally (1.19) as well as regionally (ranging from 1.01 in the Northcentral to 1.27 in the Northwest and Southeast). Similarly, there was little to no inequality in IMRs by sex at the state level except in 5 states with the highest inequality in Anambra state (2.46).

4.16.4 Absolute inequalities in IMR by child's sex (rate difference)

In 2003, the difference in IMR between male and female infants was 16 deaths per 1,000 live births. The difference in IMR in rural areas was 22 deaths per 1,000 live births in favour of females and 2 deaths per 1,000 live births in favour of males in urban areas. Regionally, the male-female gap was highest in the Southeast and smallest in the Southwest (49 and 10 deaths per 1,000 live births, respectively) in favour of male infants. At the state level, 23 states had a positive RD with the highest male-female difference in favour of of the female infants in Ebonyi state (139 deaths per 1,000 live births). In contrast, 14 states had a negative RD with the highest male-female difference in favour of male infants in Ekiti state (177 deaths per 1,000 live births).

In 2008, the difference in IMR between male and female infants in Nigeria was 12 deaths per 1,000 live births. The difference in IMR was much higher in rural areas than in urban areas (16 and 1.3 deaths per 1,000 live births, respectively) in favour of females. Regionally, the male-female gap was highest in the Northcentral region and smallest in the Southwest (15 and 10 deaths per 1,000 live births, respectively). At the state level, 25 states had a positive RD with the highest in Bayelsa state (58 deaths per 1,000 live births) while 12 states had a negative RD with the highest in Bauchi state (26 deaths per 1,000 live births) as shown in Table 4.27

In 2013, the difference in IMR between male and female infants in Nigeria was 11 deaths per 1,000 live births. The difference in IMR in rural and urban areas was 10 and 13 deaths per 1,000 live births, respectively in favour of females. Regionally, the male-female gap was highest in the Northwest and smallest in the Southwest (18 and 10 deaths per 1,000 live births, respectively). At the state level, 27 states had a positive RD with the highest in Anambra state (52 deaths per 1,000 live births) while 10 states had a negative RD with the highest in Kogi state (39 deaths per 1,000 live births).

4.16.5 Relative inequalities in IMR by mother's education (rate ratio)

Table 4.28 shows the RR and RD indicating inequalities in IMRs by Mother's Education in Nigeria. In 2003, two times (1.68) more children died among mothers with no educationcompared to those with secondary or higher education. In urban areas, three times (3.20) more infants died among mothers with no education while in rural areas there was little disparity in IMR (1.13) irrespective of the level of education of their mothers. Regionally, about seven times (6.79) more infants died among mothers with no education compared with those with secondary or higher education in the Southeast. Across states, 11 states had RRs greater than one indicating inequalities in favour of children born to mothers with secondary or higher level of education. The highest inequality was in Benue state where eight times (8.27) more children under one died among mothers with no education. In contrast, 11 states had a RR less than one indicating inequalities in favour of children born to mothers with no education.

In 2008, the RR of 1.34 indicates that mother's level of education did not have too much of an impact on IMRs nationally. Regionally, about two times more infants died among mothers with no education compared with those with secondary or higher education in the Northeast, Southeast and Southwest. At the state level, 15 states had RRs greater than one with the highest inequality in Niger state where about eight times (7.76) more infants died among mothers with no education compared with those with secondary or higher education. In contrast, 7 states had a RR less than one while 14 states had a RR equal to one. In 2013, the RR of 1.46 indicates some inequality in IMRs by mother's level of education nationally. Regionally, about two times (2.11) more infants died among mothers with no education in the Northwest while RRs indicate significantly less inequality in IMR by mother's level of education in other regions. At the state level, 9 states had RRs greater than one with the highest inequality in Ekiti state where five times (5.25) more infants died among mothers with no education. In contrast, 4 states had a RR less than one while 21 states had a RRof about one.

4.16.6 Absolute inequalities in IMR by mother's education (rate difference)

In 2003, the difference in IMR between infants born to uneducated mothers and those with secondary and higher education in Nigeria was 41 deaths per 1,000 live births. The difference in IMR between both groups was substantially higher in urban areas than in rural areas (73 and 11 deaths per 1,000 live births, respectively) in favour of the most educated group. Regionally, the RD was highest in the Northcentral region (66 deaths per 1,000 live births) in favour of the most educated group and smallest in the Southwest (16 deaths per 1,000 live births) though in favour of the uneducated group, hence the negative sign. At the state level, 18 states had a positive RDin favour of the most educated group.

Table 4.28: Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in IMR by Mother's level of education in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	3.2	1.28	1.38	72.8	13.7	16.3
	Rural	1.13	1.17	1.24	11.4	11.7	14.3
Regions	Northcentral	3.01	1.35	1.03	66.4	20.3	1.6
	Northeast	1.29	1.84	1.15	21.7	37.3	8.6
	Northwest	2.45	1.22	2.11	63.2	13.6	42.2
	Southeast	6.79	1.56	1.18	110	43	10.5
	Southsouth	0.56	1.11	1.37	-44.2	7.2	17.6
	Southwest	0.67	1.94	0.71	-16.3	38.1	-12.3
States	Abia	N/A	0	0	0	-61.9	-85.9
	Abuja	N/A	1.29	1	0	16.5	0
	Adamawa	2.26	1.93	0.71	110	56.7	-28.7
	Akwa Ibom	1.19	0	2.96	11.2	-50.5	110.4
	Anambra	0	0	0.75	-14.5	-53.3	-12.5
	Bauchi	N/A	1.29	2.77	94.9	15.8	58.8
	Bayelsa	0	1.35	1.85	-187.5	34.3	30.7
	Benue	8.27	0.81	1.14	148.4	-21.4	8.1
	Borno	3.87	2.79	0.76	92.7	58.7	-6.7
	Cross River	0	0	1.25	-96.2	-57.4	9.3
	Delta	0	1.38	0.79	-130.4	32.4	-12.1
	Ebonyi	0.38	1.32	2.33	-250	31.6	60.5
	Edo	N/A	2.57	5.04	0	88.7	76.3
	Ekiti	0	1.85	5.25	-95.2	32.8	202.4
	Enugu	2.57	2.59	0.54	87.3	85.9	-31.4
	Gombe	0.15	1.64	2.08	-162.6	27.7	37.7
	Imo	N/A	0	N/A	N/A	-114.9	N/A
	Jigawa	N/A	N/A	1.09	126.6	47.8	7.2
	Kaduna	3.78	1.18	1.41	111	10.7	11.6
	Kano	2.92	1.36	2.19	62.1	27.5	42.8
	Katsina	0.79	0.99	1.06	-20.6	-0.6	2.8
	Kebbi	N/A	1.18	1.05	98.5	9.3	4.3
	Kogi	N/A	1.09	2.75	0	3.8	35.8
	Kwara	N/A	2.22	1.01	0	19.1	0.3
	Lagos	0	0.43	1.51	-58.8	-26.4	24.2
	Nasarawa	4.77	1.69	1.11	251.5	25.8	6.1
	Niger	1.59	7.76	0.99	24.6	75.7	-0.6
	Ogun	2	1.99	1.32	43.5	41	12
	Ondo	1.75	0.52	0.66	107.1	-27.3	-17.3
	Osun	0	3.11	0	-66.7	52.2	-31.8
	Oyo	N/A	5.05	0.13	0	101.6	-31.1
	Plateau	0	1.75	0.74	-108.1	49.7	-22.9
	Rivers	2.17	0	0.65	134.9	-69.4	-20.6
	Sokoto	N/A	1.14	1.04	71.8	10.5	3
	Taraba	N/A	4.35	0.93	121.2	72.7	-5
	Yobe	0.35	0.81	N/A	-92.2	-13.3	64.5
	Zamfara	N/A	2.7	N/A	139.3	43.4	45.4
National		1.68	1.34	1.46	40.5	19.9	22.6

Note: RR is unit less; RD retains the same unit as infant mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

The largest gap was in Nasarawa state (252 deaths per 1,000 live births). In contrast, 13 states had a negative RD in favour of the uneducated group while 6 states had a rate difference of zero indicating no absolute inequality between groups.

In 2008, the difference in IMR between infants with uneducated mothers and those with secondary and higher education in Nigeria was 20 deaths per1,000 live births. Regionally, the RD was highest in the Southeast and smallest in the Southsouth (43 and 7 deaths per 1,000 live births, respectively) in favour of the most educated group. At the state level, 26 states had a positive RD. The largest gap was in Oyo state (102 deaths per 1,000 live births). In contrast, 11 states had a negative RD. In 2013, the difference in IMR between infants with uneducated mothers and those with secondary and higher education in Nigeria was 23 deaths per 1,000 live births. Regionally, the RD was highest in the Northwest and smallest in the Northcentral region (42 and 2 deaths per 1,000 live births, respectively) in favour of the most educated group. At the state level, 21 states had a positive RD with the largest gap in Ekiti state (202 deaths per 1,000 live births) while 14 states had a negative RD with the largest gap in Abia state (86 deaths per 1,000 live births).

4.16.7 Relative inequalities in IMR by mother's age group (rate ratio)

Table 4.29 shows the RR and RD indicating inequalities in IMRs by Mother's Age Group in Nigeria. In 2003, the RR of 1.04 indicates very little inequality in IMR between infants with mothers under 20 and above 34 years old in Nigeria. In urban areas, about two times (1.59) more infants died among teenage mothers than among mothers over 34 while in rural areas there was relatively less disparity in IMRs (0.90) between both groups. Regionally, infant mortality was also about the same in its distribution between both groups with RRs close to one except in the Southwest and Southeast. At the state level, 9 states had RRs greater than one with the highest inequality in Yobe and Adamawa states where about six times (5.76 and 5.50, respectively) more infants died among teenage mothers than among mothers over 34 while Bauchi, Rivers, Benue and Borno state had a RR close to one indicating little to no inequality in IMRs between both groups.

In 2008, the RR (1.24) indicates some inequality in infant mortality by mother's age nationally. Regionally, there was little to no inequality in IMRs between both groups except in the Southeast. At the state level, 13 states had RRs greater than one with the highest inequality in Anambra state where about six times (5.63) more infants died among teenage mothers than among mothers aged 35-49. In contrast, 14 states had a RR less than one while 10 states had a RR of about one indicating no inequality by mother's age.

In 2013, the RR (1.35) indicates some inequality in IMRs by mother's age nationally. In urban areas, about two times (1.92) more infants died among teenage mothers than among mothers over 34 while in rural areas there was a much smaller disparity in IMR by mother's age (1.20). Regionally, two times more children died among mothers under 20 than among mothers over 34 except in the Northwest, Southeast and Southsouth where there was significantly less disparity between both groups. Twelve states had RRs greater than one with the highest inequality in Kwara state where six times (6.10) more infants died among teenage mothers than among mothers aged 35-49. In contrast, 10 states had a RR less than one while 15 states had a RR of about one.

4.16.8 Absolute inequalities in IMR by mother's age group (rate difference)

In 2003, the difference in IMR between infants with teenage mothers and those with mothers over 34 in Nigeria was 4 deaths per 1,000 live births. Regionally, the RD was highest in the Southeast and smallest in the Northwest (97 and 10 deaths per 1,000 live births, respectively) in favour of the children with teenage mothers as indicated by the negative sign (except in the Northeast). At the state level, 11 states had a positive RD with the largest gap in Adamawa state (409 deaths per 1,000 live births). In contrast, 15 states had a negative RD with the largest gap in AkwaIbom state (189 deaths per 1,000 live births) (Table 4.29). In 2008, the difference in IMR between infants with teenage mothers and those with mothers over 34 in Nigeria was 19 deaths per 1,000 live births. Regionally, the RD was highest in the Southeast and smallest in the Southwest (52 and 10 deaths per 1,000 live births, respectively). Most states (20) had a positive RD. The largest gap was in Anambra state (206 deaths per 1,000 live births) and the smallest in Borno state (14 deaths per 1,000 live births) while 17 states had a negative RD.

In 2013, the difference in IMR between infants with teenage mothers and those with mothers over 34 in Nigeria was 24 deaths per 1,000 live births. The difference in IMR between both groups in urban areas (55 deaths per 1,000 live births) was about 4 times larger than in rural areas (14 deaths per 1,000 live births). Regionally, the RD was highest in the Northeast and smallest in the Southeast (38 and 10 deaths per 1,000 live births, respectively). At the state level, 15 states had a positive RD with the largest gap in Kwara state (167 deaths per 1,000 live births) In contrast, 22 states had a negative RD with the

Table 4.29: Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in IMR by Mother's Age in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	1.59	1.19	1.92	40.7	12.2	55
	Rural	0.9	1.21	1.2	-10.8	18	14.3
Regions	Northcentral	0.85	1.3	1.57	-10	21	28.9
	Northeast	1.31	1.18	1.58	29.9	15.8	38.3
	Northwest	0.91	1.47	1.19	-10.1	37	14.6
	Southeast	0	0.48	0.89	-97.1	-51.9	-9.6
	Southsouth	0.81	0.8	1.49	-27.3	-14.6	25.4
	Southwest	0	1.02	1.5	-31.5	1.2	29.2
States	Abia	N/A	0	0	N/A	-134.6	-50
	Abuja	N/A	0	0	N/A	-63.5	-80
	Adamawa	5.5	1.15	1.18	409.1	17.5	12.8
	Akwa Ibom	0	1.6	2.04	-188.7	35	29.1
	Anambra	0	5.63	1.67	-76.9	205.6	66.7
	Bauchi	1.22	1.78	2.56	28.5	43.7	106.1
	Bayelsa	0	1.71	1.38	-142.9	44.6	18.3
	Benue	0.62	1.65	0	-36.4	62.5	-50
	Borno	0.83	1.13	0.43	-16.9	13.9	-31.4
	Cross River	1.86	0.7	0.98	66	-15.4	-0.9
	Delta	2	0	4.01	142.8	-94.6	140.7
	Ebonyi	N/A	0	0.84	N/A	-115.6	-19.7
	Edo	N/A	0	0	0	-70	-31
	Ekiti	N/A	2.08	0	N/A	51.9	-56.6
	Enugu	0	0.78	0.76	-83.3	-23.6	-15.8
	Gombe	0	1.28	1.29	-71.4	21.1	28.2
	Imo	N/A	0	0.99	0	-120.6	-0.4
	Jigawa	0.41	0.78	0.88	-107.7	-15.8	-10.3
	Kaduna	0.46	1.3	1.86	-96.2	22.8	31.2
	Kano	1.51	1.47	0.9	47.2	51.2	-7.2
	Katsina	4.42	1.59	0.62	129	35.7	-32
	Kebbi	2.08	4.29	0.81	86.7	107	-19.3
	Kogi	0	0.41	0.59	-135.1	-45.6	-24.9
	Kwara	N/A	3.04	6.1	0	49.7	167.2
	Lagos	0	1.63	0	-42.6	42.8	-33.2
	Nasarawa	2.43	3.5	0	84.1	89.3	-28.3
	Niger	0	0.56	2.09	-40	-35.9	61.1
	Ogun	0	0.58	0	-43.5	-40.7	-73.9
	Ondo	N/A	0	0.89	0	-38	-10.3
	Osun	N/A	1.43	0	N/A	27.3	-69
	Oyo	N/A	0.84	3.23	0	-10.8	107.9
	Plateau	N/A	3.99	2.69	0	170.3	114.1
	Rivers	1.36	0	0.68	75.2	-86.6	-28.9
	Sokoto	0	0.45	2	-103.4	-63.9	70.5
	Taraba	2.4	1.25	4.36	155.6	25	117.3
	Yobe	5.76	0.55	0.64	103.3	-31.8	-23.2
	Zamfara	0	4.91	2.27	-83.3	156.4	109.7
National		1.04	1.24	1.35	4.2	18.7	24.1

Note: RR is unit less; RD retains the same unit as infant mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

largest in Kwara state (167 deaths per 1,000 live births) while 22 states had a negative RD with the largest in the Federal Capital Territory (80 deaths per 1,000 live births).

4.16.9 Relative inequalities in IMR by religion (rate ratio)

Table 4.30 shows the RR and RD indicating religion based inequalities in IMRs in Nigeria. In 2003, the RR (1.08) indicates very little disparity in infant mortality in Nigeria between infants in Muslim and Christian homes. The pattern was the same regionally except in the Southsouth where inequality in IMR was detected in favour of the infants in Muslim homes. At the state level, Benue, Ondo and Plateau had RRs greater than one indicating inequalities in favour of children in Christian homes. Eight states had a RR of about one indicating no inequality while 10 states had a RR less than one indicating disparities in favour of infants in Muslim homes.

In 2008, the RR (1.04) indicates that religion had little to no influence on infant mortality in Nigeria. It was the same across regions as well. At the state level, 5 states had RRs greater than one. The highest inequality was in Ekiti state where two times (2.36) more children under one died in Muslim homes than in Christian homes while 17 states had a RR of about one indicating little to no inequalities. In 2013, the RR (1.11) indicates that religion had little influence on infant mortality in Nigeria. It was the same across regions as well except in the Northwest where about two times (1.69) more infants died in Muslim homes than in Christian homes. Six states had RRs greater than one with the highest inequality in Cross River state where about four times (3.71) more infants died in Muslim homes. Fourteen states had a RR of about one while 9 states had a RR less than one.

4.16.10 Absolute inequalities in IMR by religion (rate difference)

In 2003, the difference in IMR between infants born into Muslim and Christian homes was 7 deaths per 1,000 live births in favour of those from Christian homes as indicated by the positive RD. Regionally, the RD was highest in the Southsouth and smallest in the Northcentral (95 and 3 deaths per 1,000 live births, respectively) though in favour of the children in Muslim homes as indicated by the negative sign. At the state level, 9 states had a positive RD with the largest difference in Benue state (160 deaths per 1,000 live births) while 15 states had a negative RD with the largest difference in Kano state (114 deaths per 1,000 live births) as shown in Table 4.30.

Table 4.30: Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in IMR by Religion in Nigeria

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	1.43	0.93	0.89	22.8	-4	-5.8
	Rural	0.99	1.03	1.12	-1.2	2	7.8
Regions	Northcentral	0.97	0.92	0.78	-2.7	-6	-13.6
	Northeast	0.86	0.96	0.75	-15.9	-2.9	-20.6
	Northwest	0.8	0.76	1.69	-23.9	-23.2	30.2
	Southeast	N/A	1.44	0	N/A	33.8	-71.7
	Southsouth	0	0.55	1.25	-94.6	-31.8	12.3
	Southwest	0.46	1.14	0.89	-39.3	6.8	-6.1
States	Abia	0	N/A	0	-43.5	N/A	-78.1
	Abuja	N/A	0.99	0.44	0	-0.6	-40.2
	Adamawa	0.79	0.82	0.67	-34	-20	-33.5
	Akwa Ibom	N/A	N/A	0	N/A	N/A	-56
	Anambra	N/A	0	0	N/A	-47.8	-63.4
	Bauchi	1.32	0.8	N/A	21.5	-19.4	81.4
	Bayelsa	0	0	0	-103.4	-98.2	-43.7
	Benue	2.77	N/A	0	159.6	N/A	-68.3
	Borno	0.86	1.3	N/A	-17.1	20.8	27.5
	Cross River	N/A	N/A	3.71	N/A	N/A	104.4
	Delta	N/A	0	2.96	N/A	-67.2	110.3
	Ebonyi	N/A	0	0	N/A	-84	-84.3
	Edo	0	0.63	0	-61.7	-29.1	-33.2
	Ekiti	0	2.36	1.04	-60.6	53.7	2
	Enugu	N/A	1.77	0	N/A	62.3	-61.7
	Gombe	1.03	1.98	0.85	2.4	33.8	-11.8
	Imo	N/A	N/A	N/A	N/A	N/A	N/A
	Jigawa	N/A	N/A	N/A	N/A	N/A	85.4
	Kaduna	0.8	0.67	0.97	-23.7	-30.4	-1.3
	Kano	0.43	0.55	N/A	-114.3	-75.4	67.9
	Katsina	N/A	0.19	N/A	79.6	-270.6	50
	Kebbi	N/A	N/A	2.04	N/A	65.5	45.4
	Kogi	N/A	1.29	1.4	63.3	14.4	12.4
	Kwara	N/A	1.07	1.88	0	2.1	26.6
	Lagos	0.37	0.86	1.01	-46.6	-7.6	0.3
	Nasarawa	1.46	1.14	0.5	65.4	7.8	-39.8
	Niger	0.9	0.93	0.87	-8.2	-6.3	-7
	Ogun	0.46	0.94	0.99	-56.5	-4.1	-0.8
	Ondo	1.76	1.02	1.26	61.8	0.8	15.3
	Osun	0	1.96	1.32	-111.1	18.8	10.4
	Oyo	0	1.45	0.68	-23.8	20	-17.5
	Plateau	2.08	1.82	1.57	94.4	49.9	35.5
	Rivers	0	0	2.92	-128	-63.4	109.6
	Sokoto	N/A	N/A	N/A	N/A	N/A	N/A
	Taraba	0.95	1.29	0.94	-7.7	19.5	-4.4
	Yobe	N/A	N/A	N/A	60.6	56.1	58.6
	Zamfara	N/A	N/A	0.76	N/A	67.2	-34.3
National		1.08	1.04	1.11	7	2.5	6.3

Note: RR is unit less; RD retains the same unit as infant mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

In 2008, the difference in IMR between infants born into Muslim and Christian homes was 3 deaths per 1,000 live births in favour of children from Christian homes. Regionally, the RD was highest in the Southeast (34 deaths per 1,000 live births) in favour of the children in Christian homes and smallest in the Northeast (3 deaths per 1,000 live births) in favour of the children in Muslim homes. At the state level, 15 states had a positive RD with the largest gap in Zamfara state (67 deaths per 1,000 live births). In contrast, 15 states had a negative RD with the largest gap in Katsina state (271 deaths per 1,000 live births).

In 2013, the difference in IMR between infants born into Muslim and Christian homes was 6 deaths per 1,000 live births in favour of children from Christian homes. Regionally, the RD was highest in the Southeast and smallest in the Southwest (72 and 6 deaths per 1,000 live births, respectively) in favour of the children in Muslim homes. At the state level, 17 states had a positive RD with the largest in Rivers state (110 deaths per 1,000 live births) while 18 states had a negative RD with the largest in Ebonyi state (84 deaths per 1,000 live births).

4.17 Relative and absolute inequalities in child and under 5 mortality in Nigeria

4.17.1 Wealth-based relative inequalities in child and under 5 mortality rate (rate ratio)

Table 4.31 and 4.32 show the RR and RD indicating inequalities in child and under 5 mortality by wealth group in Nigeria. In 2003, two times (2.38) more children between the ages of one and five died in the most disadvantaged or poorest homes compared to the richest homes. In both rural and urban areas child mortality was twice as high (1.75 and 2.19, respectively) among children in the poorest homes. Regionally, poor/rich inequality in CMR was highest in the Southeast where 10 times more children between the ages of one and five died in the poorest homes. At the state level, 7 states had poor/rich RRs greater than one indicating inequalities in favour of the rich. The highest disparity was in Niger state where five times (5.40) more children between age one and five died in the poorest homes. Four states had a poor/rich RR of about one indicating little to no inequality in IMR by wealth while 8 states had a poor/rich RR less than one indicating inequalities in favour of the poor.

With regards to under 5 mortality, the RR (2.01) indicates that two times more under 5 children died in the poorest homes compared to the richest homes. Also, in rural and urban areas, about two times (1.67 and 1.94, respectively) more under 5 children died among the poor. Regionally, the poor/rich ratio was highest in the Southeast where about

11 times more under 5 children died in the poorest homes. At the state level, 19 states had a poor/rich RR greater than one indicating inequalities in favour of the rich. The highest was in Imo state where seventeen times (17.19) more under 5 children died in the poorest homes. In contrast, 8 states had a poor/rich RR close to or equal to one indicating little to no disparity in IMR by wealth while 4 states had a poor/rich ratio less than one indicating inequalities in favour of the poor (Table 4.32).

In 2008, child mortality was two times (2.40) higher among children in the poorest homes compared to those in the richest homes. Similarly, in rural and urban areas, two times more children died in the poorest homes (1.90 and 2.44, respectively). Regionally, two times more children died in the poorest homes except in the Northcentral, Southeast and Southsouth. Across states, 14 states had poor/rich RRs greater than one with the highest in Lagos state where four times (4.25) more children between the ages of one and five died in the poorest homes. In contrast, 17 states had a poor/rich RR close to or equal to one while 4 states including Abuja had poor/rich RR less than one (Table 4.31). With respect to under 5 mortality, about two times (1.68) more under five children died in the poorest homes than in the richest homes. In urban areas, two times (1.94) more under 5 children died in the poorest homes compared to the richest homes while in rural areas there was relatively less disparity in IMRs (1.39). Regionally, the poor/rich ratio was highest in the Northeast where about two times (1.96) more under 5 deaths occurred in the poorest homes. Seventeen states had poor/rich RRs greater than one with the highest in Taraba state (4.11). In contrast, 19 states had a RR of about one while Abuja had a RR less than one (0.42)

In 2013, about four times (3.59) more children died in the poorest homes nationally. In both rural and urban areas, three times (3.01 and 2.98, respectively) more children died in the poorest homes. Regionally, four times more children died in the poorest homes in the Northeast and Northwest while two times more children died in the poorest homes in other regions. At the state level, 18 states had poor/rich RR greater than one with the highest relative inequality in Kwara state where about eight times (7.51) more children died among the poor. In contrast, 6 states had a poor/rich RR of about one while 7 states including Abuja had a poor/rich RR less than one. With regards to Under 5 mortality, about two times (1.88) more under five children died in the poorest homes. In rural and urban areas, mortality was about two times (1.61 and 1.95, respectively) more among all under 5 children in poor homes. Across regions, two times more children under 5 died in the poorest homes except in the Southwest (0.75) and Northcentral (1.33) region. Sixteen states had poor/rich RRs greater than one with the highest in Yobe state where about twelve times (11.74) more children under 5 died in the poorest homes. In contrast, 16 states had a poor/rich RR of about one while 4 states had a poor/rich rate ratio less than one.

4.17.2 Wealth-based absolute inequalities in child and under 5 mortality rates (rate difference)

In 2003, the difference in CMR between children in the poorest and richest homes was 44 deaths per 1,000 children surviving to age one. The poor-rich RD in rural and urban areas (33 and 29 deaths per 1,000 children surviving to age one, respectively) was in favour of the rich. Regionally, the poor-rich inequality was highest in the Northwest (54 deaths per 1,000 children surviving to age one). At the state level, 19 states had a positive RD in favour of the better off group with the highest in Jigawa state (130 deaths per 1,000 children surviving to age one). In contrast, 11 states had a negative RD in favour of the poor with the highest in Bayelsa state (278 deaths per 1,000 children surviving to age one). With regards to under 5 mortality, the RD in U5MR by wealth was 90 deaths per 1,000 live births. In both rural and urban areas, the RD was 72 deaths per 1,000 live births in favour of the wealthiest group. Regionally, the RD was highest in the Southeast (168 deaths per 1,000 live births). At the state level, 28 states had a positive RD with the highest in Anambra state (227 deaths per 1,000 live births). In contrast, 5 states had a negative RD with the highest in Bayelsa state (395 deaths per 1,000 live births) as shown in Table 4.32.

In 2008 survey, the difference in CMR between children in the poorest and richest homes nationally was 34 deaths per 1,000 children surviving to age one. The poor-rich gaps in CMR in rural and urban areas was about the same but in favour of the rich. Regionally, the RD was highest in the Northwest (38 deaths per 1,000 children surviving to age one). At the state level, 28 states had a positive RD with the highest in Anambra state (83 deaths per 1,000 children surviving to age one). In contrast, 9 states had a negative RD with the highest in Abia state (39 deaths per 1,000 children surviving to age one). The difference in U5MR between children in the poorest and richest homes was 54 deaths per 1,000 live births. The RD in urban areas was significantly higher in urban than in rural areas (66 and 37 deaths per 1,000 live births, respectively) in favour of the rich. Regionally, the poor-rich gap in U5MR was highest in the Northeast (68 deaths per 1,000

Table 4.31: Rate Ratio and Rate Difference indicating Wealth based Relative and Absolute Inequality in CMR in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	2.19	2.44	2.98	28.7	29	22.4
	Rural	1.75	1.9	3.01	32.9	27.6	29.8
Regions	Northcentral	1.25	1.42	1.92	11	10.4	11.1
	Northeast	1.46	2.36	3.88	26.8	32.7	32.6
	Northwest	2.52	2.01	3.65	54.3	38	36.6
	Southeast	9.67	1.13	2.31	39	4	18.3
	Southsouth	1.32	1.19	2.07	8.4	5.4	13.3
	Southwest	1.96	1.64	1.64	18.1	7.9	6.8
States	Abia	N/A	0	6.66	0	-39	28.3
	Abuja	N/A	0	0	N/A	-17.2	-6.7
	Adamawa	N/A	1.45	2.01	55.6	16.9	11.8
	Akwa Ibom	N/A	1.51	1.96	40	23.7	7.8
	Anambra	N/A	3.56	4.58	0	83	34.7
	Bauchi	1.89	3.26	2.39	37.8	46.1	36.5
	Bayelsa	0.17	0.54	0	-277.7	-18.3	-12.7
	Benue	1.05	0.94	3.58	1.5	-1.6	22.7
	Borno	2.47	2.07	1.28	62.7	27	4
	Cross River	0	1.46	2.57	-34.5	5.7	18.5
	Delta	N/A	0.8	0	0	-4.2	-13.8
	Ebonyi	N/A	1.36	1.84	N/A	8.3	19.3
	Edo	N/A	2.59	1.87	63.8	33.2	11.9
	Ekiti	0	2.66	0	-50	33.6	-6.4
	Enugu	N/A	1.21	1.88	47.6	3	10.6
	Gombe	N/A	2.09	6.54	105.9	29.4	53.7
	Imo	0	1.39	0	-9.7	9.7	-22.4
	Jigawa	N/A	1.82	N/A	130.4	32.1	59.5
	Kaduna	1.58	3.91	0.51	14.9	50	-5.3
	Kano	2.49	2.12	2.49	52.3	53.1	27.8
	Katsina	0.84	2.22	4.8	-7.1	39.5	42.6
	Kebbi	N/A	1.32	N/A	54.4	10.7	45.7
	Kogi	0.34	1.03	2.53	-81.6	1	14.1
	Kwara	N/A	0.95	7.51	0	-0.6	48.2
	Lagos	N/A	4.25	N/A	N/A	34.8	N/A
	Nasarawa	N/A	0.62	0.92	69.8	-9.7	-2.3
	Niger	5.4	1.53	1	70.9	24.8	0
	Ogun	2.21	0.44	0	18.9	-8.7	-12.2
	Ondo	N/A	0.74	2.4	66.7	-6	29.2
	Osun	0	1.1	0	-43.5	1.2	-5.6
	Oyo	0	1.67	0.52	-29.4	5.2	-8.3
	Plateau	N/A	N/A	1.18	19.2	30.5	2.1
	Rivers	0	1.13	3.64	-46.9	3.8	34
	Sokoto	0.67	1.4	1.82	-40.7	23.6	25.9
	Taraba	N/A	2.58	N/A	16.7	24.3	27.1
	Yobe	2.06	3.87	N/A	104.6	43.6	48.1
	Zamfara	0.98	1.42	N/A	-2.8	17.1	62.6
National		2.38	2.4	3.59	43.5	33.6	31.6

Note: RR is unit less; RD retains the same unit as child mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

Table 4.32: Rate Ratio and Rate Difference indicating Wealth based Relative and Absolute Inequality in U5MR in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	1.94	1.94	1.95	71.9	65.6	55.1
	Rural	1.67	1.39	1.61	72.3	37.1	44.2
Regions	Northcentral	1.78	1.46	1.33	75.9	36.4	21
	Northeast	1.48	1.96	1.96	58.6	67.9	55.7
	Northwest	1.78	1.61	2.29	83.6	55.8	71.8
	Southeast	10.52	1.13	1.82	167.6	13.4	59
	Southsouth	1.61	1.22	1.55	56.8	19.6	33.9
	Southwest	1.55	1.49	0.75	36.6	28.3	-15.7
States	Abia	N/A	0.91	0.75	166.7	-10.4	-21.9
	Abuja	N/A	0.42	0	N/A	-49.9	-57
	Adamawa	3.06	1.76	1.67	147	71.9	47.9
	Akwa Ibom	N/A	1.49	1.64	154.8	48.9	39.6
	Anambra	10.73	1.82	1.96	226.7	66.7	59.8
	Bauchi	1.46	1.8	2.95	46.4	61.2	99.5
	Bayelsa	0.21	1.15	0	-394.7	18.8	-54.5
	Benue	2.09	1.18	1.47	88.5	19.5	33.3
	Borno	1.39	2.02	0.65	55.2	73.5	-20.2
	Cross River	1.87	1.35	0.99	58.3	16.8	-0.7
	Delta	3.12	1.2	3	179.8	19.8	106
	Ebonyi	N/A	1.31	3.29	N/A	29.3	102.9
	Edo	0.45	1.65	1.83	-79.1	53	33.2
	Ekiti	1.11	2.36	0	11.1	79	-54.5
	Enugu	5.16	1.28	0.82	134.4	22.7	-14
	Gombe	3.48	1.58	1.53	130.2	44.6	42.6
	Imo	17.2	0.67	2.02	157	-47.6	85.7
	Jigawa	0.48	1.12	2.9	-259.5	13.3	92.7
	Kaduna	2.28	2.07	1.29	114.7	78	8.1
	Kano	1.5	1.92	1.97	61.7	89.3	60.7
	Katsina	1.04	1.47	1.93	5	42.7	49.7
	Kebbi	2.32	1.25	1.52	77.8	20.7	44.5
	Kogi	1.59	0.73	1.02	86.6	-24.2	0.9
	Kwara	N/A	0.68	0.88	N/A	-12.7	-7.6
	Lagos	N/A	0.71	N/A	N/A	-18.2	N/A
	Nasarawa	1	1.21	1.02	0.7	15.7	1.5
	Niger	3.05	1.52	0.98	96	53.7	-1
	Ogun	1.62	1.76	0.75	37.1	51.7	-16.1
	Ondo	1.06	0.54	1.31	9.8	-28.6	22.1
	Osun	0	3.6	1.45	-120	61.7	19.5
	Oyo	1.7	1.7	0.19	20.6	39.1	-55.9
	Plateau	1.63	2.98	1.08	52.3	74.2	6.3
	Rivers	1.72	1.12	1.49	73.6	10.3	38.2
	Sokoto	1.24	1.31	1.56	30.6	38.5	50.1
	Taraba	0.99	4.11	1.29	-1.4	95.7	24.5
	Yobe	1.94	2.07	11.74	123	62.3	103.1
	Zamfara	1.84	1.85	2.58	124.2	58.7	104
National		2.01	1.68	1.88	89.9	53.8	54.5

Note: RR is unit less; RD retains the same unit as in under 5 mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

live births). At the state level, 30 states had a positive RD with the highest in Taraba state (96 deaths per 1,000 live births). Seven states had a negative RD with the highest in the Federal Capital Territory (50 deaths per 1,000 live births).

In 2013, the national RD in CMR by wealth was 32 deaths per 1,000 children surviving to age one in favour of the rich. The RD in rural and urban areas (30 and 22 deaths per 1,000 children surviving to age one, respectively) was in favour of the better off group. Regionally, the RD was highest in the Northwest (37 deaths per 1,000 children surviving to age one). At the state level, 26 states had a positive RD with the highest in Zamfara state (63 deaths per 1,000 children surviving to age one) while 10 states had a negative RD with the highest in Imo state (22 deaths per 1,000 children surviving to age one). With respect to U5MRs, the RD between children in the poorest and richest homes was 55 deaths per 1,000 live births. In rural and urban areas, the difference was 44 and 55 deaths per 1,000 live births, respectively in favour of the rich. Regionally, the RD was highest in the Northwest (72 deaths per 1,000 live births) in favour of the poor. At the state level, 25 states had a positive RD with the highest in Delta state (106 deaths per 1,000 live births) while 11 states had a negative RD with the highest in Oyo state (56 deaths per 1,000 live births).

4.17.3 Relative inequalities in child and under 5 mortality rate by child's sex (rate ratio)

Table 4.33 and 4.34 show the RR and RD indicating sex based inequalities in child and under 5 mortality in Nigeria. In 2003, the male/female ratio (0.97) indicates little inequality in CMR between male and female children between the ages of one and five nationally. It was the same in rural and urban areas and across regions. Across states, 6 states had a male/female ratio greater than one indicating inequalities in favour of female children. The highest was in Niger state where about fourteen times (13.59) more male children between the ages of one and five died. In contrast, 12 states had a RR of about one while 11 states had a RR less than one indicating inequalities in favour of male children. With regards to under 5 mortality, the male/female ratio (1.10) indicates much smaller levels of inequality in U5MR between male and female under 5 children. It was the same in rural and urban areas as well asacross regions except in the Southeast where two times (2.27) more male children under 5 died. Eleven states had a RR greater than one with the highest in Edo state where about five times (4.67) more males under five died. In contrast, 21 states had a RR of about one while 3 states had a RR less than one.

In 2008, there was little to no inequality in CMRs by sex nationally (1.03), across regions (ranging from 0.85 in the Southwest to 1.15 in the Northcentral region) and at the state level except in 5 states. The highest inequality in CMR by sex was in Abia state where three times (3.08) more males between the ages of one and five died. Lagos, Imo and Delta state had a RR less than one indicating inequalities in favour of male children. With regards to under 5 mortality, there was little to no inequality in U5MRs by sex nationally (1.12), in rural and urban areas (1.15 and 0.98) as well as across regions (ranging from 1.05 in the Southsouth to 1.20 in the Northcentral region). At the state level, 6 states had a RR greater than one with the highest in Osun state where two times (2.12) more males under five died. In contrast, 31 states had a RR equal to one indicating no significant inequalities in U5MR between male and female children in these states.

In 2013, there was a little disparity in CMRs by sex nationally (1.05) and across regions (ranging from 0.59 in the Southeast to 1.46 in the Southsouth). At the state level, 15 states had a male/female ratio greater than one with the highest in Plateau state where four times (4.0) more males between the ages of one and five died. In contrast, 15 states had a RRclose to or equal to one while 6 states had a RR less than one. With regards to under 5 mortality, inequalities between male and female children under five nationally was relatively low (1.14). It was the same in rural and urban areas as well as across regions (ranging from 1.00 in the Northcentral region to 1.28 in the Southsouth). At the state level, 6 states had a RR greater than one. The highest was in Anambra state where about two times (1.80) more male children under five died. In contrast, 30 states had a RR equal to one while Kogi state had a RR less than one (0.34).

4.17.4 Absolute inequalities in child and under 5 mortality rate by child's sex (rate difference)

In 2003, the difference in CMR between male and female children between the ages of one and five was 2 deaths per 1,000 children surviving to age one in favour of male children. There was very little to no difference in CMRs between male and female children in both rural and urban areas. Regionally, the male-female gap in CMR was highest in the Southsouth (16 deaths per 1,000 children surviving to age one) in favour of male children. At the state level, 14 states had a positive RDwith the highest in Bayelsa state (200 deaths per 1,000 children surviving to age one). In contrast, 20 states had a negative RD with the highest in Sokoto state (96 deaths per 1,000 children surviving to age one).

Table 4.33: Rate Ratio and Rate Difference indicating Sex based Relative and Absolute Inequality in CMR in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	0.77	0.89	1.02	-8.3	-2.9	0.3
	Rural	1.01	1.05	1.06	0.9	2.7	2
Regions	Northcentral	1.24	1.15	0.94	9.3	4.8	-1.2
	Northeast	0.86	1.07	1.05	-11.9	3.5	1.8
	Northwest	1.07	1.05	1.09	4.5	3.3	3.6
	Southeast	1.27	0.88	0.59	2.8	-4.4	-10.2
	Southsouth	0.64	0.96	1.46	-16.4	-1.2	6.4
	Southwest	0.83	0.85	1.15	-3.9	-2.3	1.8
States	Abia	N/A	3.08	0.48	0	35.7	-7.1
	Abuja	0.58	1.01	1	-59.6	0.1	0
	Adamawa	0.88	1.16	1.1	-6.1	8.3	2
	Akwa Ibom	0.68	1.11	1.82	-11.3	5.1	10.7
	Anambra	N/A	0.85	0.32	0	-7.5	-13.7
	Bauchi	1.06	1.31	0.96	5	16.7	-2.4
	Bayelsa	N/A	1.14	1.95	200	4.6	8.7
	Benue	0.24	1.29	1.02	-34	5.7	0.4
	Borno	0.79	1.08	0.5	-16.3	3.6	-14.8
	Cross River	N/A	1.42	0.71	23.8	6.4	-7.6
	Delta	0	0.44	1.77	-27	-18.5	8.6
	Ebonyi	1.1	0.84	0.91	4.5	-5.7	-3.2
	Edo	2.11	0.7	1.91	33.5	-8.4	9.6
	Ekiti	N/A	0.86	0.95	45.5	-4.1	-0.6
	Enugu	N/A	0.5	0.39	34.5	-14.6	-13
	Gombe	0.47	0.7	1.75	-65.3	-18.2	23.5
	Imo	0	0.38	0.24	-13.5	-27	-24.2
	Jigawa	1.59	1.07	0.95	58	4.8	-2.8
	Kaduna	0.4	1.34	2.11	-36.5	13.3	6.3
	Kano	2.14	0.94	0.69	40	-5.1	-13.1
	Katsina	0.79	0.96	1.91	-9.4	-2.4	27
	Kebbi	0.74	1.31	1.62	-16.6	10.8	17.8
	Kogi	0.42	0.84	0.35	-59.3	-5.2	-18
	Kwara	N/A	0.95	2.07	0	-0.5	11.1
	Lagos	1.83	0.29	1.55	9.6	-14	2.8
	Nasarawa	0.37	1.44	2.41	-37.9	8.3	19.5
	Niger	13.59	1.01	0.52	110.8	0.8	-10.6
	Ogun	0.81	0.55	1.79	-4.2	-7.8	6.6
	Ondo	0	0.94	0.36	-66.7	-1.5	-21.4
	Osun	0	0.87	N/A	-76.9	-1.7	4.7
	Oyo	0.85	N/A	1.57	-3.2	19.2	8.8
	Plateau	N/A	1.87	4	39.2	15.7	12.9
	Rivers	0.13	1.08	1.78	-77.5	2.5	9.1
	Sokoto	0	1.18	1.11	-96.4	13.6	5.4
	Taraba	3.48	1.06	1.28	33	2.6	6
	Yobe	0.74	0.97	1.18	-41.5	-1.8	6.7
	Zamfara	1.06	1.27	0.98	7.3	12.7	-1.1
National		0.97	1.03	1.05	-1.7	1.1	1.3

Note: RR is unit less; RD retains the same unit as child mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

The difference in U5MR by sex was 13 deaths per 1,000 live births in favour of female children. In rural areas, the difference in U5MR by sex was 22 deaths per 1,000 live births in favour of female children and 10 deaths per 1,000 live births in favour of male children in urban areas. Regionally, the male-female gap was highest in the Southeast (51 deaths per 1,000 live births) in favour of female children. At the state level, 20 states had a positive RD with the highest in Niger state (126 deaths per 1,000 live births) while 16 states had a negative RD with the highest in Ondo state (184 deaths per 1,000 live births) while there was no inequality in AkwaIbom state as shown in Table 4.34.

In 2008, the difference in CMR between male and female children in Nigeria was 1 death per 1,000 children surviving to age one. There was very little difference in CMR by sex in rural and urban areas as well as across regions. At the state level, 20 states had a positive RD with the highest in Abia state (36 deaths per 1,000 children surviving to age one). In contrast, 17 states had a negative RD with the highest in Imo state (27 deaths per 1,000 children surviving to age one). With respect to U5MR, the RD in Nigeria was 12 deaths per 1,000 live births in favour of female children. In rural areas, the RD was 18 deaths per 1,000 live births in favour of female children and 2 deaths per 1,000 live births in favour of male children in urban areas. Regionally, the highest RD was in the Northcentral region (19 deaths per 1,000 live births). At the state level, 25 states had a positive RD with the highest in Bayelsa state (55 deaths per 1,000 live births) while 12 states had a negative RD with the highest in Enugu state (26 deaths per 1,000 live births).

In 2013, the difference in CMR between male and female children in Nigeria was 1 death per 1,000 children surviving to age one. There was very little to no difference in rural and urban areas and across regions. At the state level, 21 states had a positive RD with the highest in Katsina state (27 deaths per 1,000 children surviving to age one). In contrast, 15 states had a negative RD with the highest in Imo state (24 deaths per 1,000 children surviving to age one) while there was no inequality in Abuja. With regatds to under 5 mortality, the difference in U5MR by sex in Nigeria was 12 deaths per 1,000 live births in favour of female children. In rural and urban areas, the difference in U5MR by sex was 12 and 13 deaths per 1,000 live births, respectively in favour of female children. Regionally, the highest RD was in the Northwest (20 deaths per 1,000 live births) while there was no inequality in the Northcentral region. At the state level, 28 states had a positive RD with the highest in Bayelsa state (44 deaths per 1,000 live births). In contrast, 9 states had a negative RD with the highest in Kogi state (56 deaths per 1,000 live births).

Table 4.34: Rate Ratio and Rate Difference indicating Sex based Relative and Absolute Inequality in U5MR in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	0.9	0.98	1.22	-10.4	-1.7	12.7
	Rural	1.15	1.15	1.12	21.5	17.8	11.7
Regions	Northcentral	0.96	1.2	1	-4.9	19.1	-0.3
	Northeast	1.04	1.1	1.1	6.4	12.1	9.5
	Northwest	1.14	1.13	1.2	21.1	16.6	20.2
	Southeast	2.27	1.06	1.08	51.4	6.2	6.6
	Southsouth	1.22	1.05	1.28	26.1	5.2	15.9
	Southwest	0.8	1.13	1.11	-17.4	7.8	6.5
States	Abia	N/A	1.34	1.1	71.4	33.8	8.1
	Abuja	0.54	1.11	1.15	-66	8.4	9
	Adamawa	1.45	1.23	0.98	70.1	31.3	-1.6
	Akwa Ibom	1	0.92	1.45	0	-9.2	26
	Anambra	2.07	0.95	1.8	19.5	-4.7	41.7
	Bauchi	1.41	0.94	1.14	54.2	-9	17.6
	Bayelsa	1.87	1.57	1.14	123.8	55.4	7.2
	Benue	0.82	1.44	1.03	-24.9	41.9	2.9
	Borno	0.94	1.25	0.99	-9.8	28.7	-0.7
	Cross River	3	1.76	1.07	85.1	34	4.1
	Delta	0.8	0.82	1.72	-32.9	-20.5	38.2
	Ebonyi	1.68	1.36	1.09	109.2	37.1	9.3
	Edo	4.67	1.15	1.08	107.9	13	3.3
	Ekiti	0.26	0.81	0.96	-131	-16.1	-2.5
	Enugu	1.6	0.77	1.25	36.2	-26	17.9
	Gombe	0.69	1.04	1.31	-58.3	3.8	29.7
	Imo	1.98	0.96	0.59	13	-5.1	-46.9
	Jigawa	1.01	1.01	1.21	2.1	1.1	25.5
	Kaduna	0.72	1.01	1.57	-46.3	1.3	19.8
	Kano	1.28	1.19	0.88	33.3	28.1	-12.9
	Katsina	1.46	1.05	1.58	42.7	6.7	40.7
	Kebbi	1.78	1.25	1.31	76.3	22.2	33.4
	Kogi	0.36	1.6	0.34	-126	38.8	-55.7
	Kwara	N/A	0.7	1.28	66.7	-15.7	16.4
	Lagos	2	0.71	1.5	44.2	-21	25.1
	Nasarawa	0.79	1.52	1.66	-54.4	34.3	40.4
	Niger	2.71	1.02	0.9	126.2	3.4	-6.7
	Ogun	0.57	0.99	1.37	-52.2	-1	19.8
	Ondo	0.17	1.01	0.82	-183.7	0.6	-16.5
	Osun	0.87	2.12	1.09	-10.2	29.7	3.4
	Oyo	1.68	1.96	0.92	14.7	42.8	-4.9
	Plateau	0.73	1.17	1.21	-34.4	15.7	15
	Rivers	1.14	0.9	1.14	23.6	-10.2	9.5
	Sokoto	0.87	1.37	1.11	-23.3	49.7	13.7
	Taraba	0.59	1.4	1.14	-88	38.8	12.6
	Yobe	0.97	0.97	1	-5.7	-3.4	0.4
	Zamfara	1.32	1.1	1.33	65.6	11.6	44
National		1.1	1.12	1.14	13.4	12.1	12

Note: RR is unit less; RD retains the same unit as in under 5 mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

4.17.5 Relative inequalities in child and under 5 mortality rate by mother's education (rate ratio)

Table 4.35 and 4.36 show the RR and RD indicating inequalities in child and under 5 mortality by mother's education in Nigeria. In 2003, four times (4.00) more children between the ages of one and five died among mothers with no education compared to those with secondary or higher education. In rural and urban areas, about three (3.34) and five (4.69) times more children, respectively died among mothers with no education. Regionally, the highest disparity was in the Southeast and Northcentral where fifteen (15.12) and twelve (12.05) times more children, respectively died among mothers with no education. Six states had RRs greater than one indicating inequalities in favour of children born to mothers with at least secondary education. The highest was in Kano state where about six times (5.86) more children between the ages of one and five died among mothers with no education. In contrast, 6 states had a RR less than one indicating inequalities in favour of children born to mothers with no education.

Two times (2.20) more children under five died among mothers with no education compared to those with secondary or higher education. In rural and urban areas, about two (1.58) and four (3.52) times more children, respectively died among mothers with no education. Regionally, the highest inequality was in the Southeast where eight times (8.10) more under 5 children died among mothers with no education. At the state level, 10 states had RRs greater than one indicating inequalities in favour of children born to mothers with secondary or higher level of education. The highest was in Nasarawa state where about six times (5.58) more children under 5 died among mothers with no education. In contrast, 8 states had a RR less than one while 8 states had a RR close to or equal to one.

In 2008, about three times (2.59) more children between the ages of one and five died among mothers with no education compared to those with secondary or higher education. Regionally, about two times more children died among mothers with no education except in the Southeast (1.12) and Southwest (0.63) where mother's level of education had relatively less impact on CMRs. Eighteen states had RRs greater than one with thehighest inequality in Benue state where six times (6.23) more children between the ages of one and five died among mothers with no education. In contrast, 8 states had a RR less than one while 8 states had a RR of about one.

About two times (1.65) more children under five diedamong mothers with no education. Similarly, about two times (1.65) more children under five died among mothers with no education in urban areas while there was relatively less disparity in U5MRs in rural areas (1.42). Regionally, two times more under 5 children died among mothers with no education except in the Northwest, Southeast and Southsouth where U5MR did not differ as much irrespective of mother's level of education. At the state level, 18 states had RRs greater than one with he highest in Zamfara state where about five times (4.70) more children under 5 died among mothers with no education. In contrast, 4 states had a RR less than one while 15 states had a RR equal to one.

In 2013, about four times (3.52) more children between age one and five died among mothers with no education compared to those with secondary or higher education. Regionally, inequalities were highest in the Southwest and Southeast where about two times more children died among mothers with no education. At the state level, 14 states had RRs greater than one with the highest in Enugu state where eight times (8.36) more children died among mothers with no education. In contrast, 11 states had a RR less than one. With respect to U5MRs, about two times (1.82) more children under five died among mothers with no education. The pattern was the same in rural and urban areas. Regionally, the highest disparity was in the Northwest where about three times (2.56) more under 5 children died among mothers with no education. At the state level, 17 states had RRs greater than one with the highest in Zamfara state where thirteen times (13.31) more children under 5 died among mothers with no education. In contrast, only Abia and Osun states had a RR less than one while 16 states had a RR of about one indicating little to no inequality.

4.17.6 Absolute inequalities in child and under 5 mortality rates by mother's education (rate difference)

In 2003, the difference in CMR between children born to uneducated mothers and those with secondary and higher education in Nigeria was 58 deaths per 1,000 children surviving to age one in favour of the most educated group. Similarly, the RD in both rural and urban areas (56 and 51 deaths per 1,000 children surviving to age one, respectively) was in favour of the most educated group. Regionally, the RD was highest in the Northwest (72 deaths per 1,000 children surviving to age one) in favour of the most educated group. At the state level, 21 states had a positive RD in favour of the most educated group. The largest gap was in Cross River and Enugu states (167 deaths per 1,000 children surviving to age one). In contrast, 8 states had a negative RD in favour of the uneducated group with the highest in Osun state (71 deaths per 1,000 children

Table 4.35:Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in CMR by Mother's level of education in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	4.69	2.77	1.61	50.6	30.2	13.4
	Rural	3.34	2.09	1.2	56.3	31.3	30.1
Regions	Northcentral	12.05	2.34	1.23	63	26.5	15.7
	Northeast	3.05	1.87	1.09	56.3	26.4	20.4
	Northwest	9.7	2.05	1.14	72.2	34.6	35.5
	Southeast	15.12	1.12	1.71	69.2	3.6	18.4
	Southsouth	0.41	2.15	1.18	-21.4	27.6	6.1
	Southwest	0.93	0.63	2.48	-1.3	-4.6	23.4
States	Abia	N/A	0	0	0	-28.3	-4.3
	Abuja	N/A	0.92	N/A	90.9	-1.3	58.8
	Adamawa	0.79	0.65	0.43	-9.9	-25.3	-18.3
	Akwa Ibom	0	2.44	0	-25.6	62.1	-17.5
	Anambra	N/A	0	6.15	0	-40.8	64.4
	Bauchi	N/A	3.46	1.61	82.2	46.4	21.2
	Bayelsa	0.93	2.22	0	-10.9	28.2	-14.9
	Benue	1.5	6.23	5.05	10.5	25.1	25.9
	Borno	2.1	2.87	N/A	36	31.6	23
	Cross River	N/A	2.2	2.81	166.7	13	20.8
	Delta	N/A	0	0	0	-27	-12.7
	Ebonyi	N/A	1.77	0	58.8	15.3	-30.7
	Edo	0	2.99	4.53	-58.8	37.7	41
	Ekiti	N/A	0	0	0	-24.1	-6.3
	Enugu	N/A	3.25	8.36	166.7	32.2	67.7
	Gombe	N/A	1.97	1.8	112.2	29.4	21.5
	Imo	0	0	N/A	-9.5	-29.6	N/A
	Jigawa	N/A	1.94	0.75	N/A	33.6	-18.4
	Kaduna	N/A	3.47	2.4	67.5	41.8	5.9
	Kano	5.86	1.58	3.95	54	30	31.6
	Katsina	2.35	N/A	N/A	28.7	66.3	45.7
	Kebbi	N/A	0.65	N/A	65.6	-19.3	37.4
	Kogi	N/A	1.05	N/A	130.4	1.4	59.7
	Kwara	N/A	0.84	N/A	0	-2.5	39.7
	Lagos	0	2.19	7.4	-15.6	11.2	33.3
	Nasarawa	N/A	2.08	N/A	66.7	14	27.2
	Niger	N/A	1.06	0.61	77.4	4.2	-9
	Ogun	2.1	0	0	24.9	-11.8	-12.8
	Ondo	N/A	1.08	0	0	2.1	-15.9
	Osun	0	0	0	-71.4	-4.2	-3.3
	Oyo	3.11	0	4.98	39.9	-9.3	44.2
	Plateau	N/A	2.19	2.63	0	20.9	8.8
	Rivers	0	3.52	0	-65	58.4	-15.2
	Sokoto	N/A	0.88	2.66	99.4	-10.9	34.5
	Taraba	N/A	4.87	N/A	27.6	43	34.2
	Yobe	N/A	N/A	N/A	152.7	63.8	44.2
	Zamfara	N/A	N/A	4.72	109.5	55.2	47.3
National		4	2.59	3.52	58.2	35.6	29

Note: RR is unit less; RD retains the same unit as child mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

surviving to age one) while 7 states had a RD of zero indicating no absolute inequality between groups. The RD in U5MR by mother's level of education in Nigeria was 93 deaths per 1,000 live births. The RD was significantly higher in urban than in rural areas (117 and 63 deaths per 1,000 live births respectively) in favour of the most educated group. Regionally, the RD was highest in the Southeast (170 deaths per 1,000 live births) in favour of the most educated group. At the state level, 23 states had a positive RD with the largest gap in Nasarawa state (305 deaths per 1,000 live births). In contrast, 11 states had a negative RD in favour of the uneducated group (Table 4.36).

In 2008, the RD difference in CMR by mother's level of education in Nigeria was 36 deaths per 1,000 children surviving to age one. The RD in rural and urban areas was about the same and in favour of the most educated group. Regionally, the RD was highest in the Northwest (35 deaths per 1,000 children surviving to age one). At the state level, 24 states had a positive RD with the largest gap in Katsina state (66 deaths per 1,000 children surviving to age one). In contrast, 13 states had a negative RD. With regards to under 5 mortality, the RD in Nigeria was 52 deaths per 1,000 live births. The RD in rural and urban areas was about the same and in favour of the most educated group. Regionally, the RD was highest in the Northeast (60 deaths per 1,000 live births). At the state level, 29 states had a positive RD with the largest gap in Edo state (119 deaths per 1,000 live births) while 8 states had a negative RD.

In 2013, the difference in CMR between children with uneducated mothers and those with secondary and higher education in Nigeria was 29 deaths per 1,000 children surviving to age one. The RD was significantly more in rural than in urban areas (30 and 13 deaths per 1,000 children surviving to age one, respectively) in favour of the most educated group. Regionally, the RD was highest in the Northwest (36 deaths per 1,000 children surviving to age one). At the state level, 23 states had a positive RD with the largest gap in Enugu state (68 deaths per 1,000 children surviving to age one) while 13 states had a negative RD. With respect to U5MR, the RD in Nigeria was 49 deaths per 1,000 live births. Also, the RD was much higher in rural than in urban areas (42 and 29 deaths per 1,000 live births, respectively) in favour of the most educated group. Regionally, the RD was highest in the Northwest (75 deaths per 1,000 live births in favour of the most educated group. Twenty-seven states had a positive RD with the largest gap in Ekiti state (196 deaths per 1,000 live births) while 9 states had a negative RD.

Table 4.36:Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in U5MR by Mother's level of education n Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	3.52	1.65	1.55	117	42.1	29
	Rural	1.58	1.42	1.57	63.2	40.2	41.7
Regions	Northcentral	4.22	1.55	1.27	124.8	43	16.4
	Northeast	1.7	1.82	1.39	71.4	60.3	28.7
	Northwest	3.24	1.44	2.56	123.6	42.6	74.5
	Southeast	8.1	1.43	1.28	169.6	44.9	20.4
	Southsouth	0.53	1.31	1.37	-62.8	28.5	23
	Southwest	0.72	1.64	1.22	-19.9	33.5	10.9
States	Abia	N/A	0	0	0	-88.2	-89.8
	Abuja	N/A	1.21	1.53	90.9	15	29.7
	Adamawa	1.31	1.31	0.65	53.4	37.9	-44.8
	Akwa Ibom	0.85	1.19	3.03	-12.9	16.7	141
	Anambra	0	0	1.21	-14.5	-91.9	12.7
	Bauchi	N/A	1.82	2.16	169.2	58.6	76.6
	Bayelsa	0.46	1.33	1.33	-169.6	39.3	16.7
	Benue	4.84	1.01	1.51	156.6	1.6	32.2
	Borno	2.95	2.73	1.56	128.2	85.3	15.8
	Cross River	1.73	0.35	1.89	70.5	-43.8	42.9
	Delta	0	1.05	0.87	-130.4	5.3	-9.2
	Ebonyi	0.53	1.29	1.59	-189.5	36.4	44.5
	Edo	0	2.61	2.79	-58.8	119.3	61.1
	Ekiti	0	1.16	4.66	-95.2	9.6	196.4
	Enugu	2.71	2.65	1	180.4	112.1	0.2
	Gombe	0.72	2.15	1.93	-53.7	67.8	56.6
	Imo	N/A	0	N/A	N/A	-141.1	N/A
	Jigawa	N/A	3.19	0.93	235.7	78.2	-10.1
	Kaduna	5.21	1.63	1.48	168.3	48	15.8
	Kano	3.6	1.43	2.55	110.8	53.5	71.9
	Katsina	1.09	1.91	1.99	10.1	60.7	46.3
	Kebbi	N/A	0.74	1.46	157.6	-34.2	38.5
	Kogi	N/A	1.02	5.58	127.7	1.6	93.8
	Kwara	N/A	2.03	1.84	0	24.2	38.1
	Lagos	0	0.73	2.06	-66.2	-15.2	55.1
	Nasarawa	5.58	1.77	1.66	305.4	38.6	36.3
	Niger	3.18	1.94	0.89	90.8	74.6	-8.3
	Ogun	1.36	1.57	1.06	24.2	30	2.7
	Ondo	1.75	0.7	0.8	107.1	-24.4	-12.5
	Osun	0	2.67	0	-133.3	48.1	-38.1
	Oyo	3.11	3.7	1.38	39.9	92.5	17.8
	Plateau	0	1.8	0.84	-108.1	66.2	-15
	Rivers	1.39	0.9	0.51	70	-9.4	-36.8
	Sokoto	N/A	1.04	1.37	164.1	6.6	36
	Taraba	N/A	4.25	1.21	150.6	107.4	17.7
	Yobe	1.33	1.65	N/A	46.9	46.6	105.8
	Zamfara	N/A	4.7	13.31	233.6	94.7	156.3
National		2.2	1.65	1.82	92.7	52.2	49.2

Note: RR is unit less; RD retains the same unit as in under 5 mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

4.17.7 Relative inequalities in child and under 5 mortality rate by mother's age group (rate ratio)

Table 4.37 and 4.38 show the RR and RD indicating inequalities in child and under 5 mortality by Mother's age group in Nigeria. In 2003, the RR (0.73) indicates some inequality in CMR in Nigeria among children between age one and five with mothers under 20 and above 34 years old. Inequalities in child mortality was in favour of children with teenage mothers in both rural (0.32) and urban (0.73) areas. Regionally, inequalities in child mortality was in favour of children with teenage mothers in the Northwest (0.95) and Northeast (0.71) and in favour of children with mothers under 20 in other regions. The highest inequality in CMR by mother's age was in Kebbi and Zamfara state (4.61 and 1.53, respectively) while Bauchi, Borno, Kaduna, Kano and Sokoto states had a RR close to or equal to one indicating little to no inequality in CMR between both groups. With regards to under 5 mortality, the RR (0.92) indicates little disparity in favour of children under 5 with mothers under 20 years old. The pattern was similar in rural and urban areas. Regionally, the highest inequalities were in the Northcentral, Southeast and Southwest in favour of children with mothers under 20. At the state level, 5 states had RRs greater than one with the highest in Katsina (4.42) and Adamawa (4.25) while 9 states had a RR of one.

In 2008, the RR (0.46) indicates that inequalities in CMRs nationally was in favour of children with mothers under 20. Relative inequalities in child mortality was in favour of children with teenage mothers in both urban and rural areas as well as in all regions. At the state level, 5 states had RRs greater than one with the highest in Ogun state where about twelve times (11.53) more children died among teenage mothers than among mothers above 34. In contrast, 24 states had a RR less than one while 6 states had a RR of about one. With regards to under 5 mortality, the RR (0.94) indicates some inequalities in U5MR nationally in favour of children with mothers under 20. RRs indicate little disparity in rural and urban areas and across regions. At the state level, 9 states had RRs greater than one with the highest in Anambra, Zamfara, Nasarawa and Ekiti states. Seventeen states had a RR of about one while 11 states had a RR less than one.

In 2013, the RR (0.93) indicates some disparities but suggests that mother's age did not have much impact on CMRs nationally. It was the same in rural and urban areas (0.82 and 0.87, respectively). Regionally, the highest inequality was in the Northeast and Southwest in favour of children with mothers over 34 years old. At the state level, 5

Table 4.37:Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in CMR by Mother's Age in Nigeria.

Location		Rate Ratio (RR)			Rate Difference (RD)		
		2003	2008	2013	2003	2008	2013
Residence	Urban	0.32	0.85	0.87	-26.2	-4.7	-2.4
	Rural	0.73	0.38	0.82	-23.1	-36.7	-7
Regions	Northcentral	0	0.72	0.77	-96.6	-10	-3.8
	Northeast	0.71	0.39	1.32	-33.6	-42.8	10.7
	Northwest	0.95	0.32	0.83	-3.4	-53.7	-7.3
	Southeast	0	0.48	0	-32.3	-18.4	-25.1
	Southsouth	0	0.24	0	-24.8	-24.8	-23.6
	Southwest	0	1.01	1.23	-32.5	0.2	5.2
States	Abia	N/A	1.18	0	0	8.2	-21.1
	Abuja	0	N/A	N/A	-200	0	0
	Adamawa	0	0	1.79	-33.3	-84.8	10.3
	Akwa Ibom	0	0	0	-93	-41.7	-28.8
	Anambra	N/A	0	0	0	-46.5	-13.1
	Bauchi	1.1	0.34	1.4	11	-52.9	18.9
	Bayelsa	N/A	1.5	0	0	13.3	-33.9
	Benue	0	4.29	0	-26.3	41.5	-42.1
	Borno	1.35	0.56	3.77	23	-31	43.7
	Cross River	N/A	0	0	0	-23.1	-13.9
	Delta	N/A	0	0	0	-29.9	-24.5
	Ebonyi	0	0	0	-76.9	-30.8	-42.3
	Edo	0	0	0	-45.5	-37.6	-24
	Ekiti	0	3.67	N/A	-125	80.8	0
	Enugu	0	0	0	-45.5	-35.2	-28.2
	Gombe	0.26	0.94	0.57	-142.3	-3.4	-21.4
	Imo	0	0	0	-38.5	-22.9	-21.6
	Jigawa	0	0.23	0.85	-83.3	-63	-7.7
	Kaduna	1.45	0.15	1.51	14.2	-67.8	7
	Kano	0.73	0.26	1.76	-22.9	-58.9	25.4
	Katsina	0	0.17	0.15	-19.6	-73.9	-45.1
	Kebbi	4.61	0.5	0.98	78.3	-26.7	-0.9
	Kogi	0	1.94	0	-187.5	31.2	-21.5
	Kwara	N/A	0	0	0	-25	-8.5
	Lagos	0	0	0	-22.2	-15.7	-9.4
	Nasarawa	0	0	0	-125	-12.3	-19.4
	Niger	0	0.24	1.16	-145.8	-51.6	1.8
	Ogun	0	11.53	0	-45.5	53.7	-18.4
	Ondo	0	0	0	-71.4	-72.4	-47.9
	Osun	N/A	N/A	0	0	0	-9.3
	Oyo	N/A	0	2.27	0	-9.3	41.4
	Plateau	0	0	N/A	-41.7	-40.3	111.1
	Rivers	N/A	0	0	0	-37.9	-23.7
	Sokoto	1.18	0.56	0.9	14	-44.4	-5.4
	Taraba	0	0	0.85	-83.3	-51.3	-4.5
	Yobe	0.32	0.33	1.07	-150.8	-42.1	2.7
	Zamfara	1.53	0.53	0.61	86.4	-19.5	-23.6
National		0.73	0.46	0.93	-17.2	-28	-2.1

Note: RR is unit less; RD retains the same unit as child mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

states had RRs greater than one with the highest in Borno state where about four times (3.77) more children died among young mothers than among mothers aged 35-49. In contrast, 20 states had a RR less than one while 9 states had a RR of about one. With regards to under 5 mortality, the RR (1.22) indicates inequality in U5MR among children under 5 with mothers under 20 and above 34 years old. In urban areas, about two times (1.67) more under five children died among teenage mothers while in rural areas there was relatively less disparity in U5MRs (1.07). Regionally, inequalities ranged from 0.71 in the Southeast to 1.48 in the Northeast. At the state level, 10 states had RRs greater than one with the highest in Kwara (4.88) and Plateau state (4.03). Seventeen states had a RR of about one while 10 states had a RR less than one.

4.17.8 Absolute inequalities in child and under 5 mortality rate by mother's age group (rate difference)

In 2003, the RD in CMR between children with teenage mothers and those with mothers over 34 in Nigeria was 17 deaths per 1,000 children surviving to age one in favour of children with mothers under 20. Similarly, the RD in rural and urban areas was 23 and 26 deaths per 1,000 children surviving to age one, respectively in favour of children with mothers under 20. Regionally, the RD was highest in the Northcentral region (97 deaths per 1,000 children surviving to age one) in favour of the children with teenage mothers. Six states had a positive RD with the largest gap in Zamfara state (86 deaths per 1,000 children surviving to age one) while 22 states had a negative RD with the largest gap in Abuja (200 deaths per 1,000 children surviving to age one). Table 4.38 shows that the RD in U5MR between children with teenage mothers and those with mothers over 34 in Nigeria was 13 deaths per 1,000 live births in favour of children with mothers under 20. The RD was much higher in rural than in urban areas (33 and 25 deaths per 1,000 live births, respectively) in favour of children with mothers over 34. Regionally, the RD was highest in the Southeast (126 deaths per 1,000 live births) in favour of the children with teenage mothers. Eleven states had a positive RD with the largest gap in Adamawa state (382 deaths per 1,000 live births) while 19 states had a negative RD with the largest gap in Kogi state (297 deaths per 1,000 live births).

In 2008, the difference in CMR between children with teenage mothers and those with mothers over 34 in Nigeria was 28 deaths per 1,000 children surviving to age one in favour of children with mothers under 20. The RD was significantly higher in rural than in urban areas (37 and 5 deaths per 1,000 children surviving to age one, respectively) in

Table 4.38:Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in U5MR by Mother's Age in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	1.24	1.08	1.67	25.4	7.6	51.8
	Rural	1.27	0.89	1.07	33.3	-15.9	7.3
Regions	Northcentral	0.36	1.11	1.37	-104.4	11.3	24.9
	Northeast	0.96	0.84	1.48	-8.5	-23.7	46.6
	Northwest	0.9	0.91	1.06	-17.5	-13.4	7.2
	Southeast	0	0.49	0.71	-126.2	-67.5	-32.4
	Southsouth	0.71	0.57	1.04	-48.6	-44.3	3.1
	Southwest	0	1.02	1.42	-63	2	33.4
States	Abia	N/A	0.3	0	N/A	-120.5	-69.3
	Abuja	N/A	0	0	N/A	-79.4	-80
	Adamawa	4.25	0.7	1.26	382.4	-57.4	22.1
	Akwa Ibom	0	0.96	1.21	-259.3	-4.2	9.9
	Anambra	0	2.81	1.49	-76.9	161.1	54.9
	Bauchi	1.22	0.94	1.99	49	-7.5	114
	Bayelsa	0	1.63	0.84	-142.9	55.4	-12.7
	Benue	0.49	1.89	0	-60.2	96.5	-90
	Borno	1.01	0.86	1.17	2.2	-23.9	11.7
	Cross River	1.86	0.49	0.76	66	-37.3	-14.1
	Delta	2	0	2.69	142.8	-121.6	117.7
	Ebonyi	N/A	0	0.65	N/A	-136.1	-56.7
	Edo	0	0	0	-45.5	-104.9	-54.7
	Ekiti	N/A	2.6	0	N/A	123.1	-56.6
	Enugu	0	0.63	0.55	-125	-49.6	-41.5
	Gombe	0.23	1.29	1.06	-172.2	36.9	8.1
	Imo	0	0	0.76	-38.5	-145.7	-20.5
	Jigawa	0.3	0.5	0.87	-175.9	-73.6	-16.8
	Kaduna	0.41	0.72	1.74	-121.8	-43.2	36.5
	Kano	1.22	1.01	1.21	37.4	2.2	22.7
	Katsina	4.42	0.8	0.4	129	-28.3	-80.5
	Kebbi	1.82	1.93	0.87	81.8	78.4	-19.2
	Kogi	0	0.87	0.5	-297.3	-13.9	-35
	Kwara	N/A	1.23	4.88	N/A	13.9	159
	Lagos	0	1.34	0	-63.8	28.2	-42.4
	Nasarawa	0.81	2.63	0	-33.6	77.4	-47.2
	Niger	0	0.42	1.94	-180	-82.8	63.1
	Ogun	0	1.59	0	-83.3	61.7	-90.9
	Ondo	0	0	0.62	-71.4	-113.2	-53.5
	Osun	N/A	1.43	0	N/A	27.3	-69.6
	Oyo	N/A	0.75	2.67	0	-19.1	132.8
	Plateau	0	2.4	4.03	-41.7	132.4	205
	Rivers	1.36	0	0.53	75.2	-121.2	-55.8
	Sokoto	0.53	0.52	1.51	-81.5	-98.1	62
	Taraba	1.41	0.85	2.72	78	-21.2	109.9
	Yobe	0.52	0.47	0.81	-114.1	-69	-19.8
	Zamfara	1.02	2.67	1.54	4.1	133.9	76.4
National		0.92	0.94	1.22	-12.8	-7.4	21.5

Note: RR is unit less; RD retains the same unit as in under 5 mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

favour of children with mothers under 20). Regionally, the RD was highest in the Northwest (54 deaths per 1,000 children surviving to age one) in favour of children with mothers under 20. Six states had a positive RD with the highest in Ekiti state (81 deaths per 1,000 children surviving to age one) while 29 states had a negative RD with the highest in Adamawa state (85 deaths per 1,000 children surviving to age one).

The difference in U5MR between both groups in Nigeria was 7 deaths per 1,000 live births in favour of children with mothers under 20. The RD was twice as high in rural than in urban areas (16 and 8 deaths per 1,000 live births, respectively) in favour of children with mothers over 34. Regionally, the RD was highest in the Southeast (68 deaths per 1,000 live births) in favour of children with teenage mothers and smallest in the Southwest (2 deaths per 1,000 live births) in favour of children with mothers over 34. At the state level, 14 states had a positive RD with the highest in Anambra state (161 deaths per 1,000 live births) while 23 states had a negative RD with the highest in Imo state (146 deaths per 1,000 live births).

In 2013, the difference in CMR between children with teenage mothers and those with mothers over 34 in Nigeria was 2 deaths per 1,000 children surviving to age one in favour of children with mothers under 20. Similarly, the RD in rural and urban areas was small (7 and 2 deaths per 1,000 children surviving to age one, respectively) in favour of children with mothers under 20. Regionally, the RD was highest in the Southeast (25 deaths per 1,000 children surviving to age one) in favour of children with mothers under 20. Nine states had a positive RD with the largest gap in Plateau state (111 deaths per 1,000 children surviving to age one) while 26 states had a negative RD with the largest gap in Ondo state (48 deaths per 1,000 children surviving to age one).

The difference in U5MR between both groups in Nigeria was 22 deaths per 1,000 live births in favour of children with mothers over 34. The RD was significantly higher in urban than in rural areas (52 and 7 deaths per 1,000 live births, respectively) in favour of children with mothers over 34. Regionally, the RD was highest in the Northeast (47 deaths per 1,000 live births) in favour of children with mothers over 34. At the state level, 16 states had a positive RD with the highest in Plateau state (205 deaths per 1,000 live births) while 21 states had a negative RD with the highest in Ogun state (90 deaths per 1,000 live births).

4.17.9 Relative inequalities in child and under 5 mortality rate by religion (rate ratio)

Table 4.39 and 4.40 show the RR and RD indicating inequalities in child and under 5 mortality by religion in Nigeria. In 2003, about three times (2.61) more children between the ages of one and five died in Muslim homes. About three (2.65) and two (2.14) times more children died in Muslim homes in rural and urban areas, respectively. Regionally, the highest inequality was in the Northeast where three times (3.38) more children died in Muslim homes. Four states had RRs greater than one indicating inequalities in favour of children in Christian homes. The highest inequality was in Kogi state where two times (2.27) more children died in Muslim homes than in Christian homes. Four states had a RR of about one indicating little to no inequality in CMR by religion while 8 states had a RR less than one indicating inequalities in CMR in favour of children in Muslim homes. With regards to under 5 mortality, the RR (0.14) shows that inequalities in U5MR by religion in Nigeria were in favour of under 5 children in Muslim homes. In urban areas about two times (1.60) more children under 5 died in Muslim homes while the RR (1.37) indicates much smaller inequalities in U5MR between both groups in rural areas. RRs indicate relatively low levels of religion based inequalities in U5MRs across regions. At the state level, 6 states had RRs greater than one with the he highest in Ekiti state where about six times (5.50) more under 5 children died in Muslim homes. Nine states had a RR of about one while 6 states had a RR less than one.

In 2008, about two times more children between the ages of one and five died in Muslim homes compared to Christian homes nationally (1.89) and in rural and urban areas (1.84 and 1.60, respectively). Regionally, RRs ranged from zero in the Southeast to 2.67 in the Northwest. Six states had RRs greater than one with the highest inequality in Edo state where about three times (2.85) more children under 5 died in Muslim homes. Eight states had a RR of about one while 10 states had a RR less than one. With regards to under 5 deaths, the RR (1.27) indicates relatively lower levels of disparity in U5MR by religion in Nigeria though the distribution was in favour of under 5 children in Christian homes. It was the same in rural and urban areas as well as across regions suggesting that religion did not have much of an impact on U5MRs. At the state level, 4 states had RRs greater than one with the highest inequality in Borno state where about two times (1.91) more under 5 children died in Muslim homes. Seventeen states had a RR of about onewhile 7 states had a RR less than one.

In 2013, two times more children between the ages of one and five died in Muslim homes compared to Christian homes nationally (2.31) and in urban areas (2.28) while there was significantly less disparity in CMRs by religion in rural areas (1.43). Regionally, the highest inequality was in the Northwest where about three times (2.80) more children died in Muslim homes. At the state level, 13 states had RRs greater than one with the highest inequality in Delta state where seven times (7.19) more children died in Muslim homes. Four states had a RR of one while 11 states had a RR less than one. Table 4.40 shows relatively low inequalities in U5MR by religion in Nigeria (1.34) though the distribution was in favour of under 5 children in Christian homes. It was the same in rural and urban areas (1.37 and 0.98, respectively). Across regions, the highest disparity was in the Northwest where about two times (1.89) more under 5 children died in Muslim homes. Eight states had RRs greater than one with the highest in Delta state where about three times (2.68) more under 5 children died in Muslim homes. Fourteen states had a RR of about one while 7 states had a RR less than one.

4.17.10 Absolute inequalities in child and under 5 mortality rate by religion (rate difference)

In 2003, the difference in CMR between children in Muslim and Christian homes was 44 deaths per 1,000 children surviving to age one in favour of children in Christian homes. The RD was higher in rural than in urban areas (52 and 22 deaths per 1,000 children surviving to age one, respectively) in favour of children in Christian homes. Regionally, the RD was highest in the Northeast (58 deaths per 1,000 children surviving to age one). At the state level, 15 states had a positive RD with the highest in Ekiti state (200 deaths per 1,000 children surviving to age one). In contrast, 9 states had a negative RD with the largest gap in Nasarawa state (56 deaths per 1,000 children surviving to age one). The RD in U5MR by religion in Nigeria was 92 deaths per 1,000 live births in favour of children in Muslim homes. In rural and urban areas, the RD was about the same and in favour of children in Christian homes. Regionally, the RD was highest in the Southsouth (129 deaths per 1,000 live births) in favour of children in Muslim homes. At the state level, 11 states had a positive RD with the highest in Ekiti state (272 deaths per 1,000 live births). In contrast, 11 states had a negative RD with the highest in Niger state (370 deaths per 1,000 live births).

In 2008, the RD in CMR by religion was 26 deaths per 1,000 children surviving to age one in favour of children in Christian homes. In rural and urban areas, the RD was 28 and 12 deaths per 1,000 children surviving to age one, respectively in favour of children in Christian homes. Regionally, the RD was highest in the Northwest (42 deaths per 1,000 children surviving to age one) in favour of the children in Christian homes. At the state level, 15 states had a positive RD with the largest difference in Katsina state (66 deaths per 1,000 children surviving to age one). In contrast, 15 states had a negative RD with the largest difference in Adamawa state (54 deaths per 1,000 children surviving to age one). With respect to under 5 mortality, the RD was 26 deaths per 1,000 live births in favour of children in Christian homes. The RD was twice as high in rural areas compared to urban areas (28 and 7 deaths per 1,000 live births, respectively) in favour of children in Christian homes. Regionally, the RD was highest in the Southsouth (21 deaths per 1,000 live births) in favour of children in Muslim homes. Fifteen states had a positive RD with the highest in Yobe state (107 deaths per 1,000 live births) while 15 states had a negative RD with the highest in Katsina state (209 deaths per 1,000 live births).

In 2013, the difference in CMR between children in Muslim and Christian homes was 21 deaths per 1,000 children surviving to age one in favour of children in Christian homes. The pattern was similar in rural and urban areas. Regionally, the difference was highest in the Northwest (27 deaths per 1,000 children surviving to age one) in favour of children in Christian homes. At the state level, 21 states had a positive RD with the highest in Benue state (102 deaths per 1,000 childrensurviving to age one) while 14 states had a negative RD with the highest in Zamfara state (184 deaths per 1,000 children surviving to age one).

The difference in U5MR by religion in Nigeria was 25 deaths per 1,000 live births in favour of children in Christian homes. The RD in U5MR between both religious groups in urban areas was 30 deaths per 1,000 live births in favour of children in Christian homes and 1 death per 1,000 live births in favour of children in Muslim homes in rural areas. This indicates much wider inequalities or disparities in U5MR by religion in urban areas. It also suggests unfairly high U5MRs among children in muslim homes in urban areas. Regionally, the RD in U5MR between both groups was highest in the Southeast (89 deaths per 1,000 live births) in favour of children in Muslim homes. At the state level, 20 states had a positive RD with the highest in Jigawa state (134 deaths per 1,000 live births) while 15 states had a negative RD with the highest in Ebonyi state (113 deaths per 1,000 live births).

Table 4.39: Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in CMR by Religionin Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	2.14	1.6	1.43	21.8	12.1	5.1
	Rural	2.65	1.84	2.28	52.4	28.4	24.5
Regions	Northcentral	1.89	1.51	1.13	27.7	14.4	2.2
	Northeast	3.38	0.96	1.99	58.4	-2.2	19.3
	Northwest	2.46	2.67	2.8	43	42.4	26.6
	Southeast	N/A	0	0	N/A	-33.5	-18.5
	Southsouth	0	1.36	0.99	-37.4	10.7	-0.2
	Southwest	1.74	0.62	1.73	10.7	-6.5	7.3
States	Abia	N/A	N/A	0	N/A	N/A	-10.2
	Abuja	N/A	0.55	1.13	55.6	-9	1.3
	Adamawa	1.37	0.4	0.47	11.8	-53.5	-17.5
	Akwa Ibom	N/A	N/A	0	N/A	N/A	-16
	Anambra	N/A	0	0	N/A	-46.1	-13.5
	Bauchi	1.1	1.66	N/A	6.9	24	56.5
	Bayelsa	N/A	0	0	N/A	-33	-13.7
	Benue	0	N/A	5.48	-29.2	N/A	102.2
	Borno	N/A	N/A	N/A	79.1	46.1	22.6
	Cross River	N/A	N/A	0	N/A	N/A	-22
	Delta	N/A	0	7.19	N/A	-25.1	86.1
	Ebonyi	N/A	0	0	N/A	-33.6	-31.2
	Edo	0	2.85	1.94	-52.6	34.6	13.5
	Ekiti	N/A	0	0	200	-34.4	-5.9
	Enugu	0	0	0	-17.9	-17.5	-13.9
	Gombe	N/A	1.44	1.7	114.6	15.6	20
	Imo	N/A	N/A	N/A	N/A	N/A	N/A
	Jigawa	N/A	N/A	N/A	N/A	N/A	53
	Kaduna	1.28	2.16	2.95	9.5	30	7.2
	Kano	N/A	0.96	N/A	55.8	-3.5	36.6
	Katsina	N/A	N/A	N/A	41.7	65.5	43.7
	Kebbi	N/A	N/A	0.79	N/A	41.7	-9.5
	Kogi	2.27	0.7	2.13	45.4	-11.7	14.3
	Kwara	N/A	N/A	N/A	0	15.9	19
	Lagos	1.6	1.68	1.57	10.7	7.2	2.8
	Nasarawa	0	0.95	1.59	-55.6	-1.1	12
	Niger	2.25	0.99	0.91	35.7	-0.8	-1.7
	Ogun	N/A	1.25	1.5	25.6	2.8	5.2
	Ondo	0	1.85	4.3	-29.4	20.4	46.5
	Osun	N/A	0.36	1.73	52.6	-12.7	2.7
	Oyo	0.69	0.43	0.94	-7.5	-8.9	-1.3
	Plateau	0	1.21	2.49	-10.6	4.9	13
	Rivers	0	0	0	-54.3	-34.4	-16.7
	Sokoto	N/A	N/A	N/A	N/A	N/A	N/A
	Taraba	0.49	1.62	3.92	-29.1	20.9	28
	Yobe	1.56	N/A	N/A	51	54.3	40.3
	Zamfara	N/A	N/A	0.21	N/A	55	-184.1
National		2.61	1.89	2.31	44.3	25.7	20.5

Note: RR is unit less; RD retains the same unit as child mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

Table 4.40: Rate Ratio and Rate Difference indicating Relative and Absolute Inequality in U5MR by Religion in Nigeria.

		Rate Ratio (RR)			Rate Difference (RD)		
Location		2003	2008	2013	2003	2008	2013
Residence	Urban	1.6	1.09	0.98	42.5	7.2	-1
	Rural	1.37	1.26	1.37	46.2	28.2	30.4
Regions	Northcentral	1.21	1.08	0.86	23	8.1	-10.8
	Northeast	1.27	0.96	0.98	37.1	-5.2	-2.2
	Northwest	1.11	1.14	1.89	15.8	16.6	52.9
	Southeast	N/A	1.03	0	N/A	2.9	-88.9
	Southsouth	0	0.79	1.2	-128.6	-20.6	12.8
	Southwest	0.6	1.02	1.02	-38.4	1.1	1.3
States	Abia	N/A	N/A	0	N/A	N/A	-87.5
	Abuja	N/A	0.9	0.53	N/A	-8.4	-38.1
	Adamawa	0.95	0.65	0.63	-9.7	-66.7	-48.7
	Akwa Ibom	N/A	N/A	0	N/A	N/A	-73.1
	Anambra	N/A	0	0	N/A	-91.6	-75.9
	Bauchi	1.21	1.03	N/A	28.1	3.5	133.3
	Bayelsa	N/A	0	0	N/A	-125	-56.8
	Benue	2.14	N/A	1.4	133	N/A	35.5
	Borno	1.43	1.91	N/A	53.4	62.8	49.5
	Cross River	N/A	N/A	2.39	N/A	N/A	83.2
	Delta	N/A	0	2.68	N/A	-110.1	114
	Ebonyi	N/A	0	0	N/A	-114.8	-112.9
	Edo	0	1.02	0.59	-100	2.4	-19.3
	Ekiti	5.5	1.29	0.86	272.7	20.7	-8.9
	Enugu	N/A	1.48	0	N/A	46.1	-73
	Gombe	2.29	1.66	1.22	107.2	45.2	20.3
	Imo	N/A	N/A	N/A	N/A	N/A	N/A
	Jigawa	N/A	N/A	N/A	N/A	N/A	133.8
	Kaduna	0.91	1	1.09	-14.3	-0.2	3.9
	Kano	0.68	0.71	N/A	-63.3	-64.6	102.1
	Katsina	N/A	0.37	N/A	118	-209.2	91.5
	Kebbi	N/A	N/A	1.41	N/A	104.5	35.5
	Kogi	3.9	0.98	1.61	103.5	-1.4	26
	Kwara	N/A	1.55	2.47	0	17.4	44.6
	Lagos	0.34	0	1.08	-55.1	-63.3	5.3
	Nasarawa	1.09	0.63	0.72	17.8	-29.1	-27
	Niger	0.26	0.92	0.88	-369.6	-11.8	-8.5
	Ogun	0.9	0.95	0.99	-10.1	-4.1	-0.6
	Ondo	1.32	1.31	1.91	34.8	20.2	66.2
	Osun	0.47	1.16	1.68	-58.5	6.3	22.3
	Oyo	0.36	1.19	0.73	-30.7	11.4	-21
	Plateau	1.87	1.63	1.61	84.7	53.1	44.4
	Rivers	0	0	2.24	-175.4	-95.5	92.4
	Sokoto	N/A	N/A	N/A	N/A	N/A	N/A
	Taraba	0.86	1.35	1.25	-26.4	34	21.7
	Yobe	2.13	N/A	N/A	103	107.4	96.5
	Zamfara	N/A	1.1	0.44	N/A	11	-190.5
National		0.14	1.27	1.34	-92.3	26.4	25.3

Note: RR is unit less; RD retains the same unit as in under 5 mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author

4.18 Changes in relative and absolute inequalities in infant mortality over time(range measures)

Tables 4.26-4.40 are colour coded to show changes in relative and absolute inequalities over time between surveysat the national, rural-urban, regional and state level.

4.18.1 Inequalities in IMR by wealth

Inequalities in IMR by wealth are evident in all 3 surveys carried out in Nigeria. Range measures indicate that overall infants from the poorest homes bore the bulk of the infant mortality burden in Nigeria. Between 2003 and 2013, RRs fell from 1.91 to 1.51 while RDsdecreased from 53to 26 deaths per 1,000 live births. In rural and urban areas and across regions RRs declined except in the Northwest where RRs increased from 1.46 to 1.92 and in the Northeast where RRs remained unchanged. RD declined except in the Northwest where RD increased from 35 to 39 deaths per 1,000 live births. At the state level, RRs increased in 14 states particularly in Yobe state. Three states (Adamawa, Kaduna and Zamfara) experienced slight declines while RRs declined significantly in 22 states such as in Enugu state (3.87 to 0.79). In contrast, RD increased in 8 states particularly in Yobe state (from 16 to 58 deaths per 1,000 live births) but fell in 29 states although there was a change in the direction of absolute inequalities in 14 states. According to the range measures, 5 states – Bauchi, Ebonyi, Kano, Kwara and Yobe – experienced an increase in both relative and absolute inequalities by wealth over time. This suggests that these states should be priority areas for policies aimed at addressing wealth based inequalities in infant mortality in Nigeria.

4.18.2 Inequalities in IMR by child's sex

Range measures indicate that inequalities in IMR by child's sex was mostly in favour of female infants. Nationally, RRs remained unchanged between 2003 and 2013 while RD decreased from 16to 11deaths per 1,000 live births. Both relative and absolute inequalities in IMR between both sexes decreased in rural areas but increased in urban areas over time. Across regions, RRs increased in the Northcentral, Northwest and Southwest while RD decreased in all regions though there was a change in direction of absolute inequalities in the Northcentral and Southwest regions. At the state level, RR increased in 20 states but narrowed in 17 states. For example, in Anambra state RRs fell steadily from 1.72 in 2003 to 1.29 and 0.92 in 2008 and 2013, respectively whilein Delta stateRR increased from 0.93 in 2003 to 0.95 and 1.59 in 2008 and 2013, respectively. RD declined in 30 states with a change in the direction of absolute inequalities in favour of male infants in 14 states.

According to the range measures, 7 states – Abuja, Anambra, Borno, Delta, Enugu, Imo and Kwara – experienced an increase in both relative and absolute inequalities by child's sex over time making them major areas for gender based equity focused policies/interventions.

4.18.3 Inequalities in IMR by mother's level of education

Range measures indicate significant Inequalities in IMR by mother's education between 2003 and 2013 in Nigeria. Nationally, RRsfell from 1.68 to 1.46 while RD narrowed from 41to 23deaths per 1,000 live births. Both RR and RD increased in rural areas but decreased in urban areas over time. Across regions, RR increased in the Southsouth and Southwest while RD decreased in all regions. RRs increased in 15 states, remained unchanged in Abia and Osun state and narrowed significantly in 17 states while RD decreased in 28 states, increased in 7 states and remained unchanged in Abuja. Range measures indicate that 4 states – AkwaIbom, Edo, Ekiti and Kogi – experienced an increase in both absolute and relative inequalities in IMR by mother's education over time. This suggests that these are key priority areas for interventions aimed at tackling inequalities in infant mortality.

4.18.4 Inequalities in IMR by mother's age

Range measures indicate that inequalities in IMR by mother's age group remained almost unchanged between 2003 and 2013 nationally although there were changes within Nigeria. Both RR and RD increased over time in rural and urban areas. RRs increased in all regions while RD increased in all regions except in the Southeast, Southsouth and Southwest. RRsincreased in 19 states, remained unchanged in Abia, Abuja, Edo, Lagos and Ogun state and decreased in 13 states. RD decreased in 22 states although the direction of absolute inequalities changed in 13 states while RD increased in 15 states including the Federal Capital Territory. In general, range measures indicate that 7 states – Bauchi, Imo, Kwara, Niger, Ondo, Oyo and Zamfara – experienced an increase in both absolute and relative inequalities in IMR by mother's age over time suggesting that these are key priority areas for interventions aimed at tackling inequalities in infant mortality.

4.18.5 Inequalities in IMR by religion

Range measures indicate some inequalities in IMR by religion between 2003 and 2013 in Nigeria. Nationally, RRs increased from 1.08 to 1.11 while RD slightly declined from 7 to 6 deaths per 1,000 live births. In rural areas, both RR and RDincreasedwhile both reduced in urban areas. Across regions, RRs decreased only in the Northcentral, Northeast and Southeast while RD decreased in the Southsouth and Southwest. RRs increased in 12 states and remained unchanged in Abia, Anambra, Bayelsa, Ebonyi and Edo state but narrowed significantly in 11 states including Abuja. RD decreased in 22 states, increased in 9 states and remained the same in Adamawa state. In general, range measures indicate that 4 states – Borno, Delta, Kaduna and Kwara – experienced an increase in both absolute and relative inequalities in IMR by religion over time. This suggests that these are key priority areas for interventions aimed at tackling inequalities in infant mortality among religious groups.

4.19 Changes in relative and absolute inequalities in child and under 5 mortality over time (range measures)

4.19.1 Inequalities in child and under 5 mortality rate by wealth

Between 2003 and 2013, relative inequalities in CMR as indicated by RRs increased from 2.38 to 3.59 while absolute inequalities as indicated by the RD narrowed from 44 to 32 deaths per 1,000 children surviving to age one. RRs increased in rural and urban areas and across regions in Nigeria except in the Southeast and Southwest. RD declined in the same period except in the Southsouth, Northeast and in the Northcentral region. RRs increased in 20 states, declined significantly in 7 states and remained unchanged in Abuja, Ekiti, Imo, Kano and Osun states. In contrast, RD increased in 10 states but fell in 26 states although there was a change in the direction of absolute inequalities in 9 states. According to the range measures, 7 states – Abia, Anambra, Benue, Ebonyi, Katsina, Kwara and Zamfara – experienced an increase in both relative and absolute inequalities by wealth group over time. This suggests that these states are priority areas for policies aimed at addressing wealth related inequalities in child mortality in Nigeria.

With regards to under 5 mortality, RRs declined from 2.01 to 1.88 while RD initially fell from 90 to 55 deaths per 1,000 live births. In rural areas, RR declined from 1.67 to 1.61 but increased from 1.94 to 1.95 in urban areas. Across regions RR decreased except in the Northeast and Northwest. RD declined in rural and urban areas and across regions in the same period. RRs increased in 15 states and declined significantly in 21 states. For example, in Yobe state, RR increased from 1.94 to 11.74 while in Kaduna state RR decreased from 2.28 to 1.29. In contrast, RD increased in 10 states but fell in 26 states although there was a change in the direction of absolute inequalities in 12 states. According to the range measures, 7 states – Bauchi, Ebonyi, Katsina, Nasarawa, Ondo, Sokoto and Taraba – experienced an increase in both relative and absolute inequalities in

U5MR by wealth over time. This suggests that these states are priority areas for policies aimed at addressing wealth based inequalities in child mortality in Nigeria.

4.19.2 Inequalities in child and under 5 mortality by child's sex

Between 2003 and 2013,RRs increased nationally from 0.97 to 1.05 while RD declined from 1.7 to 1.3 deaths per 1,000 children surviving to age one. In rural and urban areas and across regions RR increased except in the Southeast and Northcentral region whileRD declined except in the Southeast. At the state level, RRs increased in 22 states and declined in 15 states while RD increased in 8 states but declined in 29 states although there was a change in the direction of absolute inequalities in 27 states. According to the range measures, 6 states – Imo, Katsina, Kebbi, Kwara, Ogun and Oyo – experienced an increase in both relative and absolute inequalities by child's sex over time making them major areas for health equity focused policies/interventions.

With regards to under 5 mortality, RRs increased from 1.10 to 1.14 while RD fell from 13 to 12 deaths per 1,000 live births. RRs declined in rural areas from 1.15 to 1.12 but increased in urban areas from 0.90 to 1.22. RRs increased across regions except in the Southeast while RD declined except in the Northeast. RRs increased in 20 states, declined significantly in 16 states and remained unchanged in Rivers state. In contrast, RD increased in 5 states but fell in 32 states although there was a change in the direction of absolute inequalities in 17 states. According to the range measures, 3 states –AkwaIbom, Delta, and Jigawa– experienced an increase in both relative and absolute inequalities in U5MR by child's sex group over time. This suggests that these states are priority areas for policies aimed at addressing sex based inequalities in under 5 mortality in Nigeria.

4.19.3 Inequalities in child and under 5 mortality by mother's education

Range measures indicate significant inequalities in both child and under 5 mortality by maternal education between 2003 and 2013 in Nigeria. With regards to child mortality, national RRsfell from 4.00 to 3.52 while RD fell from 58 to 29 deaths per 1,000 children surviving to age one. Both RR and RD decreased in rural and urban areas. RR decreased in all regions except the Southsouth and Southwest while RD decreased in all regions except in the Southwest. RRs increased in 10 states, narrowed significantly in 11 states but remained unchanged in 7 states while RD decreased in 22 states but widened in 15 states although the direction of absolute inequalities changed in 10 states. Range measures indicate that 5 states – Anambra, Benue, Oyo, Lagos and Plateau – experienced an increase in both absolute and relative inequalities in CMR by mother's education over time suggesting that these are key priority areas for interventions aimed at tackling inequalities in child mortality.

With regards to under 5 mortality, RRs decreased from 2.20 to 1.82 while RD fell from 93 to 49 deaths per 1,000 live births. Similar temporal patterns of inequality were observed in rural and urban areas over time. Regionally, RRs decreased except in the Southsouth and Southwest while RD declined in all regions. RRs increased in 19 states, declined significantly in 15 states and remained unchanged in Abia and Osun states. RD increased in 8 states but fell in 28 states although there was a change in the direction of absolute inequalities in 13 states. According to the range measures, 6 states –AkwaIbom, Edo, Ekiti, Gombe, Katsina and Yobe– experienced an increase in both relative and absolute inequalities in U5MR by mother's level of education over time.

4.19.4 Inequalities in child and under 5 mortality by mother's age

Between 2003 and 2013, RRsincreased from 0.73 to to 0.93 while RD decreased from 17 to 2 deaths per 1,000 children surviving to age one. Both relative and absolute inequalities in CMR by mother's age increased in rural and urban areas. Regionally, RRs decreased in the Northwest, increased in the Northcentral, Northeast and Southwest and remained unchanged in the Southeast and Southsouth. However, RD decreased in all regions except in the Northwest. At the state level, RRs increased in 13 states and decreased in 5 states but remained unchanged in 17 states while RD increased in 15 states and decreased in 22 states although the direction of absolute inequalities changed in 21 states. Range measures indicate that 5 states – Bauchi, Borno, Kano, Katsina and Oyo– experienced an increase in both absolute and relative inequalities in CMR by mother's age over time suggesting that these are key priority areas for interventions aimed at tackling inequalities in child mortality.

With respect to under 5 mortality, RRs increased from 0.92 to 1.22 while RD increased from 13 to 22 deaths per 1,000 live births. Both RR and RD decreased in rural areas while RR increased and RD decreased in urban areas. Regionally, RRs increased while RD declined in all regions except in the Northeast. In the same period, RRs increased in 22 states, declined significantly in 11 states and remained unchanged in Abuja, Edo, Lagos and Ogun state. RD increased in 13 states but fell in 24 states although there was a change in the direction of absolute inequalities in 13 states. According to the range measures, 7 states –Bauchi, Borno, Kwara, Oyo, Plateau, Taraba and Zamfara–

experienced an increase in both relative and absolute inequalities in U5MR by mother's age over time.

4.19.5 Inequalities in child and under 5 mortality by religion

Between 2003 and 2013, RRs nationally decreased from 2.61 to 2.31 while RD decreased from 44to 21 deaths per 1,000 children surviving to age one. In rural and urban areas areas, both RR and RD decreased. Across regions, RRs decreased only in the Northcentral, Northeast, Northwest and Southwest while RD decreased in all regions. At the state level, RRs increased in 14 states, decreased in 4 states and remained unchanged in 6 states while RD decreased in 22 states but increased in 9 states. Range measures indicate that 5 states – Bauchi, Benue, Delta, Ondo and Plateau – experienced an increase in both absolute and relative inequalities in CMR by religion over time. This suggests that these are key priority areas for interventions aimed at tackling inequalities in child mortality among religious groups.

RRs with respect to U5MRs increased from 0.14 to 1.34 while RD fell from 92to 25 deaths per 1,000 live births. In rural and urban areas, both RR and RD declined. Regionally,RRs decreased only in the Northcentral, Northeast and Southeast while RD decreased in all regions except the Northwest and Southeast. In addition, RRs increased in 12 states, declined in 13 states and remained unchanged in Anambra, Bayelsa and Ebonyi state. In contrast, RD increased in 9 states but decreased in 22 states although there was a change in the direction of absolute inequalities in 11 states. Four states –Delta, Kano, Kwara and Ondo– experienced an increase in both relative and absolute inequalities in U5MR by religion over time thus making them key areas for programmes aimed at addressing religious based inequalities or disparities in U5MRs.

Although both measures don't always agree on the areas where mortality rates are most unfairly distributed amongst socioeconomic groups, they still identify significant relative and absolute inequalities in infant, child and under 5 mortality between groups within Nigeria over time. However, range measures ignore intermediate socioeconomic groups and do not take into consideration the sizes of the groups being compared. Hence, the SII and CI that take into account changes in the the size of all socioeconomic groups as well as changes in mortality were also employed in assessing relative and absolute inequalities in mortality rates in Nigeria over time.

4.20 Slope Index of Inequality (SII) in IMR in Nigeria

The Slope Index of Inequality was computed at the national, regional, rural, urban and state level for all three surveys. The Sign indicates the direction of the relationship between mortality rates and socioeconomic status (SES)and its magnitude (value) reflects both the strength of the relationship as well as the degree of variability in mortality rate. Table 4.41-4.42 presents the SII in IMR by wealth, mother's level of education and mother's age regionally, by place of residence and across states.

4.20.1 Slope index of inequality by wealth index

The SII in IMR by wealth indicates that the absolute differenceor change in IMR across wealth groups from the poorest to the richest group in 2003 was 87 deaths per 1,000 live births. The negative sign indicates that infant mortality was higher among infants in the poorest homes. In rural and urban areas, the SII by wealth was 70 and 113 deaths per 1,000 live births, respectively with IMR higher among the poorest. Regionally, the SII ranged from 38 deaths per 1,000 live births in the Northeast to as high as 229 deaths per 1,000 live births in the Southeast with infant mortality higher among the poorest in all regions. At the state level, the highest SII (i.e. the absolute difference in IMR moving from the poorest to the wealthiest group) was in Rivers (346 deaths per 1,000 live births), Bayelsa (303 deaths per 1,000 live births), Delta (296 deaths per 1,000 live births) and Taraba state (294 deaths per 1,000 live births) with IMR higher among the poorestexcept in Bayelsa.

In 2008, the absolute difference in IMR across wealth groups from the poorest to the richest group was 38 deaths per 1,000 live births with infant mortality higher in the poorest homes. The SII was higher in urban than in rural areas (43 and 13 deaths per 1,000 live births, respectively) with higher IMRs among the poorest. Regionally, the SII ranged from 17 to 52 deaths per 1,000 live births in the Southeast and Northeast, respectively with IMR highest among the poor in all regions. At the state level, the highest SII was in Osun (114 deaths per 1,000 live births) with IMR higheramong infants in the pooresthomes.

In 2013, the SII in IMR across wealth groups from the poorest to the richest group was 44 deaths per 1,000 live births with infant mortality higher among infants in the poorest homes. In rural and urban areas, the SII by wealth was 30 and 33 deaths per 1,000 live births, respectively, with IMR concentrated among the poorest. Regionally, the SIIranged from 10 deaths per 1,000 live births in the Southwest to 65 deaths per 1,000 live births in the Southeast withIMR higher among the poor in all regions except the

Southwest. At the state level, the highest SII was in Bauchi and Ebonyi states (118 and 116 deaths per 1,000 live births, respectively) withIMR higher among the poorest.

4.20.2 Slope index of inequality by mother's education

In 2003, the absolute difference or change in IMR moving from uneducated mothers to mothers with secondary and higher level of education was 56 deaths per 1,000 live births with the negative sign indicating that infant mortality was higher at the bottom of the social hierarchy i.e. among infants with uneducated mothers. The SII in IMR by mother's level of education was significantly larger in urban than in rural areas (118 and 8 deaths per 1,000 live births, respectively) suggesting that maternal education had a lot more impact on IMRs in urban areas. Regionally, the SII ranged from 7 deaths per 1,000 live births in the Northeast to 152 deaths per 1,000 live births in the Southeast. IMRs were concentrated among infants with uneducated mothers in all regions except in the Northeast and Southsouth. At the state level, the highest SIIwas in Nasarawa (410 deaths per 1,000 live births) with infant mortality much higher among infants in the wealthiest homes.

In 2008, the absolute difference or change in IMR moving from uneducated mothers to mothers with secondary and higher level of education was 31 deaths per 1,000 live births with infant mortality higher among infants with uneducated mothers. The SII in IMR by mother's level of education was larger in urban than in rural areas (25 and 19 deaths per 1,000 live births, respectively). Regionally, the SII ranged from 6 deaths per 1,000 live births in the Southsouth to 55 deaths per 1,000 live births in the Southwest with infant mortality higher among infants with uneducated mothers in all regions. At the state level, the highest SIIwas in Oyo state (136 deaths per 1,000 live births) with infant mortality higher among infants with uneducated mothers except in Imo state.

In 2013, the SII in IMR by mother's education was 35 deaths per 1,000 live births with infant mortality higher among infants with uneducated mothers. In rural and urban areas, the SII was 22 and 34 deaths per 1,000 live births, respectively. Regionally, the SII in IMR by mother's level of education was highest in the Northwest (70 deaths per 1,000 live births)butinfant mortality was higher among infants with uneducated mothers in all regions. At the state level, the highest SII was in Imo state (196 deaths per 1,000 live births)with infant mortality higher among infants with uneducated mothers.

4.20.3 Slope index of inequality by mother's age

In 2003, the absolute difference or change in IMR moving from young mothers under 20 to mothers 35 or older was 10 deaths per 1,000 live births with the positive sign indicating that infant mortality was higher among infants with mothers 35 years or older. In rural areas, the SII was 22 deaths per 1,000 live births (with infant mortality higher among infants with mothers 35 or older) while in urban areas, the SII was 13 deaths per 1,000 live births (with infant mortality higher among infants with young mothers). Regionally, the SII ranged from 22deaths per 1,000 live births in the Northwest to as high as 129 deaths per 1,000 live births in the Southeast. At the state level, the highest SII was in Ebonyi and AkwaIbom states (313 and 304 deaths per 1,000 live births, respectively) with infant mortality higher among infants with mothers 35 years or older.

In 2008, the SII in IMR by mother's age was 8 deaths per 1,000 live births with infant mortality higher among infants with mothers 35 or older. In rural and urban areas, the SII was 4 and 17 deaths per 1,000 live births, respectively with IMR concentrated among infants with mothers 35 or older. Regionally, the SII ranged from 2 deaths per 1,000 live births in the Northeast to 58 deaths per 1,000 live births in the Southeast with infant mortality higher among infants with older mothers except in the Northcentral and Northwest. At the state level, the highest SII in IMR by mother's age was in Abia (138 deaths per 1,000 live births) with infant mortality higher among infants with mothers over 35 years.

In 2013, the SII in IMR by mother's age indicates no significant absolute difference or change in IMR moving from young mothers under 20 to mothers 35 or older in Nigeria. However, in rural areas, the SII in IMR by mother's age was 1 death per 1,000 live births (with infant mortality higher among infants with young mothers) while in urban areas, the SII was 10 deaths per 1,000 live births (with infant mortality higher among infants with mothers 35 or older). Regionally, the SII ranged from 2 deaths per 1,000 live births in the Southsouth to 40 deaths per 1,000 live births in the Southeast with infant mortality higher among infants with young mothers in the Northcentral, Northeast and Southsouth. At the state level, the highest SII was in Taraba state (115 deaths per 1,000 live births), with IMR higher among infants with young mothers suggesting that IMR decreased with the increase in the age of mothers.

Table 4.41

Slope Index of Inequality in Infant Mortality by Regions and by Place of Residence in Nigeria.									
Region/Place of Residence	SII by Wealth			SII by Mother's Education			SII by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
NorthCentral	-111.1	-44.4	-16.2	-71.5	-29.6	-1.6	-33.4	-10.6	-19.1
Northeast	-37.8	-51.9	-54.4	6.9	-23.7	-10.6	-23.9	1.6	-15.3
Northwest	-61.5	-20.7	-60.1	-101.7	-19.6	-69.6	22.3	-9.4	3.4
Southeast	-228.7	-17.3	-64.5	-151.7	-24.6	-68.8	129.4	57.8	39.6
Southsouth	-98.4	-26.4	-10.4	18.4	-5.8	-12.7	88.8	11.4	-2.0
Southwest	-67.0	-40.1	9.5	-11.6	-54.6	-33.7	-42.3	36.0	13.1
Urban	-112.9	-43.2	-33.4	-118.2	-25.4	-34.0	-12.8	16.9	10.2
Rural	-69.9	-12.5	-30.1	-8.3	-18.7	-22.1	21.9	3.9	-1.3
NATIONAL	-87.4	-38.0	-44.0	-55.7	-31.2	-35.2	9.6	7.5	0.4
Slope Index of Inequality in Child Mortality by Regions and by Place of Residence in Nigeria.									
Region/Place of Residence	SII by Wealth			SII by Mother's Education			SII by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
NorthCentral	-19.4	-10.7	-16.7	-91.4	-41.1	-22.9	130.6	5.8	-2.9
Northeast	-42.9	-35.2	-50.8	-64.5	-32.8	-25.7	65.6	48.7	-8.6
Northwest	-83.1	-60.9	-66.4	-85.9	-24.8	-50.6	1.6	46.6	7.1
Southeast	-61.9	-13.7	-27.3	-46.1	-15.5	-27.5	46.8	6.9	17.2
Southsouth	-21.5	-9.1	-22.0	7.5	-31.3	-14.2	-9.6	11.8	20.4
Southwest	-19.2	-16.8	-16.9	-6.8	-5.6	-27.9	32.7	14.1	21.7
Urban	-64.6	-44.7	-26.5	-76.9	-43.5	-20.9	22.3	12.4	10.0
Rural	-52.8	-41.3	-48.7	-79.3	-45.6	-43.9	41.3	30.8	7.4
NATIONAL	-71.8	-55.7	-53.8	-92.1	-57.0	-48.0	33.2	25.5	6.1
Slope Index of Inequality in Under 5 Mortality by Regions and by Place of Residence in Nigeria.									
Region/Place of Residence	SII by Wealth			SII by Mother's Education			SII by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
NorthCentral	-124.4	-52.9	-31.7	-156.3	-64.9	-23.2	96.9	-4.7	-21.8
Northeast	-74.0	-79.5	-100.8	-47.6	-52.8	-34.8	41.1	45.9	-22.6
Northwest	-134.8	-75.6	-120.0	-170.6	-39.1	-114.9	25.7	33.9	10.0
Southeast	-259.2	-28.2	-88.7	-193.1	-37.9	-89.9	170.8	61.9	55.3
Southsouth	-110.7	-34.0	-30.3	24.6	-31.9	-25.8	77.2	24.1	17.2
Southwest	-63.1	-53.3	-7.4	-6.7	-58.4	-60.5	-14.1	47.4	33.8
Urban	-166.3	-82.8	-57.8	-186.0	-66.4	-53.7	3.4	27.9	19.4
Rural	-111.4	-50.1	-74.5	-80.8	-59.9	-62.0	-44.9	31.8	5.7
NATIONAL	-147.4	-88.3	-93.1	-137.5	-82.9	-79.9	38.8	30.6	5.9

Note: SII retains the same unit as mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time.
Calculated by Author

Table 4.42: SIIin Infant Mortality by Wealth, Mother's Education and Mother's Age.

STATE	SII by Wealth			SII by Mother's Education			SII by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	-221.2	-25.8	27.3	-177.3	-128.9	81.7	200.0	137.8	-70.9
Abuja	N/A	55.9	-10.2	N/A	-24.4	-7.2	N/A	11.8	73.5
Adamawa	-205.4	-99.1	-70.7	-213.4	-83.8	42.6	-187.8	27.4	-15.9
Akwa Ibom	-190.7	-33.6	-34.9	-9.1	-62.3	-10.3	303.8	-27.2	-54.8
Anambra	-141.3	21.8	-95.9	-68.2	21.2	-99.7	126.8	-34.7	93.4
Bauchi	109.2	10.8	-117.5	-58.8	74.1	-105.8	22.2	-57.3	-74.2
Bayelsa	303.1	-51.6	38.8	343.9	-20.0	-37.9	123.8	-69.5	8.7
Benue	-142.4	-60.6	-19.4	-213.9	28.6	-18.2	12.7	-22.8	-18.8
Borno	1.7	-75.4	36.2	-111.6	-37.2	41.9	11.8	18.4	50.7
Cross River	-152.4	-22.7	41.2	103.5	59.5	-18.4	-7.8	17.4	10.4
Delta	-296.4	-18.6	-114.2	7.7	0.6	1.7	-26.7	42.4	-56.1
Ebonyi	-158.8	-30.5	-116.3	160.4	-50.0	-116.4	313.2	75.2	103.2
Edo	272.9	-82.4	-28.4	15.6	-91.0	-57.3	-87.9	-5.9	6.3
Ekiti	-127.0	-66.9	-27.2	97.9	-68.1	-111.6	84.2	-19.2	20.7
Enugu	-165.7	-21.5	18.8	-64.4	-112.4	28.9	71.5	72.0	5.4
Gombe	-21.0	-42.3	18.8	295.4	-52.5	-32.8	62.4	8.3	34.3
Imo	-190.3	83.8	-78.7	18.8	111.3	-196.2	-15.0	57.7	-10.3
Jigawa	-9.9	18.7	-15.4	-135.6	73.7	-56.1	143.6	37.8	8.8
Kaduna	-148.9	-55.1	-18.9	-204.6	-11.9	-17.8	163.1	-0.7	-17.7
Kano	-3.1	-41.4	-64.3	-74.8	-72.1	-75.5	-28.2	1.4	21.2
Katsina	-17.9	-0.5	-19.2	22.8	-8.5	2.8	-125.5	-27.5	68.8
Kebbi	-22.3	-16.9	4.4	-196.3	-17.2	12.7	-45.0	-93.2	33.1
Kogi	-185.0	26.1	-2.9	32.0	-17.1	-61.8	177.4	57.3	48.3
Kwara	N/A	12.7	2.1	N/A	-22.2	-4.1	N/A	-38.3	-66.2
Lagos	104.8	68.6	-98.6	15.3	-29.4	-88.3	-7.4	40.1	-59.3
Nasarawa	51.1	-38.6	-4.3	-410.3	-30.9	-8.4	-198.9	-79.5	-57.6
Niger	-16.9	-51.7	-2.3	61.6	-98.7	-14.0	-84.8	19.3	-19.4
Ogun	-151.4	-83.1	-8.3	-97.4	-68.1	-42.8	-62.8	72.6	59.4
Ondo	177.8	28.9	-28.3	3.9	48.2	-43.2	-236.4	-7.1	83.0
Osun	82.9	-114.4	13.5	120.9	-40.4	-10.9	-111.2	66.3	82.7
Oyo	-67.4	-61.4	70.8	-26.3	-135.9	5.8	-23.9	27.6	-7.7
Plateau	-73.7	-63.9	-8.6	105.7	-61.6	41.3	-173.6	-82.7	-23.3
Rivers	-345.6	-26.5	28.9	-90.8	53.4	10.4	114.7	71.9	75.2
Sokoto	-23.8	-43.3	-77.4	133.2	-52.5	-74.1	107.6	82.4	-44.9
Taraba	-293.9	-67.1	-53.0	116.6	-89.2	11.1	-121.3	32.4	-114.9
Yobe	-35.6	-62.6	-108.9	118.7	-6.9	-111.1	-109.8	37.4	21.2
Zamfara	-152.3	-72.4	-92.6	-197.6	-51.9	-12.4	-23.9	-115.3	-84.5

Note: SII retains the same unit as mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time.
Calculated by Author

4.21 Slope index of inequality in child and under 5 mortality rate in Nigeria

Table 4.41, 4.43 and 4.44 presents the SII in child and under 5 mortality by wealth, mother's level of education and mother's age, regionally, by place of residence and across states.

4.21.1 Slope index of inequality in child and under 5 mortality rate by wealth index

The SII in CMR by wealth for 2003 indicates that the absolute difference or change in CMR across wealth groups from the poorest to the richest group was 72 deaths per 1,000 children surviving to age one. The negative sign indicates that mortality was higher among children in the poorest homes. In rural and urban areas, the SII in CMR by wealth was 53 and 65 deaths per 1,000 children surviving to age one, respectively with CMRs highest among the poor. Regionally, the SII was highest in the Northwest (83 deaths per 1,000 children surviving to age one) with CMRs higher among the poorest in all regions. At the state level, the highest SII was in Bayelsa state (393 deaths per 1,000 children surviving to age one) with child mortality higher among the rich.

With regards to under 5 mortality, the SII indicates that the absolute difference in U5MR across wealth groups from the poorest to the richest group was 147 deaths per 1,000 live births with mortality higher among under 5 children in the poorest homes. In rural and urban areas, the SII in U5MR by wealth was 111 and 166 deaths per 1,000 live births, respectively with U5MR higher among the poor. Regionally, the SII was highest in the Southeast (259 deaths per 1,000 live births in the Southeast) with U5MR higher among the poor in all regions. At the state level, the highest SII was in Bayelsa state (606 deaths per 1,000 live births) with U5MR higher among the rich or better off group.

In 2008, the absolute difference in CMR across wealth groups was 56 deaths per 1,000 children surviving to age one with mortality higher among children in poor homes. The pattern was the same in rural and urban areas. Regionally, the SII was highest in the Northwest (61 deaths per 1,000 children surviving to age one in the Northwest) with CMR higher among the poor in all regions. At the state level, the highest SII was in Anambra (137 deaths per 1,000 children surviving to age one) with CMR higher among the poor. With regards to under 5 mortality, the SII in U5MR across wealth groups was 88 deaths per 1,000 live births with the negative sign indicating that mortality was higher among under 5 children in the poorest homes. In rural and urban areas, the SII was much higher in urban than in rural areas (83 and 50 deaths per 1,000 live births, respectively) with U5MR higher among the poorest. Regionally, the SII was highest in the Northeast (80 deaths per

1,000 live births in the Northeast) indicating much wider absolute inequalities in U5MRs by wealth in this region. At the state level, the highest SII was in Kano state (128 deaths per 1,000 live births) with U5MR higher among the poor suggesting that mortality rate decreased up the socioeconomic hierarchy from the poorest to the richest.

In 2013, the absolute difference or change in CMR across wealth groups from the poorest to the richest group was 54 deaths per 1,000 children surviving to age one with mortality higher among children in poor homes. The SII by wealth was significantly larger in rural than in urban areas (49 and 27 deaths per 1,000 children surviving to age one, respectively) with child mortality concentrated among the poorest. This suggests that disparities in wealth had a lot more impact on CMRs in rural areas. Regionally, the SII was highest in the Northwest (66 deaths per 1,000 children surviving to age one) with child mortality higher among the poor in all regions. At the state level, the highest SII was in Lagos state (107 deaths per 1,000 children surviving to age one, respectively) with child mortality highest among the poor.

The absolute difference in U5MR across wealth groups from the poorest to the richest group was 93 deaths per 1,000 live births with mortality higher among under 5 children in poor homes. In rural and urban areas, the SII in U5MR by wealth was 75 and 58 deaths per 1,000 live births, respectively with U5MR higher among the poorest. Regionally, the absolute difference in U5MR among wealth groups as indicated by the SII, ranged from 7 to 120 deaths per 1,000 live births in the Southwest and Northwest, respectively with mortality higher among the poorest in all regions. At the state level, the highest SII was in Yobe and Lagos states (198 and 194 deaths per 1,000 live births, respectively) with U5MR higher among the poor.

4.21.2 Slope index of inequality in child and under 5 mortality rate by mother's education

In 2003, the absolute difference or change in CMR moving from uneducated mothers to mothers with secondary and higher level of education was 92 deaths per 1,000 children surviving to age one with mortality higher among children with uneducated mothers. The SII by mother's level of education was also high in rural and urban areas (79 and 77 deaths per 1,000 children surviving to age one, respectively). Regionally, the SII ranged from 7 to 91 deaths per 1,000 children surviving to age one in the Southwest and Northcentral, respectively with mortality higher among children with uneducated mothers in all regions except in the Southsouth. At the state level, the highest SII was in Zamfara state (242 deaths per 1,000 children surviving to age one) though with child mortality higher amongchildren with uneducated mothers. With regards to under 5 mortality, the SII indicates that the absolute difference in U5MR from the uneducated to the most educated group was 138 deaths per 1,000 live births with mortality higher among under 5 children with uneducated mothers. The SII was significantly higher in urban than in rural areas (186 and 81 deaths per 1,000 live births, respectively) with thehighest U5MRs among children with the least educated mothers. Regionally, the SII was highest in the Southeast (193 deaths per 1,000 live births) with mortality higher among those with uneducated mothers in all regions except the Southsouth. At the state level, the highest SII was in Nasarawa and Kebbi states (504 and 314 deaths per 1,000 live births, respectively) with higher U5MR among children of the uneducated mothers. This suggests that mortality rate substantially decreased up the socioeconomic hierarchy from the uneducated to the most educated mothers.

In 2008, the SII in CMR by mother's education was 57 deaths per 1,000 children surviving to age one with mortality higher among children with uneducated mothers. The pattern was similar in rural and urban areas (46 and 44 deaths per 1,000 children surviving to age one, respectively). Regionally, the SII was highest in the Northcentral (41 deaths per 1,000 children surviving to age one) with higher mortality among children with the least educated mothers in all regions. At the state level, the highest SII was in Yobestate (109 deaths per 1,000 children surviving to age one) with CMR higher among children with uneducated mothers. With regards to U5MR, the SII was 83 deaths per 1,000 live births with mortality higher among under 5 children with uneducated mothers. Similar patterns were found in rural and urban areas. Regionally, the SII ranged from 32 to 65 deaths per 1,000 live births in the Southsouth and Northcentral, respectively withmortality higher among children with uneducated mothers in all regions. At the state level, the highest SIIwas in Abia state (174 deaths per 1,000 live births) with U5MR higher among children with uneducated mothers.

In 2013, the absolute difference in CMR by education was 48 deaths per 1,000 children surviving to age one with mortality higher among children with uneducated mothers. In rural and urban areas, the SII by mother's level of education was 44 and 21 deaths per 1,000 children surviving to age one, respectively. Regionally, the SII was highest n the Northwest(51 deaths per 1,000 children surviving to age one) with higher mortality among children with uneducated mothers in all regions. At the state level, the highest levels of absolute inequality in CMR by education was in Zamfara state (106 deaths per 1,000 children surviving to age one)with CMR higher among children with uneducated mothers. With regards to U5MR, the SII was 80 deaths per 1,000 live births nationally and 62 and 54 deaths per 1,000 live births, respectively in rural and urban areas with mortality higher among under 5 children with uneducated mothers. Regionally, the SII was highest in the Northwest (115 deaths per 1,000 live births) with higher mortality among under 5 children with uneducated mothers in all regions. At the state level, the highest SII in U5MR by education was in Zamfara (246 deaths per 1,000 live births) with U5MR higher among children with uneducated mothers.

4.21.3 Slope index of inequality in child and under 5 mortality rate by mother's age

The SII in CMR by mother's age in 2003 was 33 deaths per 1,000 children surviving to age one with the positive sign indicating that child mortality was higher among mothers 35 or older. The pattern was the same by place of residence especially in rural areas. Regionally, the SII in CMR among maternal age groups ranged from 2 to 131 deaths per 1,000 children surviving to age one in the Northwest and Northcentral, respectively with mortality higher among children with mothers 35 or older in all regions. At the state level, the highest SII was in Kogi state (281 deaths per 1,000 children surviving to age one) with higher CMR among children with mothers 35 or older suggesting that the disparity in CMR substantially increased with the increase in maternal age.

With regards to under 5 mortality, the SII was 39 deaths per 1,000 live births with higher mortality among under 5 children with mothers 35 or older. In rural areas, the SII was 45 deaths per 1,000 live births with mortality higher among under 5 children with teenage mothers while in urban areas, the SII was significantly lower (3 deaths per 1,000 live births) with mortality higher among under 5 children with mothers 35 or older. This suggests that maternal age had a more significant influence on U5MRs in rural areas. Regionally, the SII ranged from 14 to 171 deaths per 1,000 live births in the Southwest and Southeast, respectively with mortality higher among under 5 children with mothers 35 or older in all regions except the Southwest. At the state level, the highest SII was in Kogi and AkwaIbom states (417 and 416 deaths per 1,000 live births, respectively) with U5MR higher among children with mothers 35 or older which suggests that maternal age had some impact on U5MRs in these states.

In 2008, the SII in CMR by mother's age was 26 deaths per 1,000 children surviving to age one with mortality higher among children with mothers 35 or older. The pattern was similar in both rural and urban areas. Regionally, the SII was highest in the Northeast (49 deaths per 1,000 children surviving to age one) with mortality higher among children with

Table 4.43: SII in Child Mortality by Wealth, Mother's Education and Mother's Age.

STATE	SII by Wealth			SII by Mother's Education			SII by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	N/A	42.4	-52.0	N/A	-39.9	-53.8	N/A	14.8	31.7
Abuja	111.2	-14.2	-25.7	-37.0	-4.3	-66.5	257.2	-38.6	-22.9
Adamawa	-51.3	-0.9	-15.2	12.4	43.4	28.8	-17.0	81.4	-19.6
Akwa Ibom	-56.6	-26.9	-27.9	-21.9	-34.0	10.4	135.1	-0.8	30.7
Anambra	N/A	-136.9	-45.6	N/A	-23.7	-12.3	N/A	10.0	0.7
Bauchi	-25.4	-47.8	-68.4	-44.3	-27.2	-13.2	21.2	57.8	-20.9
Bayelsa	392.7	27.8	-4.3	73.5	-50.7	-11.0	-211.9	-19.2	42.2
Benue	-9.4	-8.2	-41.3	-14.5	-34.3	-41.4	15.6	-32.2	45.3
Borno	-101.7	-46.1	3.9	-59.7	-40.0	-12.7	-24.2	50.2	-36.6
Cross River	52.3	-6.4	-26.8	-82.1	-30.2	-39.2	-20.1	16.4	-13.5
Delta	-65.2	-5.4	-5.9	-49.4	17.4	2.3	-29.9	16.4	27.0
Ebonyi	-117.6	-2.5	-30.7	-49.5	-20.4	6.7	84.8	-0.1	30.5
Edo	-103.2	-20.7	-15.2	82.3	-32.9	-26.7	17.9	40.6	25.7
Ekiti	100.0	-50.8	12.8	-79.7	-14.9	12.6	250.0	-7.4	-13.2
Enugu	-79.8	-6.6	-18.3	-121.4	-33.9	-50.9	86.3	41.4	30.6
Gombe	-95.6	-33.8	-101.5	-149.2	-52.6	-31.9	181.4	11.4	19.8
Imo	-153.2	-12.3	21.1	19.0	5.4	10.0	50.9	-8.4	8.4
Jigawa	-136.6	3.1	-80.7	-135.8	16.5	-16.2	59.0	41.1	-0.3
Kaduna	-43.3	-72.9	8.6	-108.3	-58.9	-9.7	-26.4	85.7	2.9
Kano	-81.2	-100.3	-50.0	-62.9	-37.3	-42.0	50.1	31.6	-13.5
Katsina	9.6	-56.8	-81.8	-72.2	-29.5	-30.3	-12.0	76.1	38.6
Kebbi	-26.4	-23.2	-70.6	-130.6	39.9	-18.4	-97.1	31.4	16.2
Kogi	180.2	-6.6	-37.1	-173.3	-4.9	-80.3	280.8	-12.4	15.3
Kwara	N/A	1.2	-59.5	N/A	0.4	-63.1	N/A	33.8	-19.7
Lagos	33.2	-59.8	-107.4	-4.6	-27.1	-24.5	17.9	8.7	9.9
Nasarawa	-129.1	17.4	2.4	-111.2	-19.4	-33.7	180.9	-17.4	-3.5
Niger	-110.7	-18.0	0.4	-151.8	-11.6	16.0	211.7	14.9	-8.8
Ogun	-31.5	15.6	5.7	-16.7	11.4	9.7	62.8	-25.8	18.0
Ondo	-106.7	6.9	-31.4	-46.3	3.9	-21.4	136.7	128.2	70.7
Osun	86.4	-3.3	11.1	128.1	-20.6	-8.8	-117.6	-27.0	12.2
Oyo	56.7	-10.8	-5.8	-26.9	6.9	-51.6	-48.2	1.9	19.3
Plateau	-34.3	-22.8	-12.6	-8.4	-28.5	-14.4	56.7	39.8	-41.1
Rivers	-11.7	-15.1	-27.3	70.4	-65.8	-6.2	-93.5	18.1	22.2
Sokoto	124.9	-9.1	-42.7	-198.6	53.4	-45.8	-18.1	50.2	5.9
Taraba	57.1	0.0	-15.6	-5.9	-61.9	-44.1	124.4	34.6	9.4
Yobe	-170.4	-44.9	-95.6	-151.2	-109.4	-70.6	208.9	35.7	-1.7
Zamfara	-63.4	-25.6	-100.5	241.8	-1.8	-106.4	5.2	-17.0	19.2

Note: SII retains the same unit as child mortality rate
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time.
Calculated by Author

Table 4.44: SII in Under 5 Mortality by Wealth, Mother's Education and Mother's Age.

STATE	SII by Wealth			SII by Mother's Education			SII by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	-221.2	11.4	1.4	-177.3	-174.7	32.2	200.0	150.1	-42.8
Abuja	111.2	41.4	-38.4	-37.0	-27.8	-40.1	257.2	5.7	62.0
Adamawa	-240.7	-97.5	-83.5	-145.6	-52.1	68.2	-200.9	98.2	-31.8
Akwa Ibom	-248.4	-65.6	-53.1	-13.6	-95.8	-23.3	416.1	-23.4	-38.4
Anambra	-141.3	-115.1	-136.1	-68.2	-1.8	-106.0	126.8	-23.6	89.1
Bauchi	77.8	-26.7	-184.1	-92.7	45.2	-113.2	25.2	-0.3	-83.6
Bayelsa	605.9	-25.1	20.4	299.7	-39.3	-30.9	-146.1	-84.8	46.9
Benue	-179.9	-58.5	-54.2	-224.9	-3.2	-57.4	26.5	-50.9	24.8
Borno	-89.2	-112.4	37.8	-165.0	-70.4	28.7	-6.2	69.4	14.6
Cross River	-102.5	-21.8	15.3	-10.2	29.2	-61.6	-27.4	32.6	1.1
Delta	-342.0	-23.2	-135.6	-17.2	21.1	-8.6	-51.4	58.9	-30.4
Ebonyi	-243.0	-31.8	-141.9	98.2	-56.0	-113.9	363.6	59.7	127.2
Edo	158.3	-85.3	-42.8	95.6	-118.3	-54.0	-65.7	31.9	38.6
Ekiti	-222.2	-107.9	-15.2	19.6	-79.8	-99.6	306.4	-25.9	8.1
Enugu	-236.2	-36.1	7.6	-89.9	-139.8	-6.7	150.9	91.7	36.3
Gombe	-128.2	-72.6	-76.3	139.2	-113.7	-61.3	193.3	1.9	50.4
Imo	-313.1	63.8	-48.3	-212.2	113.3	-184.0	36.0	53.8	-1.9
Jigawa	-139.1	10.9	-95.0	-236.2	83.4	-68.2	174.4	72.8	8.1
Kaduna	-187.9	-115.7	-7.4	-295.2	-63.9	-23.7	158.1	84.7	-14.4
Kano	-83.5	-127.6	-110.1	-131.2	-102.1	-111.8	4.9	26.9	5.6
Katsina	-9.9	-55.6	-100.7	-51.4	-23.7	-31.4	-158.9	40.7	106.4
Kebbi	-44.9	-37.9	-59.9	-314.0	71.4	-4.6	-94.7	-59.9	46.4
Kogi	-12.4	30.9	-38.4	-134.1	-20.1	-139.3	416.9	44.0	41.1
Kwara	N/A	23.3	-26.9	N/A	-33.8	-63.8	142.8	13.1	-83.8
Lagos	135.4	9.4	-194.2	28.2	-54.1	-103.6	10.0	47.6	-50.9
Nasarawa	-46.0	-22.4	-1.9	-503.9	-48.7	-47.8	-30.4	-93.9	-59.4
Niger	-119.5	-64.4	1.2	-68.1	-94.5	-0.2	132.8	31.7	-27.3
Ogun	-130.9	-75.9	5.2	-63.5	-57.2	-38.4	-28.1	47.2	75.5
Ondo	-10.2	35.1	-43.3	-35.3	50.8	-80.2	-100.1	127.1	146.1
Osun	238.7	-116.1	24.3	241.6	-59.5	-13.2	-315.8	40.1	77.7
Oyo	-12.9	-64.1	62.6	-52.6	-127.9	-49.2	-71.5	28.6	10.6
Plateau	-91.8	-83.7	-20.1	96.6	-84.8	28.2	-112.7	-44.3	-61.5
Rivers	-321.4	-36.9	6.2	8.6	-10.8	8.3	34.2	86.3	103.9
Sokoto	94.9	-50.9	-105.7	-51.2	1.9	-114.5	82.3	120.3	-37.2
Taraba	-203.3	-76.2	-66.0	98.3	-136.6	-18.2	-6.8	62.2	-103.1
Yobe	-211.1	-101.9	-198.0	-60.3	-109.6	-176.0	147.3	67.6	20.8

Zamfara	-197.9	-114.9	-186.1	56.8	-50.4	-246.3	5.1	-123.8	-57.4
Note: SII retains the same unit as under 5 mortality rate Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time. Calculated by Author									

mothers 35 or older in all regions. At the state level, the highest SII was in Ondo state (128 deaths per 1,000 children surviving to age one) with CMR higher among children with mothers 35 or older. With regards to U5MR, the SII was 31 deaths per 1,000 live births with mortality higher among under 5 children with mothers 35 or older. A similar pattern was identified in rural and urban areas. Regionally, the SII was highest in the Southeast (62 deaths per 1,000 live births) with mortality higher among under 5 children with mothers 35 or older in all regions except the Northcentral region. At the state level, the highest SII was in Abia state (150 deaths per 1,000 live births) with U5MR higher among children with mothers 35 or older suggesting that the disparity in CMR significantly increased with maternal age.

In 2013, the absolute difference in CMR was 6 deaths per 1,000 children surviving to age one nationally and 7 and 10 deaths per 1,000 children surviving to age one, respectively in rural and urban areas. CMR was higher among children with mothers 35 or older. Regionally, the SII ranged from 3 to 22 deaths per 1,000 live births in the Northcentral and Southwest, respectively with mortality higher among children with mothers 35 or older in all regions except in the Northcentral and Northeast. At the state level, the highest absolute inequality was in Ondo state (71 deaths per 1,000 children surviving to age one) with CMR concentrated among children with mothers 35 or older.

With respect to under 5 mortality, the SII was 6 deaths per 1,000 live births with mortality higher among under 5 children with mothers 35 or older. Similar absolute inequalities were found in rural and urban areas. Across regions, the SII was highest in the Southeast (55 deaths per 1,000 live births) with mortality higher among under 5 children with mothers 35 or older in all regions except the Northcentral and Northeast regions. At the state level, the highest SII was in Ondo state (146 deaths per 1,000 live births) with mortality higher among under 5 children with mothers 35 or older.

4.22 Concentration Index (CI) of infant mortality rates in Nigeria

The concentration index was computed at the national, regional, rural, urban and state level for all three surveys. Like the SII, signs indicate the direction and strength of the relationship between mortality rates and the socioeconomic indicator. Negative values infer that mortality falls disproportionately among lower socioeconomic groups while positive values infer that mortality falls disproportionately among higher socioeconomic groups.To examine the pattern of socioeconomic inequalities, maps based on state concentration indices were classified into two main categories consisting of three classes each – low, middle and high- using a natural break classification scheme while changes in inequality over time were examined using concentration curves (CC). Table 4.45 and 4.46 presents the CI in IMR by wealth, mother's level of education and mother's age.

4.22.1 Concentration index of infant mortality by wealth index

In 2003, infant mortality fell disproportionately among the poor (i.e. in favour of the rich) nationally (-0.139) and in rural and urban areas (-0.093 and -0.158, respectively). Regionally, relative inequalities in IMR among wealth groups as indicanted by the CI, was highest in the Southeast (-0.534) with IMR higher among the poor i.e. in favour of the rich in all regions. At the state level, the CI was especially high in Imo (-0.947) and Oyo states (-0.794) with infant mortality higher among the poor. In 2008, infant mortality fell disproportionately among the poor, nationally (-0.076) and in both rural (-0.020) and urban (-0.076) areas. Regionally, the CI was highest in the Northcentral (-0.089) and Southwest (-0.083) with IMR higher among the poor in all regions. Across states, the highest CI was in Osun state (-0.421) with IMR higher among the poor. In 2013, infant mortality fell disproportionately among the poor nationally (-0.098). and in both rural (-0.050) and urban (-0.065) areas indicating inequality in IMRs in favour of the rich. Regionally, the CI was highest in the Southeast (-0.119) with IMR higher among the poor and lowest in the Southwest (0.016) with IMR higher among the rich. At the state level, Delta state had the highest CI (-0.215) while Kwara state had the lowest (0.004).

Figure 4.23a-c shows that relative inequalities in IMR by wealth were mainly to the disadvantage of the poor (pro-rich inequality) in most states. In addition, the concentration curves (CC) are above the line of equality in all plots for 2003, 2008 and 2013 which indicates persistent inequalities in IMR by wealth with infant deaths concentrated among the poor over time (See Appendix 51a-h).

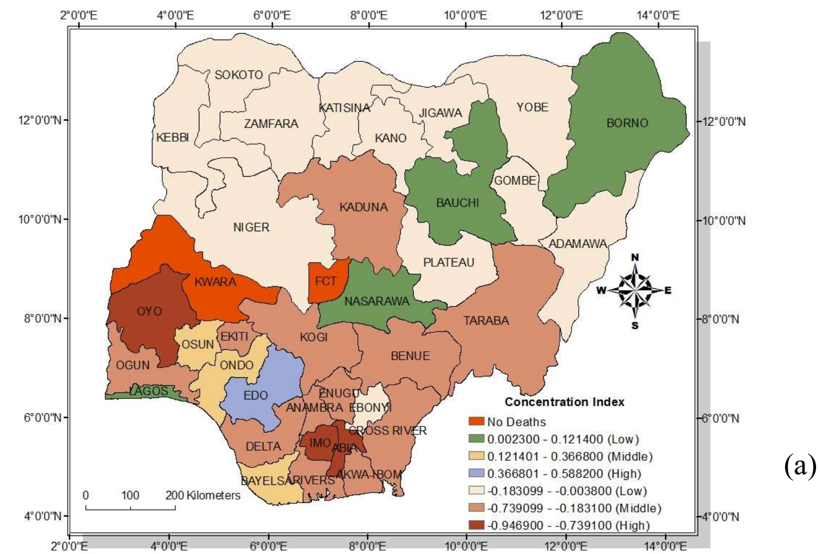
4.22.2 Concentration index of infant mortality by mother's education

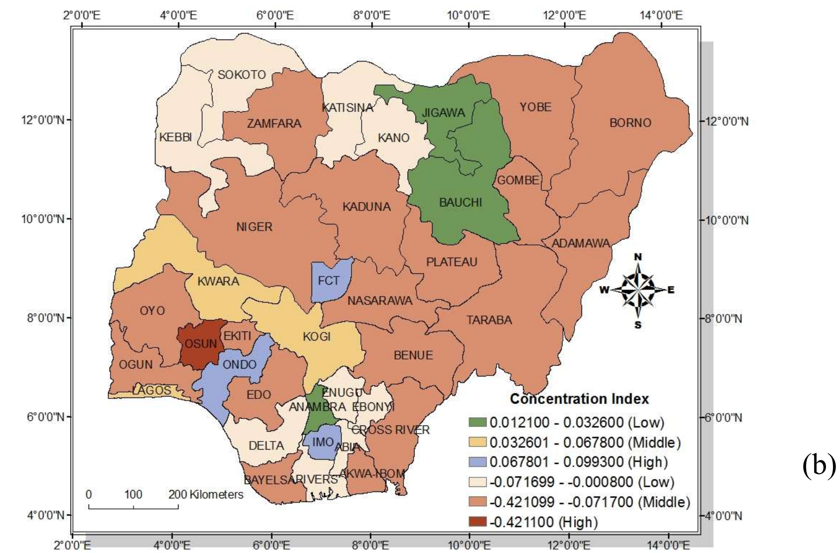
In 2003, infant mortality fell disproportionately among infants with uneducated mothers (i.e. in favour of infants with the most educated mothers) nationally (-0.086) and in rural (-0.011) and urban (-0.253) areas. However, inequalities or disparities in IMRs were significantly higher in urban areas suggesting that differences in maternal education had a much stronger impact on IMRs in urban areas. Regionally, the CI was highest in the Southeast (-0.387) with IMR higher among infants with uneducated mothers. At the state

Table 4.45

Concentration Index for Infant Mortality by Regions and by Place of Residence in Nigeria.									
Region/Place of Residence	CI by Wealth			CI by Mother's Education			CI by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
NorthCentral	-0.182	-0.089	-0.043	-0.116	-0.060	-0.004	-0.037	-0.016	-0.034
Northeast	-0.048	-0.068	-0.097	0.007	-0.030	-0.018	-0.027	0.002	-0.026
Northwest	-0.091	-0.033	-0.091	-0.103	-0.023	-0.086	0.025	-0.014	0.005
Southeast	-0.534	-0.028	-0.119	-0.387	-0.038	-0.108	0.280	0.078	0.059
Southsouth	-0.142	-0.052	-0.026	0.025	-0.011	-0.030	0.096	0.017	-0.005
Southwest	-0.114	-0.083	0.016	-0.028	-0.139	-0.080	-0.080	0.072	0.026
Urban	-0.158	-0.076	-0.065	-0.253	-0.063	-0.089	-0.020	0.030	0.021
Rural	-0.093	-0.020	-0.050	-0.011	-0.032	-0.038	0.024	0.006	-0.002
NATIONAL	-0.139	-0.076	-0.098	-0.086	-0.063	-0.077	0.011	0.011	0.001
Concentration Index for Child Mortality by Regions and by Place of Residence in Nigeria.									
Region/Place of Residence	CI by Wealth			CI by Mother's Education			CI by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
NorthCentral	-0.067	-0.044	-0.135	-0.308	-0.171	-0.181	0.298	0.018	-0.016
Northeast	-0.073	-0.071	-0.161	-0.089	-0.062	-0.076	0.097	0.103	-0.026
Northwest	-0.165	-0.110	-0.184	-0.120	-0.033	-0.115	0.002	0.080	0.020
Southeast	-0.499	-0.053	-0.185	-0.490	-0.057	-0.156	0.337	0.022	0.093
Southsouth	-0.083	-0.042	-0.164	0.028	-0.132	-0.100	-0.028	0.040	0.133
Southwest	-0.085	-0.120	-0.118	-0.043	-0.049	-0.265	0.161	0.097	0.171
Urban	-0.184	-0.169	-0.182	-0.352	-0.231	-0.193	0.074	0.047	0.072
Rural	-0.106	-0.102	-0.158	-0.155	-0.121	-0.149	0.067	0.068	0.023
NATIONAL	-0.185	-0.184	-0.268	-0.230	-0.190	-0.236	0.063	0.064	0.023
Concentration Index for Under 5 Mortality by Regions and by Place of Residence in Nigeria.									
Region/Place of Residence	CI by Wealth			CI by Mother's Education			CI by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
NorthCentral	-0.141	-0.073	-0.063	-0.175	-0.091	-0.046	0.073	-0.005	-0.029
Northeast	-0.056	-0.065	-0.117	-0.030	-0.041	-0.038	0.028	0.040	-0.025
Northwest	-0.119	-0.066	-0.120	-0.103	-0.025	-0.093	0.017	0.028	0.010
Southeast	-0.517	-0.033	-0.131	-0.402	-0.042	-0.113	0.289	0.060	0.066
Southsouth	-0.117	-0.048	-0.057	0.025	-0.042	-0.046	0.063	0.025	0.029
Southwest	-0.079	-0.087	-0.010	-0.012	-0.117	-0.116	-0.019	0.075	0.055
Urban	-0.161	-0.102	-0.090	0.271	-0.114	-0.110	0.004	0.035	0.031
Rural	-0.093	-0.051	-0.084	-0.066	-0.064	-0.073	-0.033	0.029	0.006
NATIONAL	-0.151	-0.113	-0.146	-0.175	-0.091	-0.046	0.029	0.030	0.007

Note: CI is unit less
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time
Calculated by Author





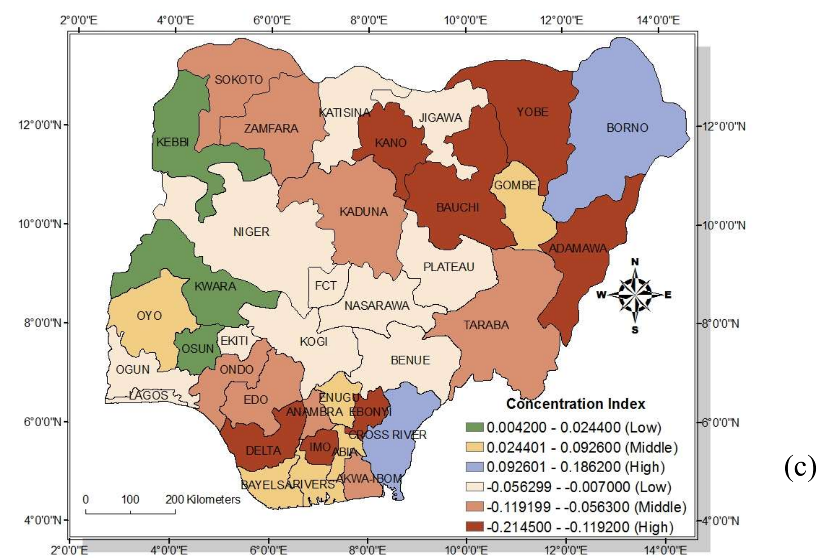


Figure 4.23a-c: Spatial Pattern of Socioeconomic Inequality in IMR by wealth in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

level, Abia and Osun stateshad the highest CI (-0.5000 and 0.48, respectively) while Ondo state had the lowest (0.005). In 2008, infant mortality fell disproportionately among the infants with uneducated mothers nationally (-0.063) as well as in rural (-0.032) and urban (-0.063) areas. Regionally, the CI was highest in the Southwest (-0.139) with IMR higher among the infants with uneducated mothers in all regions. Across states, Oyo state had the highest CI (-0.343) while Delta state had the lowest (0.001). In 2013, infant mortality fell disproportionately among the infants with uneducated mothers nationally (-0.077) as well as in rural (-0.038) and urban (-0.089) areas. Regionally, inequalities in IMR by mother's education was highest in the Southeast (-0.108) with IMR higher among infants with uneducated mothers in all regions. At the state level, the highest CI was in Edo (-0.239) and Kogi (-0.229) states in favour of those with the most educatedmothers while Katsina state had the lowest (0.005).

Figure 4.24a-c shows the spatial pattern of relative inequalities in IMR by mother's level of education across states in 2003, 2008 and 2013 based on concentration indices. Maps show that disparities in IMR by mother's level of education were mainly to the disadvantage of the lowest socioeconomic group i.e. infants with the least educated mothers especially in 2008. In addition, all curves lie above the line of equality indicating higher deaths among infants with uneducated mothers over time (See Appendix 52a-h). However, most CC lie close to the line of equality indicating relatively lower levels of disparity in IMR amongst education groups regionally especially in the Northeast and Southsouth. This suggests that IMRs are generally high among infants regardless of the level of education of their mothers in these regions.

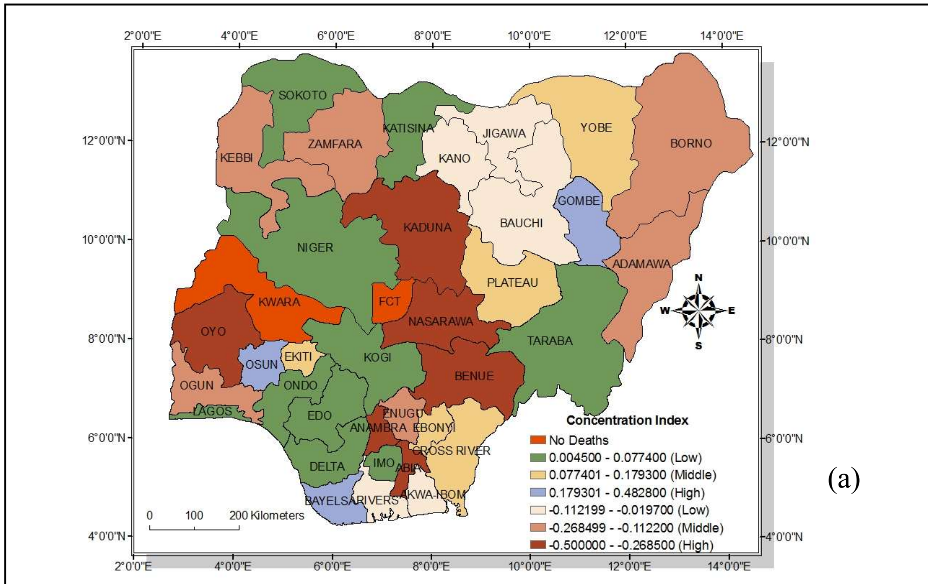
4.22.3 Concentration index of infant mortality by mother's age

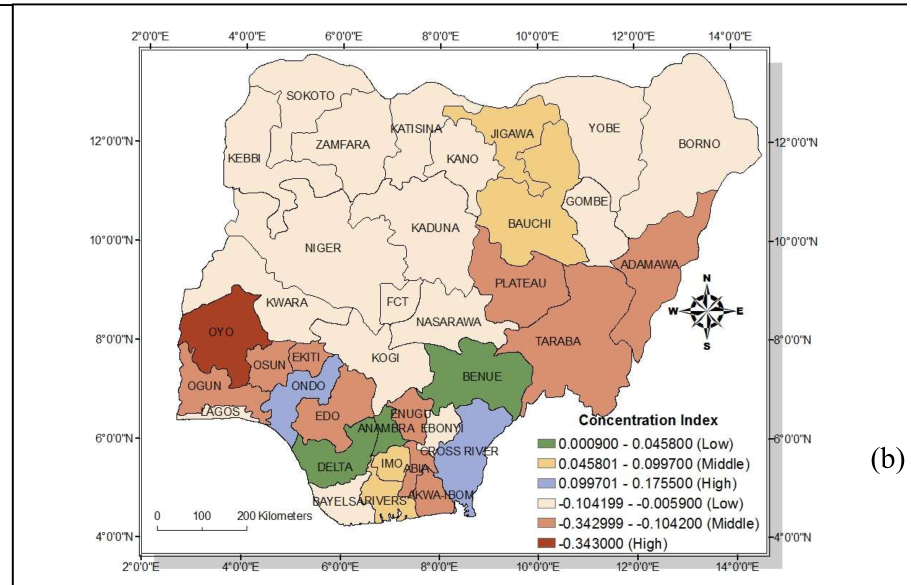
The CI (0.011) indicates some inequality in IMR by mother's age in 2003, with infant mortality falling disproportionately on the infants with mothers 35 or older. The CI indicates higher infant mortality among the infants with older mothers in rural areas (0.024) while the CI indicates higher infant mortality among the infants with teenage mothers in urban areas (-0.020). Regionally, inequalities in IMR by mother's age was highest in the Southeast (0.280) and least pronounced in the Northwest (0.025) with IMR higher among infants with mothers 35 or older except in the Northcentral, Northeast and Southwest. At the state level, inequalities in IMR by mother's age were especially high in Abia (0.565) followed by AkwaIbom (0.547) and Anambra state (0.430).

Table 4.46: CIfor Infant Mortality by Wealth, Mother's Education and Mother's Age.

STATE	CI by Wealth			CI by Mother's Education			CI by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	-0.739	-0.029	0.039	-0.500	-0.165	0.085	0.565	0.160	-0.101
Abuja	N/A	0.093	-0.018	N/A	-0.056	-0.016	N/A	0.018	0.134
Adamawa	-0.138	-0.113	-0.125	-0.196	-0.104	0.080	-0.136	0.030	-0.021
Akwa Ibom	-0.406	-0.073	-0.084	-0.020	-0.117	-0.022	0.547	-0.044	-0.107
Anambra	-0.323	0.033	-0.107	-0.287	0.046	-0.142	0.430	-0.061	-0.214
Bauchi	0.121	0.012	-0.120	-0.055	0.084	-0.113	0.029	-0.086	-0.102
Bayelsa	0.367	-0.077	0.093	0.448	-0.027	0.043	0.122	-0.081	0.025
Benue	-0.183	-0.076	-0.038	-0.302	0.044	-0.038	0.013	-0.024	-0.026
Borno	0.002	-0.093	0.186	-0.135	-0.030	0.143	0.012	0.022	0.189
Cross River	-0.298	-0.072	0.141	0.179	0.176	-0.060	-0.014	0.041	0.028
Delta	-0.261	-0.029	-0.215	0.007	0.001	0.004	-0.021	0.046	-0.107
Ebonyi	-0.065	-0.045	-0.201	0.124	-0.078	-0.187	0.203	0.094	-0.234
Edo	0.588	-0.119	-0.091	0.035	-0.161	-0.239	-0.174	-0.008	0.024
Ekiti	-0.205	-0.182	-0.037	0.171	-0.153	-0.054	0.096	-0.039	0.042
Enugu	-0.294	-0.039	0.042	-0.129	-0.187	0.054	0.141	0.105	0.009
Gombe	-0.032	-0.078	0.032	0.424	-0.089	-0.053	0.082	0.015	0.056
Imo	-0.947	0.099	-0.119	0.062	0.083	-0.166	-0.175	0.063	-0.015
Jigawa	-0.004	0.027	-0.013	-0.050	0.100	-0.046	0.154	0.081	0.011
Kaduna	-0.214	-0.117	-0.076	-0.269	-0.023	-0.066	0.171	-0.001	-0.051
Kano	-0.005	-0.059	-0.120	-0.098	-0.083	-0.123	-0.039	0.002	0.038
Katsina	-0.033	-0.001	-0.037	0.032	-0.006	0.005	-0.141	-0.048	0.155
Kebbi	-0.029	-0.032	0.005	-0.129	-0.013	0.008	-0.052	-0.154	0.041
Kogi	-0.418	0.068	-0.010	0.069	-0.043	-0.229	0.254	0.118	0.143
Kwara	N/A	0.054	0.004	N/A	-0.089	-0.012	N/A	-0.112	-0.099
Lagos	0.005	0.043	-0.025	0.028	-0.054	-0.130	-0.015	0.081	-0.101
Nasarawa	0.035	-0.092	-0.010	-0.291	-0.075	-0.021	-0.101	-0.140	-0.095
Niger	-0.032	-0.090	-0.007	0.077	-0.095	-0.030	-0.100	0.028	-0.037
Ogun	-0.218	-0.157	-0.016	-0.167	-0.142	-0.112	-0.075	0.116	0.108
Ondo	0.284	0.098	-0.060	0.005	0.158	-0.086	-0.296	-0.018	0.154
Osun	0.172	-0.421	0.024	0.483	-0.183	-0.033	-0.357	0.203	0.211
Oyo	-0.794	-0.122	0.033	-0.360	-0.343	-0.113	-0.226	0.047	-0.019
Plateau	-0.118	-0.106	-0.015	0.154	-0.119	0.087	-0.181	-0.114	-0.034
Rivers	-0.336	-0.054	0.054	-0.082	0.096	0.016	0.073	0.116	0.139
Sokoto	-0.019	-0.044	-0.090	0.054	-0.028	-0.036	0.125	0.111	-0.060
Taraba	-0.238	-0.097	-0.079	0.073	-0.147	0.021	-0.097	0.045	-0.162
Yobe	-0.079	-0.105	-0.123	0.163	-0.009	-0.096	-0.228	0.074	0.042
Zamfara	-0.138	-0.084	-0.056	-0.112	-0.038	-0.013	-0.019	-0.197	-0.084

Note: CI is unit less
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time.
Calculated by Author





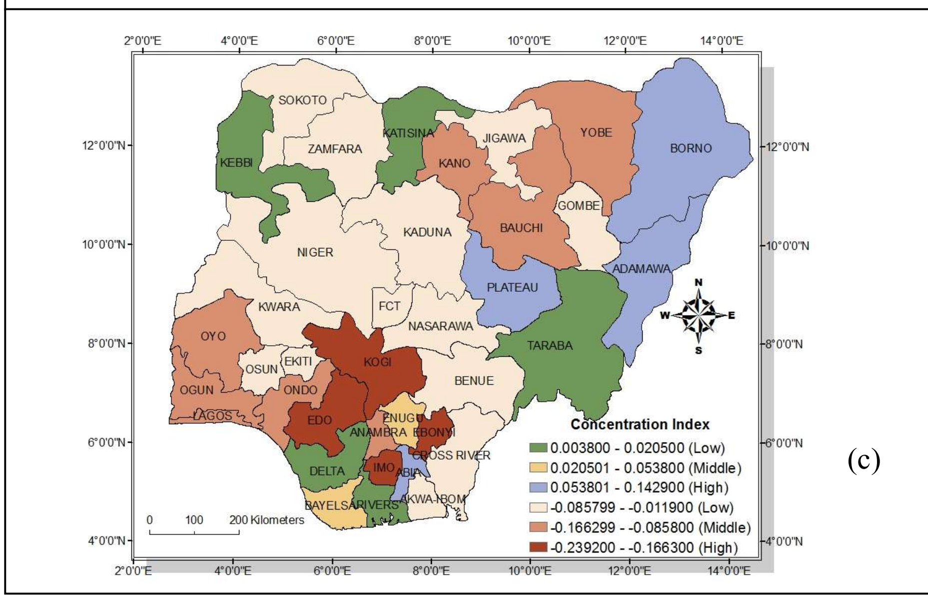
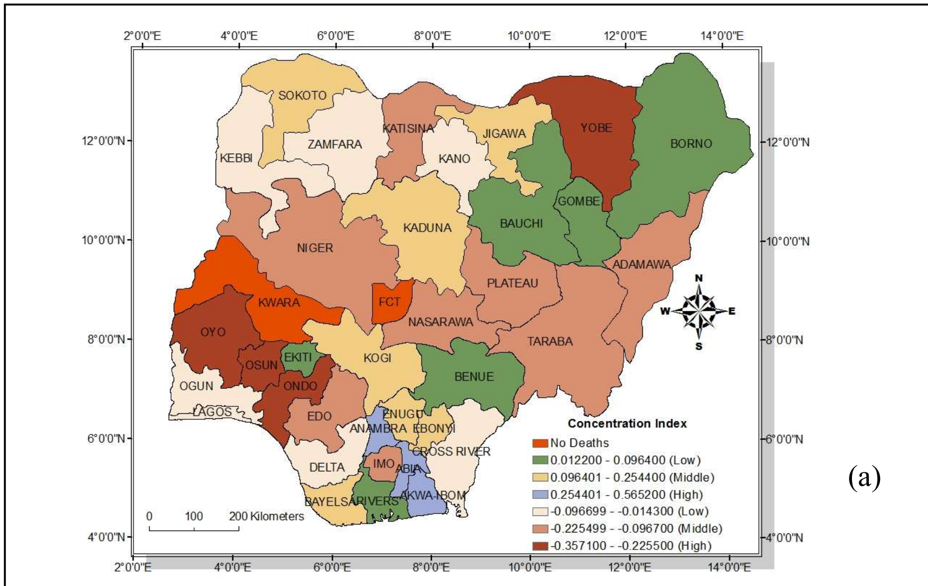
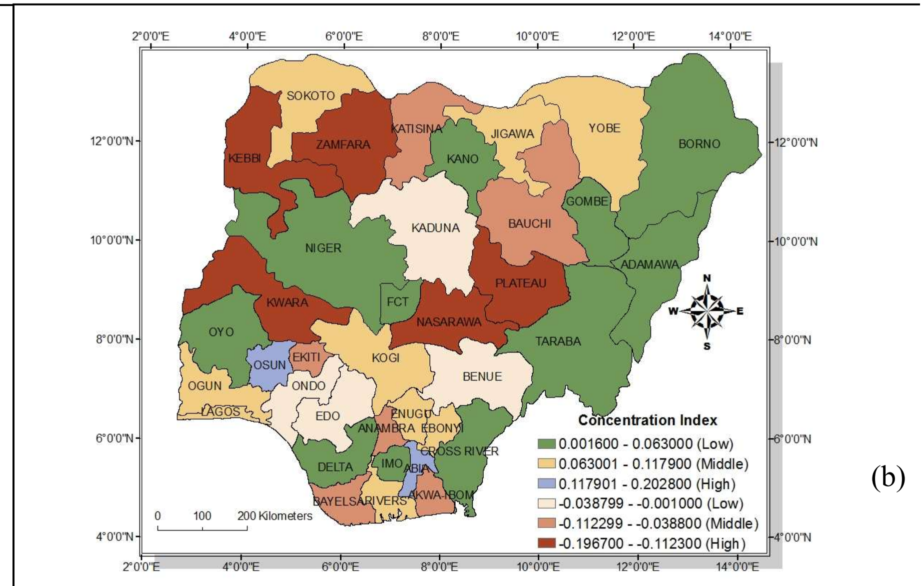


Figure 4.24a-c: Spatial Pattern of Socioeconomic Inequality in IMR
Mother's education in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respe

In 2008, infant mortality fell disproportionately on the infants with uneducated mothers (0.011). The CI in both rural (0.006) and urban (0.030) areas indicate higher infant mortality among infants with mothers 35 or older. Regionally, the CI was highest in the Southeast (0.078) with IMR higher among the infants with mothers 35 or older in all regions except in the Northcentral and Northwest. Across states, the highest CI was in Osun (0.203), Zamfara (-0.197) and Abia state (0.160). In 2013, the CI for IMR by mother's age (0.001) indicates the burden of infant mortality was about the same amongst all age groups. The CI for both rural (-0.002) and urban (0.021) areas indicates relatively low levels of relative inequality in infant mortality amongst age groups. Regionally, CI was highest in the Southeast (0.059) with IMR higher among infants with older mothers in all regions except in the Northcentral, Northeast and Southsouth. At the state level, Ebonyi state had the highest CI (-0.234), while Enugu state had the lowest (0.009).

Figure 4.25a-c shows the pattern of relative inequality in IMR by mother's age across states in 2003, 2008 and 2013 using concentration indices. Maps indicate the disparities in IMR were mainly to the disadvantage of the infants with older mothers across Nigeria. In addition, plots (See Appendix 53a-h and 54a-c) show that all CC lie close to the line of equality. This indicates little or no disparity in IMR amongst maternal age groups nationally and regionally over time except in the Southwest where the CC for 2003 lie significantly above the line of inequality. The CC for 2008 and 2013 lie below the line of equality indicating a shift in the direction of inequality from infants with younger mothers in 2003 to those with older mothers in later periods.





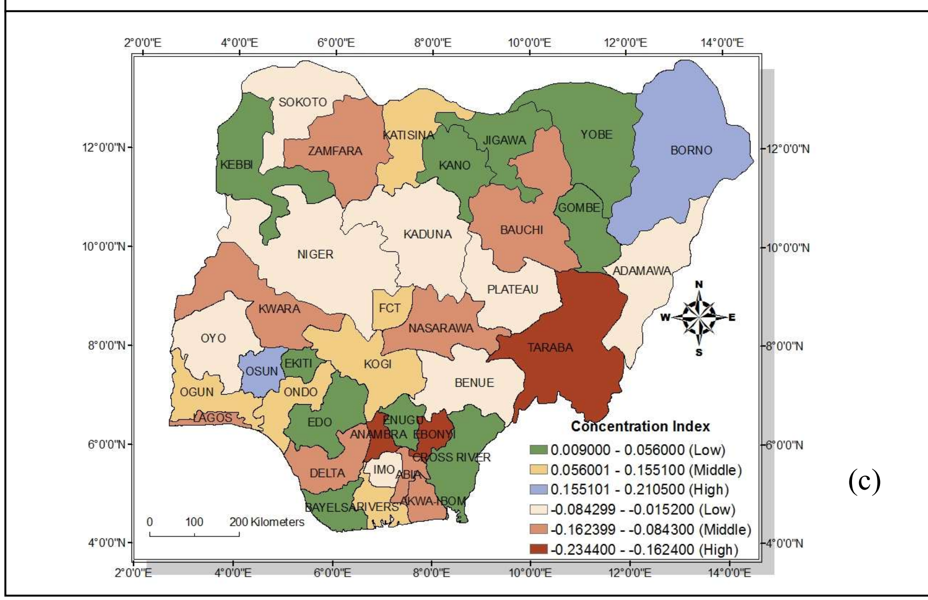


Figure 4.25a-c: Spatial Pattern of Socioeconomic Inequality in IMR b Mother's age in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respective

4.23 Concentration index of child and under 5 mortality rates in Nigeria

Table 4.45, 4.47 and 4.48 presents the CI in child and under 5 mortality by wealth, mother's level of education and mother's age regionally, by place of residence and across states.

4.23.1 Concentration index by wealth index

The CI for 2003 (-0.185) indicates inequalities in CMR among wealth groups with child mortality falling disproportionately among the poor. Likewise, the CI in both rural (-0.106) and urban (-0.184) areas indicates inequality in child mortality in favour of the rich. Regionally, CI was highest in the Southeast (-0.499) and lowest in the Northcentral (-0.067) with CMR higher among the poor in all regions. At the state level, wealth based relative inequalities in CMR as indicated by the CI, were especially high in CrossRiver (0.667), Enugu (-0.644) and Ondo states (-0.625) and significantly lower in Lagos state (0.006). Under 5 mortality fell disproportionately among the poor nationally (-0.151) and in rural and urban areas (-0.093 and -0.161, respectively) indicating inequalities or disparities in under 5 mortality in favour of the rich. Regionally, CI was highest in the Southeast (-0.517) and lowest in the Northeast (-0.056) with U5MR higher among the poor in all regions. At the state level, the highest CI was in Abia (-0.739), Imo (-0.563) and Enugu states (-0.349) and the lowest in Lagos state (0.005).

In 2008, child mortality fell disproportionately among the poor nationally (-0.184) and in rual and urban areas (-0.102 and -0.169, respectively) therefore indicating that differences in wealth contributed significantly to disparities in U5MRs. Regionally, the CI was highest in the Southwest (-0.120) and lowest in the Southsouth (-0.042) with CMRhigher among the poor in all regions. Across states, Anambra (-0.230), Kaduna (-0.231) and Ekiti (-0.226) had the highest levels of inequality with CMR higher among the poor while the burden of child mortality was proportionately distributed amongst wealth groups in Taraba state. Under 5 mortality also fell disproportionately among the poor nationally (-0.113) and in rural and urban areas (-0.051 and -0.102, respectively). Regionally, the CI was highest in the Southwest (-0.087) and lowest in the Southeast (-0.033) with U5MR higher among the poor in all regions. Across states, Osun (-0.306), Ekiti (-0.192) and Kaduna (-0.150) had the highest levels of inequality with under 5 mortality higher among the poor.

Table 4.47: CIfor child Mortality by Wealth, Mother's Education and Mother's Age.

STATE	CI by Wealth			CI by Mother's Education			CI by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	N/A	0.117	-0.432	N/A	-0.118	-0.440	N/A	0.041	0.350
Abuja	0.053	-0.072	-0.229	-0.050	-0.030	-0.827	0.237	-0.226	-0.214
Adamawa	-0.106	-0.002	-0.102	0.043	0.098	0.199	-0.046	0.151	-0.093
Akwa Ibom	-0.273	-0.076	-0.234	-0.082	-0.087	0.076	0.435	-0.002	0.186
Anambra	N/A	-0.230	-0.231	N/A	-0.058	-0.079	N/A	0.021	0.005
Bauchi	-0.031	-0.068	-0.107	-0.048	-0.038	-0.022	0.030	0.112	-0.042
Bayelsa	0.407	0.128	-0.033	0.090	-0.191	-0.075	-0.185	-0.061	0.264
Benue	-0.046	-0.044	-0.220	-0.078	-0.226	-0.253	0.061	-0.140	0.176
Borno	-0.215	-0.114	0.025	-0.115	-0.065	-0.052	-0.040	0.118	-0.152
Cross River	0.667	-0.051	-0.175	-0.931	-0.213	-0.243	-0.205	0.093	-0.069
Delta	-0.511	-0.030	-0.042	-0.458	0.096	0.022	-0.220	0.059	0.199
Ebonyi	-0.191	-0.010	-0.138	-0.139	-0.098	0.028	0.190	0.000	0.101
Edo	-0.256	-0.097	-0.093	0.225	-0.172	-0.197	0.043	0.174	0.189
Ekiti	0.444	-0.226	0.160	-0.389	-0.059	0.144	0.771	-0.029	-0.251
Enugu	-0.644	-0.045	-0.148	-0.900	-0.212	-0.347	0.633	0.226	0.191
Gombe	-0.133	-0.075	-0.259	-0.183	-0.110	-0.082	0.225	0.026	0.050
Imo	-0.382	-0.057	0.121	0.063	0.015	0.028	0.298	-0.035	0.045
Jigawa	-0.052	0.003	-0.110	-0.051	0.017	-0.022	0.061	0.067	-0.001
Kaduna	-0.145	-0.231	0.145	-0.353	-0.171	-0.167	-0.060	0.204	0.036
Kano	-0.205	-0.172	-0.176	-0.124	-0.053	-0.129	0.111	0.045	-0.045
Katsina	0.038	-0.085	-0.185	-0.209	-0.021	-0.059	-0.026	0.135	0.099
Kebbi	-0.052	-0.066	-0.176	-0.141	0.049	-0.027	-0.156	0.077	0.047
Kogi	0.414	-0.029	-0.264	-0.358	-0.022	-0.610	0.360	-0.043	0.092
Kwara	N/A	0.013	-0.394	N/A	0.005	-0.577	N/A	0.335	-0.136
Lagos	0.006	-0.153	-0.221	-0.030	-0.198	-0.267	0.112	0.069	0.172
Nasarawa	-0.434	0.111	0.015	-0.610	-0.121	-0.210	0.483	-0.083	-0.015
Niger	-0.273	-0.035	0.004	-0.244	-0.013	0.103	0.309	0.024	-0.049
Ogun	-0.179	0.170	0.051	-0.118	0.139	0.117	0.286	-0.236	0.146
Ondo	-0.625	0.040	-0.173	-0.225	0.022	-0.119	0.650	0.554	0.363
Osun	0.179	-0.028	0.156	0.500	-0.225	-0.191	-0.370	-0.195	0.247
Oyo	0.327	-0.126	-0.034	-0.181	0.103	-0.359	-0.228	0.020	0.095
Plateau	-0.505	-0.100	-0.147	-0.124	-0.145	-0.196	0.287	0.158	-0.394
Rivers	-0.024	-0.057	-0.186	0.152	-0.221	-0.034	-0.134	0.053	0.144
Sokoto	0.081	-0.010	-0.075	-0.062	0.030	-0.034	-0.018	0.069	0.012
Taraba	0.239	0.000	-0.068	-0.018	-0.195	-0.233	0.425	0.089	0.039
Yobe	-0.177	-0.081	-0.166	-0.090	-0.151	-0.093	0.178	0.075	-0.005
Zamfara	-0.055	-0.037	-0.125	0.137	-0.002	-0.100	0.004	-0.036	0.038

Note: CI is unit less
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time.
Calculated by Author

Table 4.48: CIfor under 5 Mortality by Wealth, Mother's Education and Mother's Age.

STATE	CI by Wealth			CI by Mother's Education			CI by Mother's Age		
	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	-0.739	0.009	0.002	-0.500	-0.159	0.030	0.565	0.129	-0.054
Abuja	0.053	0.053	-0.055	-0.050	-0.049	-0.081	0.237	0.007	0.104
Adamawa	-0.125	-0.074	-0.118	-0.105	-0.044	0.102	-0.120	0.070	-0.034
Akwa Ibom	-0.392	-0.082	-0.097	-0.020	-0.109	-0.039	0.534	-0.023	-0.059
Anambra	-0.323	-0.094	-0.127	-0.287	-0.002	-0.126	0.430	-0.023	0.117
Bauchi	0.048	-0.017	-0.116	-0.048	0.030	-0.075	0.018	0.000	-0.071
Bayelsa	0.367	-0.029	0.040	0.167	-0.041	-0.068	-0.062	-0.074	0.096
Benue	-0.194	-0.060	-0.077	-0.255	-0.004	-0.090	0.022	-0.043	0.025
Borno	-0.077	-0.096	0.110	-0.130	-0.039	0.054	-0.004	0.057	0.029
Cross River	-0.175	-0.051	0.035	-0.014	0.062	-0.133	-0.043	0.055	0.002
Delta	-0.276	-0.028	-0.205	-0.015	0.026	-0.015	-0.037	0.051	-0.047
Ebonyi	-0.082	-0.035	-0.181	0.061	-0.066	-0.133	0.193	0.058	0.123
Edo	0.194	-0.098	-0.091	0.120	-0.160	-0.146	-0.072	0.032	0.102
Ekiti	-0.026	-0.192	-0.019	0.026	-0.117	-0.106	0.263	-0.035	0.015
Enugu	-0.349	-0.052	0.013	-0.123	-0.188	-0.010	0.238	0.107	0.050
Gombe	-0.100	-0.075	-0.081	0.100	-0.110	-0.063	0.130	0.002	0.052
Imo	-0.563	0.060	-0.059	-0.263	0.067	-0.124	0.141	0.047	-0.002
Jigawa	-0.027	0.007	-0.051	-0.046	0.051	-0.035	0.098	0.070	0.007
Kaduna	-0.190	-0.150	-0.025	-0.283	-0.078	-0.073	0.121	0.083	-0.034
Kano	-0.088	-0.103	-0.136	-0.107	-0.067	-0.120	0.004	0.018	0.007
Katsina	-0.013	-0.043	-0.109	-0.049	-0.009	-0.029	-0.123	0.037	0.133
Kebbi	-0.036	-0.044	-0.046	-0.129	0.033	-0.002	-0.068	-0.061	0.042
Kogi	-0.015	0.053	-0.090	-0.146	-0.035	-0.351	0.299	0.058	0.083
Kwara	N/A	0.076	-0.041	N/A	-0.106	-0.142	0.659	0.029	-0.135
Lagos	0.005	0.005	-0.044	0.047	-0.081	-0.137	0.015	0.077	-0.078
Nasarawa	-0.028	-0.039	-0.003	-0.321	-0.086	-0.083	-0.013	-0.123	-0.072
Niger	-0.133	-0.061	0.003	-0.052	-0.049	0.000	0.091	0.025	-0.040
Ogun	-0.167	-0.122	0.009	-0.096	-0.103	-0.085	-0.025	0.064	0.114
Ondo	-0.011	0.076	-0.070	-0.033	0.106	-0.120	-0.100	0.202	0.204
Osun	0.167	-0.306	0.039	0.483	-0.192	-0.033	-0.345	0.088	0.185
Oyo	-0.050	-0.110	0.116	-0.240	-0.279	-0.109	-0.226	0.043	0.018
Plateau	-0.115	-0.103	-0.032	0.129	-0.121	0.052	-0.098	-0.046	-0.079
Rivers	-0.222	-0.051	0.009	0.006	-0.013	0.010	0.016	0.092	0.149
Sokoto	0.035	-0.027	-0.075	-0.010	0.001	-0.035	0.048	0.085	-0.031
Taraba	-0.132	-0.073	-0.074	0.051	-0.154	-0.025	-0.005	0.058	-0.110
Yobe	-0.160	-0.090	-0.137	-0.028	-0.075	-0.092	0.096	0.071	0.025
Zamfara	-0.091	-0.076	-0.078	0.017	-0.021	-0.075	0.002	-0.120	-0.040

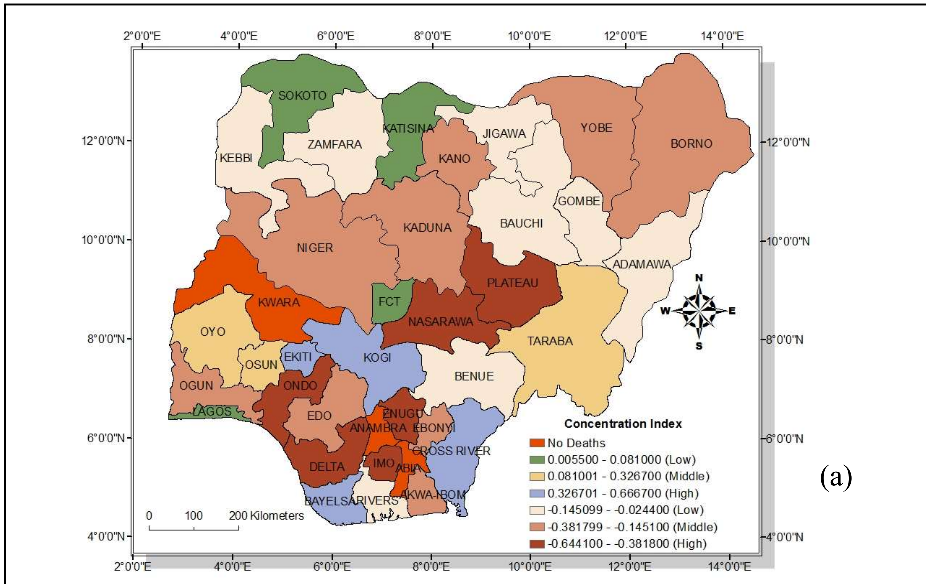
Note: CI is unit less
Colour code: Decreased (Blue), Increased (Red) and Unchanged (Green) over time.
Calculated by Author

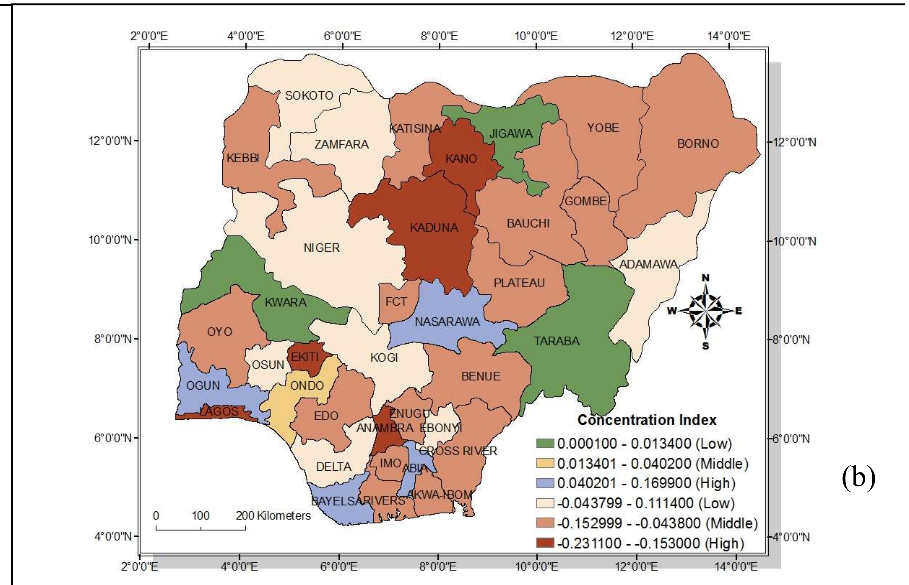
In 2013, child mortality fell disproportionately among the poor nationally (-0.268) and in rural and urban areas (-0.158 and -0.182, respectively). Regionally, the highest CI was in the Southeast (-0.185) with CMR higher among the poor in all regions. At the state level, the highest CI was in Abia (-0.432) and Kwara states (-0.394) in favour of the rich. With regards to under 5 mortality, the CI (-0.146) indicates that under 5 mortality fell disproportionately among the poor. The CI for both rural (-0.084) and urban (-0.090) areas also indicates inequality in under 5 mortality in favour of the rich. Regionally, the highest CI was in the Southeast (-0.131) with U5MR higher among the poor in all regions. At the state level, Delta state had the highest CI (-0.205) with U5MR higher among the poor.

Figure 4.26a-c shows the spatial pattern of inequalities in CMR by wealth groups at the state level in 2003, 2008 and 2013. Inequalities in CMR were mainly to the disadvantage of the poor (pro-rich inequality). In addition, all concentration curves (CC) are above the line of equality (See Appendix 55a-h) at the three points in time examined. This indicates persistent inequalities in child mortality by wealth over time. With respect to under 5 mortality, inequalities in U5MRs were mainly to the disadvantage of the poor (pro-rich inequality) as shown in Figure 4.27a-c. In addition, all CC are above the line of equality (See Appendix 56a-h) which indicates persistent inequalities or disparities in under 5 mortality by wealth over time with mortality higher among the most socioeconomically disadvantaged groups. This also suggests that differnces in wealth had a significant impact on child health/survival.

4.23.2 Concentration Index by mother's education

In 2003, child mortality fell disproportionately among children with uneducated mothers nationally (-0.230) and in rural and urban areas (-0.155 and -0.352, respectively) indicating inequalities in child mortality in favour of children with educated mothers particularly in urban areas. This suggests that maternal education had even more impact on child health/survival in urban areas. Regionally, the highest CI was in the Southeast (-0.490) with CMR higher among children with uneducated mothers in all regions except in the Southsouth. Across states, inequalities in CMR by mother's education were very high in CrossRiver (-0.931) and Enugu (-0.900) states and significantly lower in Taraba state (-0.018). In the same way, under 5 mortality fell disproportionately among children with uneducated mothers nationally (-0.175). The CI for rural areas (-0.066) indicates inequality with mortality higher among the children with uneducated mothers while in urban areas the CI (0.271) indicates significant inequality with mortality higher among the





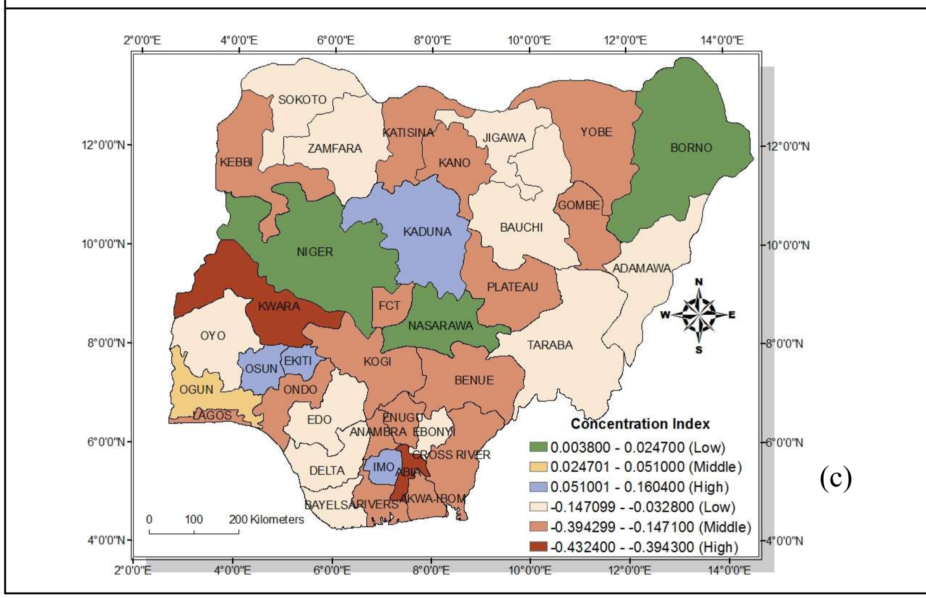
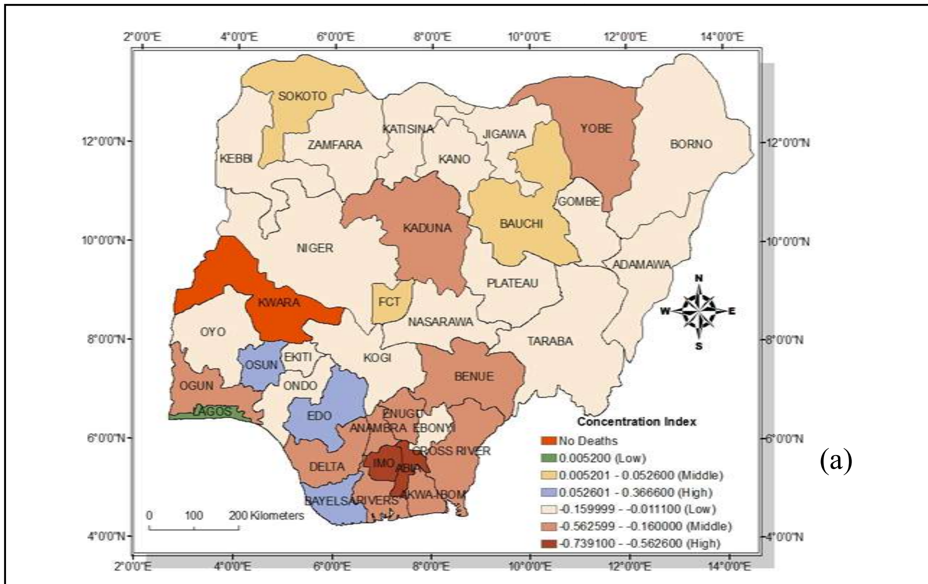
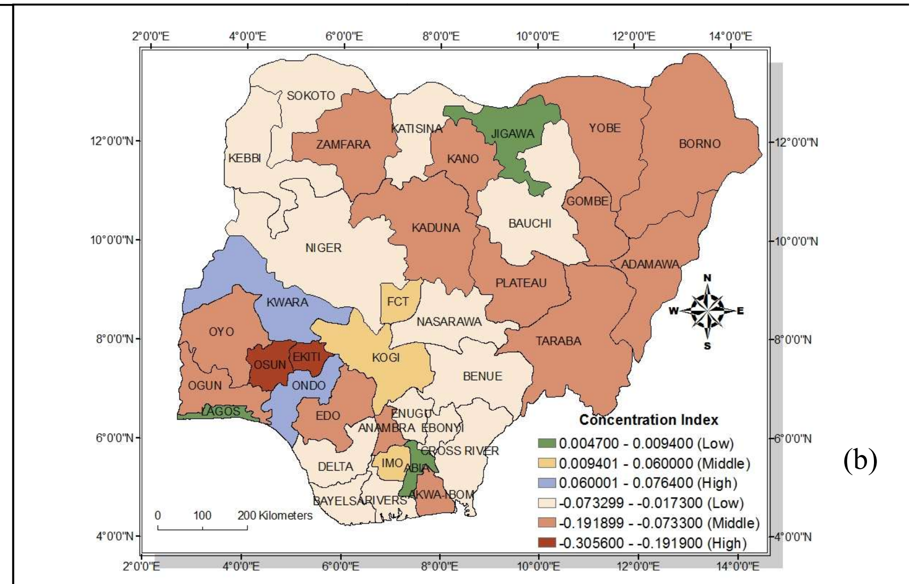


Figure 4.26a-c: Spatial Pattern of Socioeconomic Inequality in CMR by Wealth in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively





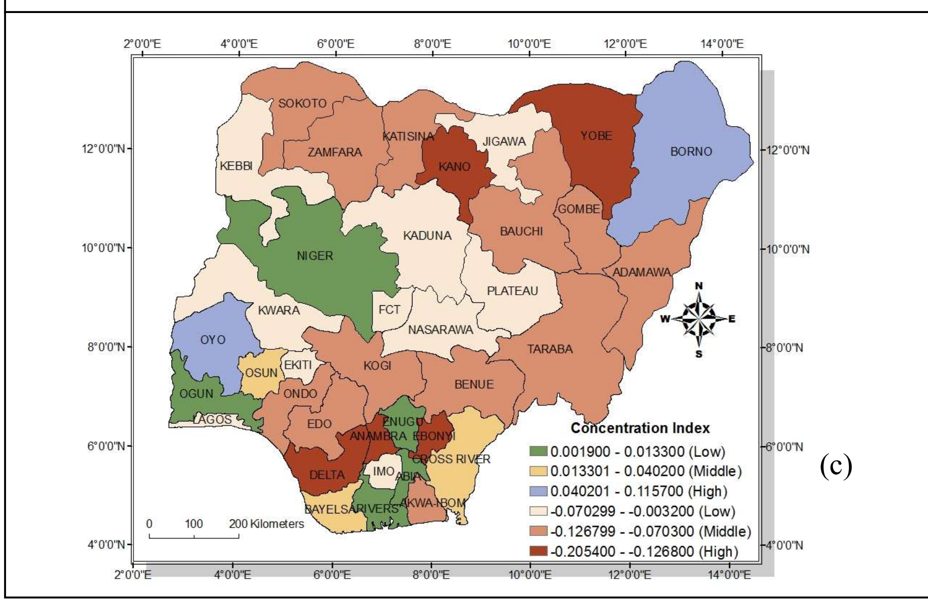


Figure 4.27a-c: Spatial Pattern of Socioeconomic Inequality in U5MR b
Wealth in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

children with educated mothers. Regionally, CI was highest in the Southeast (-0.402) and lowest in the Southwest (-0.012) with under 5 mortality higher among the poor in all regions except the Southsouth. At the state level, the highest CI was in Abia (-0.500) states and the lowest in Rivers state (0.006).

The CI for CMR by mother's education (-0.190) indicates significant inequalities in 2008 with child mortality falling disproportionately among children with uneducated mothers. The CI for both rural (-0.121) and urban (-0.231) areas also indicates inequalities in child mortality in favour of children with educated mothers particularly in urban areas. Regionally, inequalities in CMR among education groups was highest in the Northcentral region (-0.171) and lowest in the Northwest (-0.033) with child mortality higher among children with uneducated mothers in all regions. Across states, Benue (-0.226), Osun (-0.225) and Rivers states (-0.221) had the highest inequality in child mortality by mother's education with CMR higher among children with uneducated mothers.

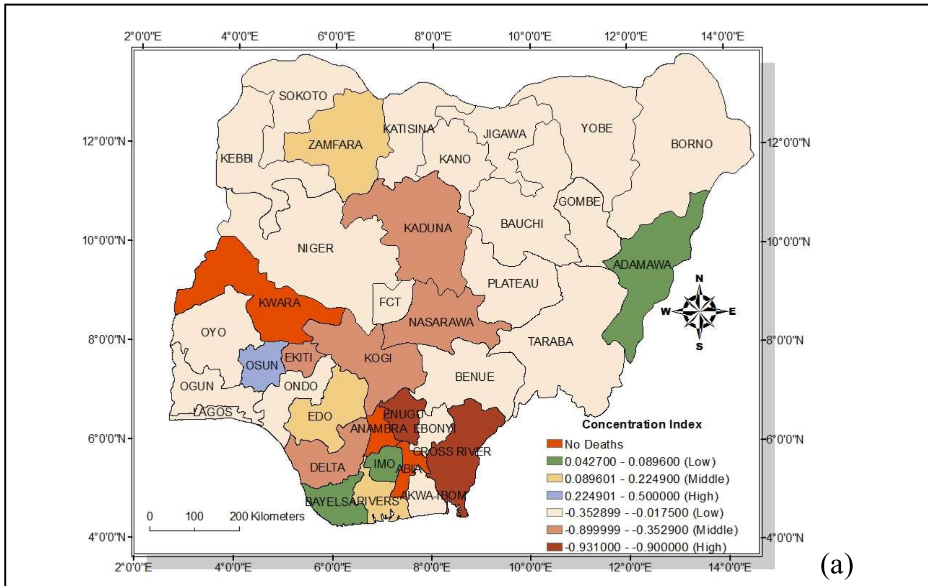
Under 5 mortality fell disproportionately among children with uneducated mothers nationally (-0.091) and in rural and urban areas (-0.064 and -0.114, respectively) indicating inequalities in under 5 mortality in favour of children with educated mothers especially in urban areas. This indicates that maternal education contributed significantly to disparities in child health/survival. Regionally, inequalities in U5MR by mother's education was highest in the Southwest (-0.117) and lowest in the Northwest (-0.025) with U5MR higher among children with uneducated mothers in all regions. At the state level, inequalities were highest in Oyo (-0.279) Osun (-0.192) and Enugu State (-0.188) with under 5 mortality higher among children with uneducated mothers.

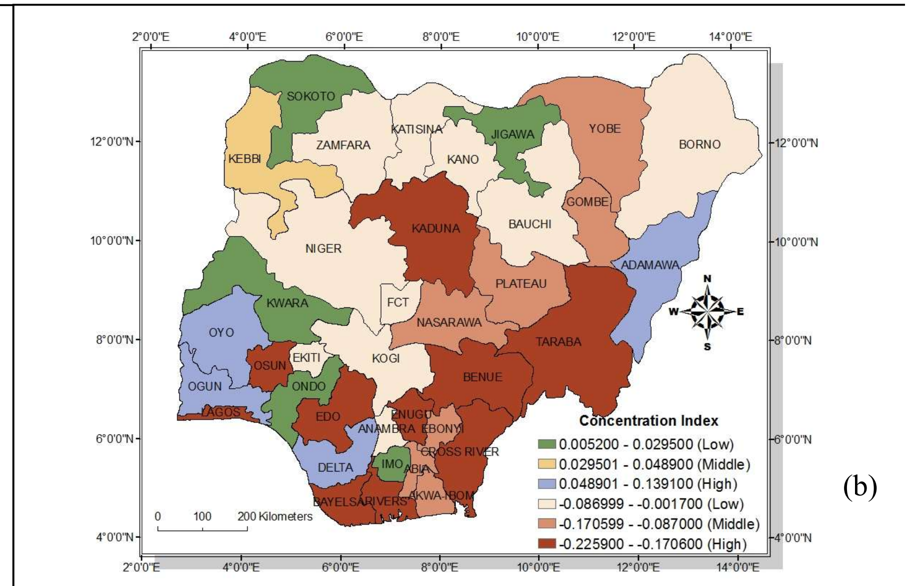
In 2013, CI values showed significant inequalities in CMR among education groups nationally (-0.236) and in rural and urban areas (-0.149 and -0.193, respectively) with child mortality falling disproportionately among children with uneducated mothers. Regionally, inequalities were highest in the Southwest (-0.265) and lowest in the Northeast (-0.076) with high CMR among children of uneducated mothers in all regions. Across states, the Federal Capital Territory (-0.827) had the most unequal distribution in child mortality by mother's education, followed by Kogi (-0.610) and Kwara states (-0.577) while Bauchi (-0.022), Delta (0.022) and Jigawa (-0.022) had the lowest. In the same way, under 5 mortality fell disproportionately among children with uneducated mothers nationally (-0.046) as well as in rural and urban areas (-0.073 and -0.110, respectively) indicating inequalities in child mortality in favour of children with educatedmothers. Regionally, inequalities were highest in the Southwest (-0.116) and lowest in the Northeast (-0.038) with U5MR higheramong children with uneducated mothers in all regions. At the state level, Kogi state (-0.351) had the highest level of inequality in U5MR among education groups with under 5 mortality higheramong children with uneducated mothers while Niger state with a CI of zero had no inequality i.e. the burden of under 5 mortality was proportionately distributed amongst maternal education groups.

Figure 4.28a-c shows the spatial pattern of inequalities in CMR by mother's level of education at the state level in 2003, 2008 and 2013 based on concentration indices. In general, maps show that inequalities were mainly to the disadvantage of the children with uneducated mothers. In addition, plots (Appendix 57a-h) show that CC for 2003, 2008 and 2013 lie above the line of equality indicating higher child deaths among children with uneducated mothers. Also, plots indicate that inequalities declined in 2008 (as indicated by the CC being closer to the line of equality) but then increased by 2013 though not as high as in 2003 (as indicated by the CC moving farther away from the line of equality). With regards to under 5 mortality, inequalities were mainly to the disadvantage of the children with uneducated mothers (Figure 4.29a-c). In addition, plots (Appendix 58a-h) show all CC lie above the line of equality at the three points in time examined indicating the concentration of under 5 deaths among children with uneducated mothers. This indicates persistent inequalities or disparities in mortality by maternal education over time with mortality higher among the least educated groups. This also suggests that differnces in the level of education of mothers had a significant impact on child health/survival.

4.23.3 Concentration index by mother's age

In 2003, child mortality fell disproportionately among children with older mothers nationally (0.063) and in rural and urban areas (0.067 and 0.074, respectively). Regionally, relative inequalities in CMR by mother's age as indicated by the CI, was highest in the Southeast (0.337) and lowest in the Northwest (0.002) with CMR higher among children with older mothers in all regions except the Southsouth. Across states, Ondo (0.650) and Enugu (0.633) state had the highest CI while Zamfara state had the lowest (0.004) suggesting that CMRs were high across all groups. With regards to under 5 mortality, the CI (0.029) indicates that under 5 mortality fell disproportionately among the children with older mothers. In rural areas, the CI (-0.033) indicates higher mortality among the children with young mothers while in urban areas the CI (0.004) indicates that the burden of under 5 mortality was almost the same amongst maternal age groups. Regionally, the CI was





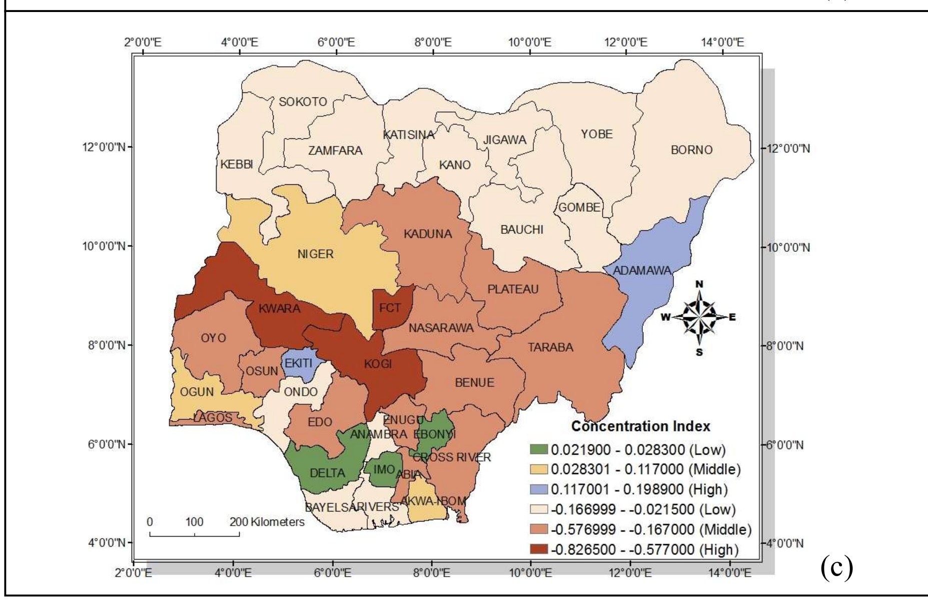
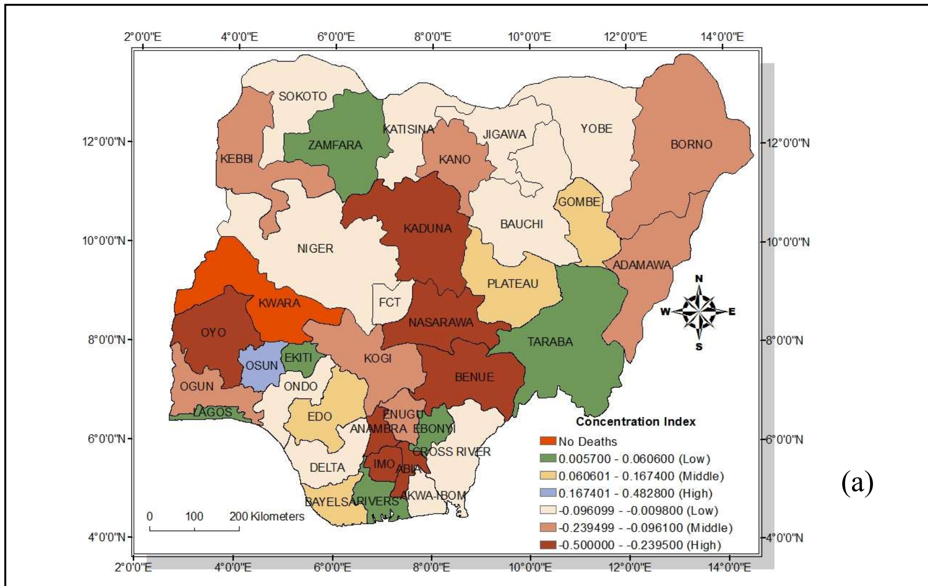
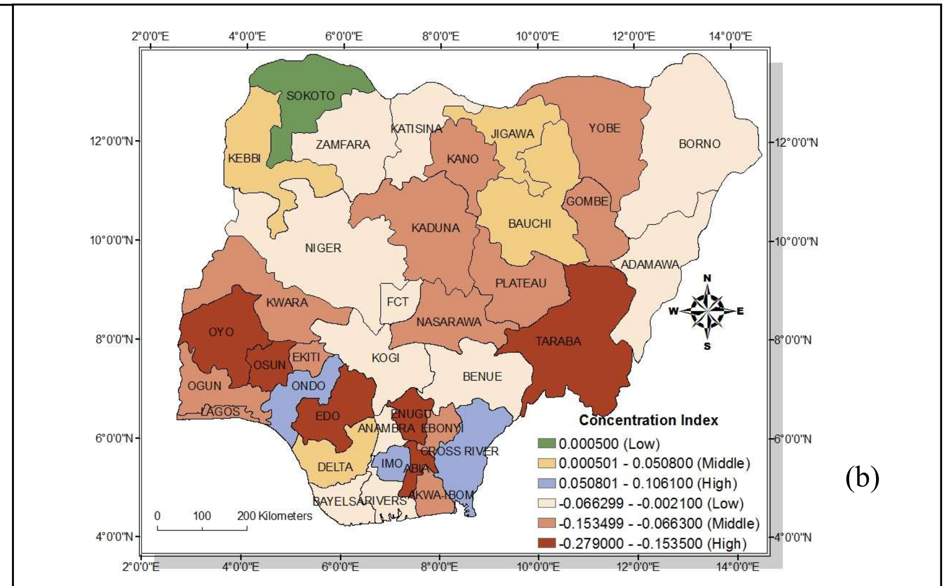


Figure 4.28a-c: Spatial Pattern of Socioeconomic Inequality in CMR by
education in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respective





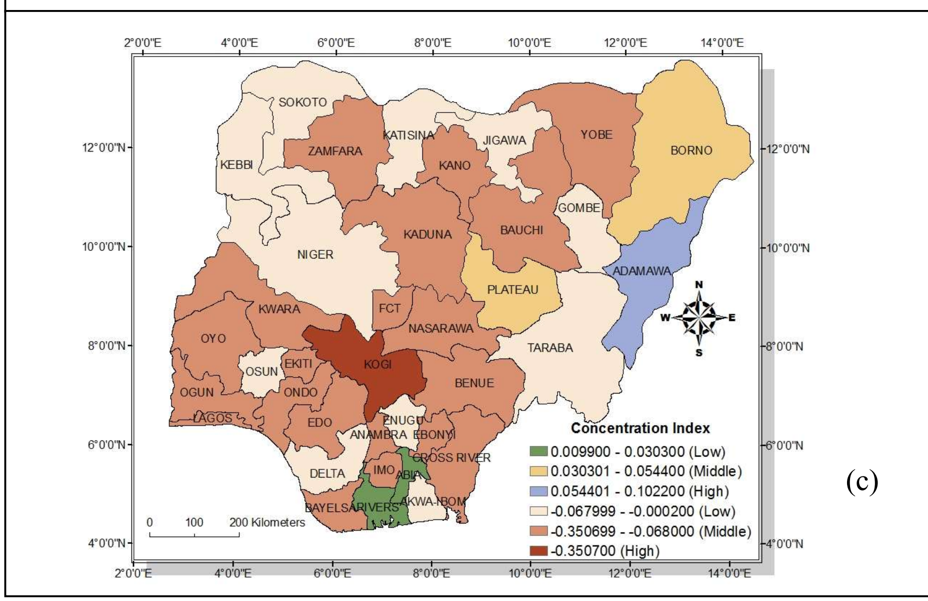


Figure 4.29a-c: Spatial Pattern of Socioeconomic Inequality in U5MR by Mother's education in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectiv

highest in the Southeast (0.289) and lowest in the Northwest (0.017) with under 5 mortality higheramong children with older mothers in all regions except the Southwest. At the state level, the highest CI was in Kwara (0.659) stateand the lowest in Zamfara (0.002).

In 2008, child mortality fell disproportionately among children with older mothers nationally (0.064) and in rural and urban areas (0.068 and 0.047, respectively) indicating inequalities in child mortality in favour of children with young mothers. Regionally, inequalities were highest in the Northeast (0.103) and lowest in the Northcentral (0.018) with child mortality higher among children with older mothers in all regions. Across states, Ondo state (0.554) had the highest CI with CMR higher among children with mothers 35 or older while there was no inequality in U5MR amongst maternal age groups in Ebonyi state. In the same way, under 5 mortality fell disproportionately among children with older mothers nationally (0.030) and in rural and urban areas (0.029 and 0.035, respectively). Regionally, the CI was highest in the Southwest (0.075) and lowest in the Northcentral (-0.005) with U5MR higher among children with older mothers in all regions except in the Northcentral. At the state level, Ondo state had the highest CI (0.202) while the burden of U5MRs was proportionately distributed amongst maternal age groups in Bauchi state.

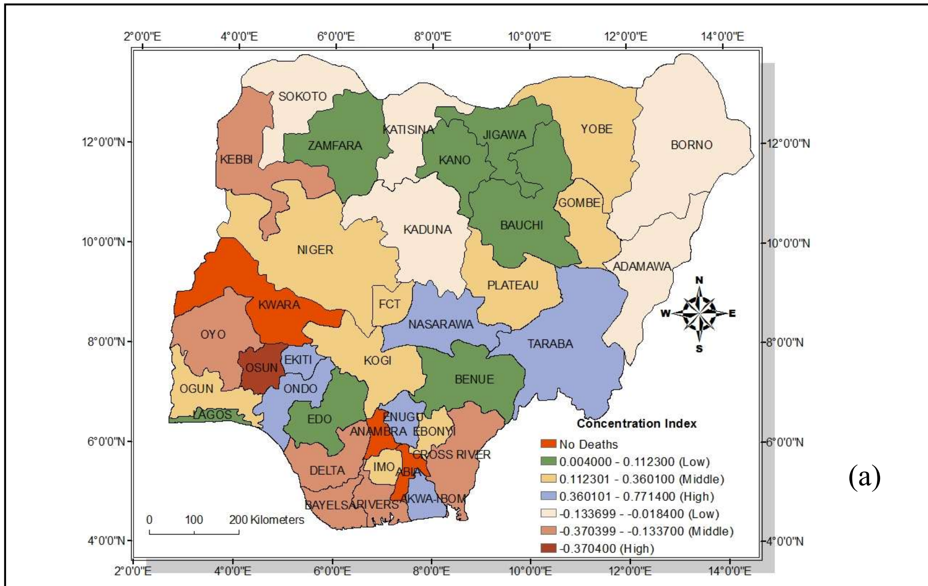
In 2013, child mortality fell disproportionately among children with older mothers nationally (0.023) and in rural and urban areas (0.023 and 0.072, respectively) indicating that the age of mothers influenced child health/survival. Regionally, inequalities were highest in the Southwest (0.171) with CMR higher among children of older mothers in all regions except in the Northcentral and Northeast. Across states, Plateau (-0.394), Ondo (0.363) and Abia (0.350) states had the most disparity in CMR by mother's age while Jigawa (-0.001), Anambra (0.005) and Yobe (-0.005) had the lowest. With regards to under 5 mortality, the CI (0.007) indicates low levels of inequalities in U5MR by mother's age though under 5 mortality still fell disproportionately among children with older mothers. Similar patterns were observed in rural and urban areas. Regionally, CI was highest in the Southeast (0.066) and lowest in the Northwest (0.010) with U5MR higher among children with older mothers except in the Northcentral and Northeast. At the state level, Ondo state had the highest CI (0.204) while Cross River (0.002) and Imo (-0.002) had the lowest.

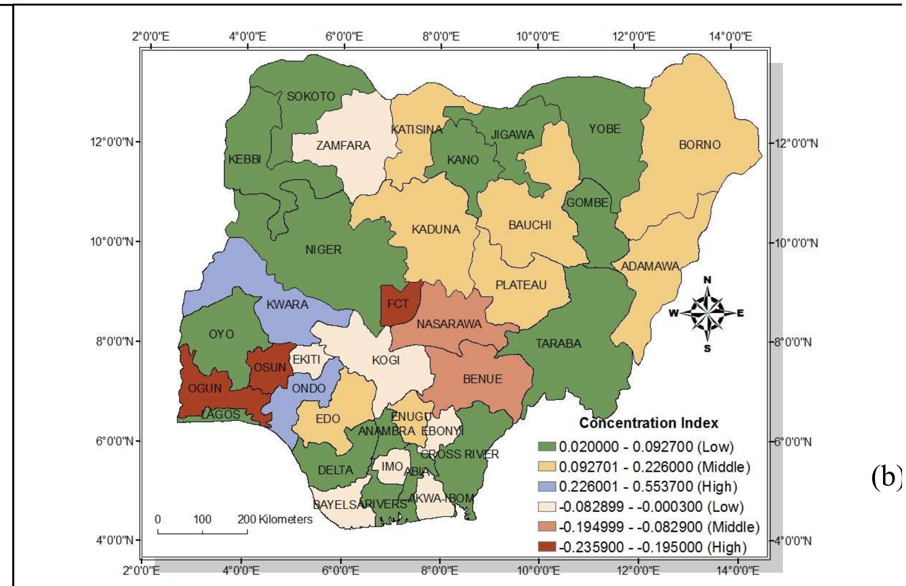
Figure 4.30a-c shows the spatial pattern of relative inequalities in CMR by mother's age at the state level in 2003, 2008 and 2013. In general, maps show that inequalities were mainly to the disadvantage of the infants with older mothers across Nigeria. In addition, the CC mostly lie below the line of equality over time indicating inequalities in CMR by mother's age but with child deaths concentrated among those with older mothers. They are however mostly close to the line of equality indicating relatively low levels of inequality (See Appendix 59a-h). With regards to under 5 mortality, inequalities were mainly to the disadvantage of the children with older mothers (Figure 4.31a-c). In addition, all CC are below the line of equality over time indicating inequalities in U5MR by mother's age regionally but with deaths concentrated among under 5 children with older mothers (See Appendix 60a-h). They are however, very close to the line of equality indicating low levels of inequality in U5MR by mother's age in Nigeria. On one hand, all CC are clearly above the line of equality indicating significant disparities in child and under 5 mortality by wealth and mother's level of education nationally. On the other hand, the CC for mortality by mother's age is very close to the line of equality throughout the period covered by the three surveys indicating very little to no disparity in both child and under 5 mortality by maternal age (See Appendix 61-62). This suggests that differnces in the age of mothers had relatively little impact on child health/survival over time in Nigeria.

4.24 Changes in relative and absolute inequalities in IMR over time (SII and CI)

Tables 4.41-4.48 are colour coded to show changes in relative and absolute inequalities based on the CI and SII at the national, rural-urban, regional and state level over time.

According to the more comprehensive measures of inequality (SII and CI), significant inequalities in mortality rates amongst socioeconomic groups are evident in all 3 surveys conducted in Nigeria. Nationally, the SII and CI indicate that both absolute and relative inequalities in IMR between 2003 and 2013, decreased by wealth groups, mother's level of education and by mother's age. In rural areas, the SII and CI decreased by wealth groups and mother's age but increased by mother's level of education. In urban areas, the SII decreased by wealth groups, mother's level of education and by mother's age while the CI decreased by wealth groups and mother's level of education but increased by mother's age. Across regions, the SII decreased by wealth groups in all regions except the Northeast while the CI decreased in all regions except the Northeast and Norhtwest. The SII decreased by mother's level of education in all regions except the Northeast and Southwest while the CI decreased in all regions except in the Northeast, Southsouth and





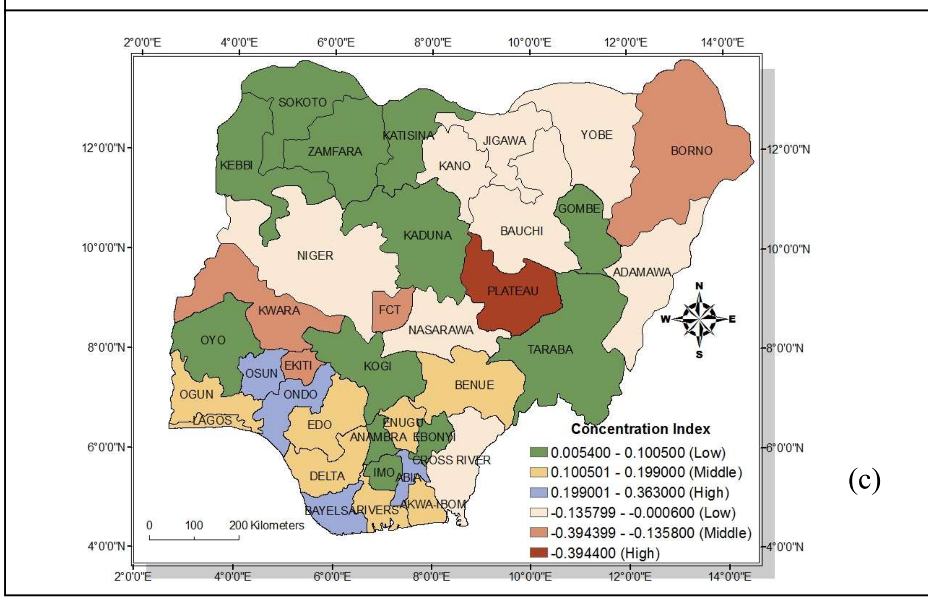
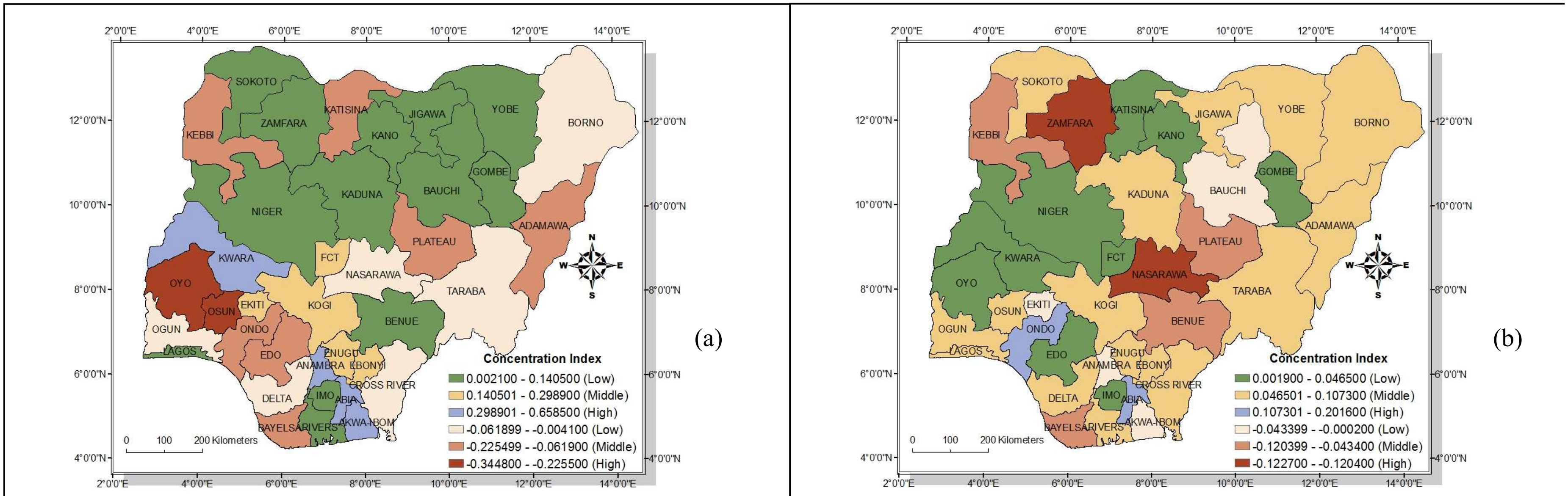


Figure 4.30a-c: Spatial Pattern of Socioeconomic Inequality in CMR Mother's age in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respecti



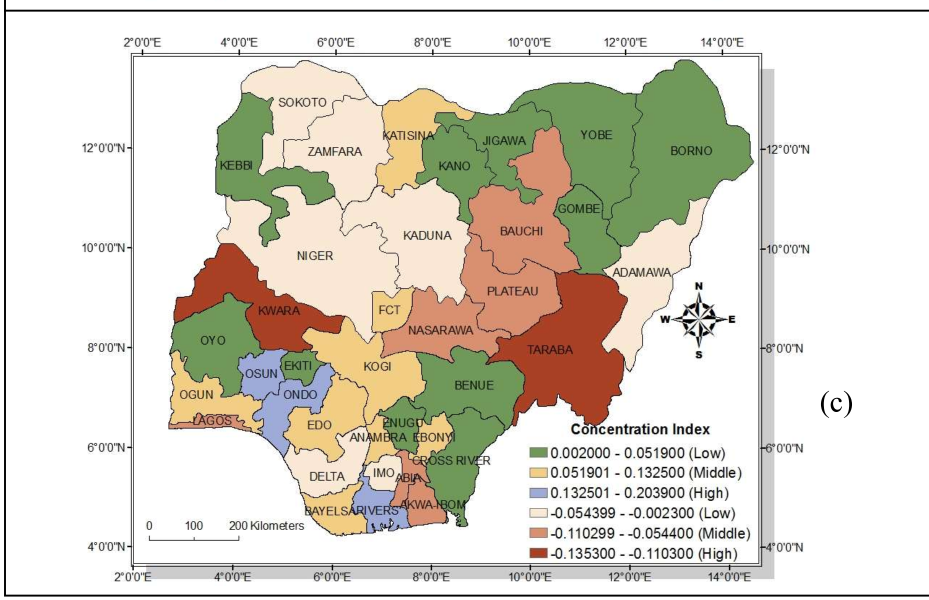


Figure 4.31a-c: Spatial Pattern of Socioeconomic Inequality in U5MR by Mother's age in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

Southwest. The SII and CI indicate that both absolute and relative inequalities in IMR decreased by mother's age in all regions.

At the state level, the SII in IMR by wealth increased in 8 states and decreased in 29 states with a change in the direction of absolute inequality in 13 states. In contrast, the CI increased in 7 states, decreased in 29 states and remained unchanged in Gombe state although there was a change in the direction of inequality in 13 states. Overall, both measures identified 5 states - Borno, Jigawa, Kano, Katsina and Yobe - as having experienced an increase in both absolute and relative inequalities in IMR by wealth over time. With respect to the mother's level of education, the SII increased in 10 states and decreased in 27 states with a change in the direction of absolute inequality in 21 states while the CI increased in 10 states and decreased in 27 states with a change in the direction of inequality in 19 states. Overall, both measures identified 8 states (AkwaIbom, Edo, Bauchi, Imo, Kano, Kogi, Lagos and Ondo) as having experienced an increase in both absolute and relative inequalities in IMR by mother's level of education. Likewise, the SII in IMR by mother's age, increased in 9 states including the Federal Capital Territory and decreased in 28 states with a change in the direction of absolute inequality in 15 states while the CI increased in 14 states including the Federal Capital Territory and decreased in 23 states with a change in the direction of inequality in 17 states. Overall, both measures identified 8 states (Bauchi, Benue, Borno, CrossRiver, Delta, Lagos, Zamfara and Abuja) as having experienced an increase in both absolute and relative inequalities in IMR by mother's age. This indicates persistent and increasing disparities in child health/survival in these states.

4.25 Changes in relative and absolute inequalities in child and under 5 mortality over time (SII and CI)

Between 2003 and 2013, the SII indicates that absolute inequality in CMR nationally, decreased by wealth groups, mother's level of education and by mother's age while the CI indicates that relative inequalities in CMR over the same period, increased by wealth groups and mother's level of education but decreased by mother's age. In rural areas, the SII decreased by wealth groups, mother's level of education and by mother's age while, the CI increased by wealth groups but decreased by mother's level of education and by mother's age. In urban areas,both the SII and CI decreased by wealth groups, mother's level of education and by mother's age. Across regions, the SII decreased by wealth groups in all regions except the Northeast and Southsouth while the CI decreased only in the Southeast. Both the SII and CI decreased by mother's level of education in all regions except in the Southsouth and Southwest. The SII decreased by mother's age except in the Northwest and Southsouth while the CI decreased except in the Northwest, Southsouth and Southwest indicating unfair disparities in child health/survival in these regions.

At the state level, the SII in CMR by wealth increased in 10 states and decreased in 27 states with a change in the direction of absolute inequality in 17 states. In contrast, the CI increased in 14 states including the Federal Capital Territory, decreased in 22 states and remained unchanged in Kaduna state. However, there was a change in the direction of inequality in 16 states. Overall, both measures identified 10 states (Abia, Bauchi, Benue, Gombe, Katsina, Kebbi, Kwara, Lagos, Rivers and Zamfara) as having experienced an increase in both absolute and relative inequalities in CMR by wealth over time. The SII in CMR by mother's level of education, increased in 9 states and decreased in 28 states with a change in the direction of absolute inequality in 12 states while the CI increased in 13 states and decreased in 24 states with a change in the direction of inequality in 12 states. Overall, both measures identified 9 states (Abia, Adamawa, Benue, Kwara, Lagos, Oyo, Plateau, Taraba and the Federal Capital Territory) as having experienced an increase in both absolute and relative inequalities in CMR by mother's level of education. Likewise, the SII in CMR by mother's age, increased in 6 states and decreased in 31 states with a change in the direction of absolute inequality in 19 states while the CI increased in 12 states and decreased in 25 states with a change in the direction of inequality in 19 states. Overall, both measures identified 6 states (Abia, Adamawa, Benue, Edo, Katsina and Zamfara) as having experienced an increase in both absolute and relative inequalities in CMR by mother's age indicating persistent and increasing socioeconomic inequalities in child mortality in these states.

With regards to under 5 mortality, the SII indicates that the absolute gap in U5MR decreased nationally between 2003 and 2013 by wealth groups, mother's level of education and by mother's age. Also, the CI indicates that relative inequalities in U5MR over the same period, decreased by wealth groups, mother's level of education and by mother's age. In rural areas, the SII decreased by wealth groups, mother's level of education and by mother's age while the CI decreased by wealth groups and mother's age but increased by mother's level of education. In urban areas, the SII decreased by wealth groups and mother's level of education but increased by mother's age while the CI decreased by wealth groups and mother's level of education but increased by mother'sage.

Across regions, the SII indicates that absolute inequalities in U5MR decreased by wealth groups in all regions except the Northeast while the CI indicates that relative inequalities decreased except in the Northeast and Northwest. The SII decreased by mother's level of education except in the Southsouth and Southwest while the CI decreased except in the Northeast, Southsouth and Southwest. In contrast, both the SII and CI decreased by mother's age except in the Southwest.

At the state level, the SII in U5MR by wealth increased in 10 states and decreased in 27 states with a change in the direction of absolute inequality in 14 states. In contrast, the CI increased in 13 states including the Federal Capital Territory and decreased in 24 states with a change in the direction of inequality in 14 states. Overall, both measures identified 9 states (Bauchi, Kogi, Kano, Katsina, Kebbi, Lagos, Ondo, Oyo and Sokoto) as having experienced an increase in both absolute and relative inequalities in U5MR by wealth over time. The SII in U5MR by mother's level of education increased in 14 states and decreased in 23 states with a change in the direction of absolute inequality in 12 states while the CI increased in 16 states, decreased in 20 states and remained unchanged in Delta state with a change in the direction of inequality in 12 states. Overall, both measures identified 13 states (AkwaIbom, Bauchi, CrossRiver, Ebonyi, Ekiti, Kogi, Kwara, Lagos, Ondo, Sokoto, Yobe, Zamfara and the Federal Capital Territory) as having experienced an increase in both absolute and relative inequalities in U5MR by mother's level of education. The SII in U5MR by mother's age increased in 10 states and decreased in 27 states with a change in the direction of absolute inequality in 20 states while the CI increased in 16 states and decreased in 21 states with a change in the direction of inequality in 20 states. Overall, both measures identified 10 states (Bauchi, Borno, Kano, Lagos, Nasarawa, Ogun, Ondo, Rivers, Taraba and Zamfara) as having experienced an increase in both absolute and relative inequalities in IMR by mother's age.

Both the SII and CI indicate significant absolute and relative inequalities in infant, child and under 5 mortality amongst socioeconomic groups with children from the poorest homes, with uneducated mothers and mothers 35 or older mainly bearing the bulk of the mortality burden within Nigeria over time in spite of declines in overall mortality rates. To understand the total impact of observed soicoeconomic inequalities on mortality, the Population Attributable Fraction (PAF) was employed to identify deaths attributable to socioeconomic inequalities or disparities in mortality amongst socioeconomic groups. This indicates the best possible scenario i.e. the highest reduction that could have been achievedif all subgroups had the same mortality rate as the subgroup with the lowest mortality rate. The PAF therefore indicates the potential for future reductions.

4.26 Relative and absolute inequalities in infant mortality rate (PAF)

In relative terms, the PAF (%) indicates that in 2003, 2008 and 2013, respectively, IMR could have been reduced nationally by: 34%, 20% and 21 % with the elimination of inequalities by wealth; 8.7%, 8.4% and 8.6% without inequalities by child's sex; 32%, 17.3% and 22.8% without inequalities by mother's education; 4%, 7% and 6% without inequalities by mother's age and reduced by 7.6%, 2.4% and 6.1% without inequalities by religion. In absolute terms, the PAF estimates that in the same period 184, 413 and 416 infant deaths, respectively could have been prevented with the elimination of inequalities by wealth; 47, 172 and 173 infant deaths, respectively could have been prevented without inequalities by child's sex; 177, 352 and 457 infant deaths, respectively could have been prevented without inequalities by mother's education; 21, 140 and 117 infant deaths, respectively could have been prevented without inequalities by mother's age; and 41, 49 and 123 infant deaths, respectively could have been avoided if there were no inequalities or disparities in IMRs by religion.

Similar reductions could also have been achieved in rural and urban areas in Nigeria. Across regions, PAF (%) indicate that the highest reduction in IMR by wealth could have been achieved in the Southeast (75%) in 2003, Northeast (42.5%) in 2008 and Southwest (43.2%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northeast (46) in 2003, Northwest (170) in 2008 and Northwest (349) in 2013. In relative terms, the highest reduction in IMR by child's sex could have been in the Southeast (42.3%) in 2003, Northcentral (11%) in 2008 and Southeast (12.5%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northwest (19) in 2003, Northwest (66) in 2008 and Northwest (100) in 2013.

In relative terms, the Southeast (64.1%) in 2003, Northeast (44.4%) in 2008 and Northwest (47.5%) in 2013 could have achieved the highest reduction in IMR by mother's education while in absolute terms, the highest avoidable death count could have been in the Northwest (106) in 2003, Northeast (165) in 2008 and Northwest (401) in 2013. In relative terms, the Southeast and Southwest (100%) in 2003, Southeast (39.3%) in 2008 and Northcentral (10%) in 2013 could have achieved the highest reduction in IMR by mother's age while in absolute terms, the highest avoidable death count could have been in the Southwest (28) in 2003, Southeast (87) in 2008 and Northwest (48) in 2013. In relativeterms, the highest reduction in IMR by religion could have been in the Southsouth (100%) in 2003, Southsouth (43.4%) in 2008 and Southeast (100%) in 2013 while in absolute terms, the highest avoidable death count could have been achieved in the Southsouth (76) in 2003, Southsouth (112) in 2008 and Northwest (331) in 2013.

At the state level, the PAF (%) indicates that the highest reduction in IMR by wealth could have been achieved in 14 states (100%) in 2003, Lagos state (100%) in 2008 and 3 states (100%) - Abuja, Bayelsa, Ekiti - in 2013 while in absolute terms, the highest avoidable death count could potentially have been in Zamfara state (36) in 2003, Kano state (107) in 2008 and Bauchi state (69) in 2013 (Table 4.49). In relative terms, the highest reduction in IMR by child's sex could have been achieved in 5 states (100%) - Abia, Ekiti, Imo, Osun, Oyo- in 2003, Osun state (56.3%) in 2008 and Kogi state (49%) in 2013 while in absolute terms, the highest avoidable death count could have been in Bauchi state (14) in 2003, Kano state (42) in 2008 and Zamfara state (39) in 2013 (Table 4.50).

In relative terms, the highest reduction in IMR by mother's education could have been achieved in 19 states (100%) in 2003, 7 states (100%)- Abia, AkwaIbom, Anambra, CrossRiver, Imo, Jigawa, Rivers- in 2008 and 5 states (100%)- Abia, Osun, Sokoto, Yobe, Zamfara- in 2013 while in absolute terms, the highest avoidable death count could have been in Bauchi state (44) in 2003, Kano state (85) in 2008 and Kano state (94) in 2013 (Table 4.51). In relative terms, 18 states (100%) in 2003, 8 states (100%)- Abia, Abuja, Delta, Ebonyi, Edo, Imo, Ondo, Rivers- in 2008 and 9 states (100%)- Abia, Abuja, Benue, Edo, Ekiti, Lagos, Nasarawa, Ogun, Osun- in 2013 could have achieved the highest reduction in IMR by mother's age while in absolute terms, the highest avoidable death count could have been in Zamfara state (36) in 2003, Imo state (65) in 2008 and Lagos state (74) in 2013 (Table 4.52). In relative terms, 10 states (100%) in 2003, 8 states (100%) - Anambra, Bayelsa, Delta, Ebonyi, Kebbi, Rivers, Yobe, Zamfara- in 2008 and 14 states (100%) in 2013 could have achieved the highest reduction in IMR by religion while in absolute terms, the highest avoidable death count could have been in Katsina (27) and Rivers (27) in 2003, Rivers state (59) in 2008 and Kano state (202) in 2013 (Table 4.53)

4.27 Relative and absolute inequalities in child and under 5 mortality rate (PAF)

In relative terms, the PAF (%) indicates that in 2003, 2008 and 2013, respectively, CMR could have been reduced nationally by: 43%, 44% and 57% with the elimination of inequalities by wealth; 1%, 1.2% and 2.4% without inequalities by child's sex; 65%, 48%

and 59.8% without inequalities by mother's education, 16.2%, 45.5% and 3.8% without inequalities by mother's age and reduced by 50.2%, 33.2% and 45.1% with the elimination of inequalities or disparities by religion.

In absolute terms, the PAF estimates that in the same period 131, 509 and 482 child deaths, respectively could have been prevented without inequalities by wealth; 3, 13 and 21 child deaths, respectively could have been prevented without inequalities by child's sex; 198, 551 and 503 child deaths, respectively could have been prevented without inequalities by mother's education; 49, 522 and 32 child deaths, respectively could have been avoided without inequalities by mother's age; and 153, 381 and 380 child deaths, respectively could have been avoided without inequalities by religion. Similar reductions could also have been achieved in rural and urban areas in Nigeria.

Across regions, PAF (%) indicate that the highest reduction in CMR by wealth could have been achieved in the Southwest (100%) in 2003, Northeast (54.3%) in 2008 and Northeast (68.8%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northwest (66) in 2003, Northwest (229) in 2008 and Northwest (283) in 2013. In relative terms, the Southsouth (19%) in 2003, Southwest (8.2%) in 2008 and Southeast (26%) in 2013 could have achieved the highest reduction in CMR by child's sex while in absolute terms, the highest avoidable death count could have been in the Northeast (7) in 2003, Northwest (12) in 2008 and Northwest (19) in 2013. In relative terms, the highest reduction in CMR by mother's education could have been in the Northwest (88.2%) in 2003, Northwest (49.6%) in 2008 and Northwest (74.8%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northwest (118) in 2003, Northeast (268) in 2008 and Northwest (323) in 2013. In relative terms, the Northcentral and Southern parts of Nigeria (100%) in 2003, Southsouth (73.9%) in 2008 and Southsouth and Southeast (100%) in 2013 could have achieved the highest reduction in CMR by mother's age while in absolute terms, the highest avoidable death count could have been in the Northcentral (34) in 2003, Northwest (334) in 2008 and Northwest (54) in 2013. In relative terms, the highest reduction in CMR by religion could have been in the Southsouth (100%) in 2003, Southeast (100%) in 2008 and Southeast (100%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northwest (78) in 2003, Northwest (331) in 2008 and Northwest (272) in 2013 (Table 4.54-4.58).

Table 4.49: PAF (%) in Infant Mortality by Wealth Index in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths Absolute	Count	PAF (%)	Avoidable Deaths Absolute	Count	PAF (%)	Avoidable Deaths Absolute	Count
Residence	Urban	21.2	14.4	25	9.0	5	43	7.2	3.7	41
	Rural	31.2	30.8	132	13.3	10.3	207	16.6	11.7	239
Regions	Northcentral	38.5	34.6	30	22.1	15.7	61	9.5	5.4	23
	Northeast	31.8	31.9	46	42.5	33.9	158	37.4	23.8	131
	Northwest	19.2	18.1	38	25.5	19	170	41.4	30	349
	Southeast	75.0	39.7	14	4.3	3.4	9	18.5	13.3	37
	Southsouth	33.7	33.5	26	9.1	6.3	24	15.6	7.8	23
	Southwest	15.4	8.4	4	11.1	5.8	27	43.2	22.1	95
States	Abia	100	43.5	1	3.7	3.1	1	19.5	15.1	5
	Abuja	0	0	0	42.2	26.1	7	100.0	53.1	11
	Adamawa	57.0	82.8	10	41.7	42.1	31	31.0	24.4	18
	Akwa Ibom	100.0	67.4	12	14.6	9.7	6	9.9	5.5	3
	Anambra	16.2	4.5	0	26.4	13.3	11	13.2	8.1	5
	Bauchi	32.9	29.4	14	39.0	31.0	37	60.5	48.8	69
	Bayelsa	100.0	100	3	12.3	12.0	4	100.0	43.3	10
	Benue	63.0	65.5	13	24.3	22.9	19	10.3	7.1	7
	Borno	4.2	4.5	1	45.2	39.7	42	28.0	7.6	8
	Cross River	48.4	31.2	3	19.5	8.7	5	50.1	20.9	11
	Delta	37.1	50.1	8	19.4	16.2	11	28.9	17.2	10
	Ebonyi	37.1	65.4	3	-0.3	-0.2	0	73.2	61.4	45
	Edo	100.0	58.1	5	-22.8	-11.4	-10	10.7	3.2	1
	Ekiti	38.1	29.3	1	70.5	65.6	13	100.0	50.8	10
	Enugu	48.3	30.2	2	17.9	14.6	7	15.1	9.6	5
	Gombe	32.5	25.3	4	16.7	10.3	6	5.3	3.6	2
	Imo	100.0	8.8	1	68.6	72.6	45	33.5	24.0	13
	Jigawa	47.6	56.8	10	13.5	7.4	8	43.1	36.9	58
	Kaduna	35.2	35.8	12	23.2	16.4	20	53.4	19.5	28
	Kano	39.8	34.5	17	46.4	43.2	107	33.2	22.4	67
	Katsina	8.0	6.3	2	7.0	4.6	7	24.5	12.1	20
	Kebbi	31.5	27	6	15.6	9.7	7	4.0	3.5	4
	Kogi	57.8	36.5	6	13.9	7.7	4	40.1	15.2	6
	Kwara	0.0	0	0	13.8	4.6	2	1.9	1.0	0
	Lagos	100.0	52.1	10	100.0	51.3	76	2.4	1.4	2
	Nasarawa	34.0	64.5	6	20.4	12.5	4	8.4	5.0	2
	Niger	58.9	44.9	10	25.6	20.3	19	8.0	3.9	5
	Ogun	46.7	39.3	4	23.4	16.3	12	11.0	5.9	4
	Ondo	100.0	88.9	4	61.2	26.2	14	17.9	11.5	6
	Osun	100.0	35.7	1	60.9	18.5	9	47.3	17.2	8
	Oyo	100.0	9.9	1	17.3	9.9	10	89.5	37.6	41
	Plateau	39.3	36.9	4	49.5	36.8	23	4.0	2.8	1
	Rivers	58.9	74.3	16	9.9	6.1	6	43.5	25.3	18
	Sokoto	100.0	76.6	16	29.8	25.0	25	48.8	38.2	43
	Taraba	100.0	136.8	29	80.9	64.2	32	55.1	40.8	31
	Yobe	17.5	10	2	60.2	34.4	22	83.5	48.7	45
	Zamfara	100.0	122.9	36	47.9	32.3	27	38.7	41.6	66
National		34.1	30.5	184	20.2	14.40	413	20.8	13.2	416
Calculated by Author										

Table 4.50: PAF (%) in Infant Mortality by Child's Sex in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	1.2	0.8	1	1.1	0.6	5	12.5	6.4	71
	Rural	11.6	11.4	49	10.4	8.1	163	7.2	5.1	104
Regions	Northcentral	10.4	9.3	8	11.0	7.8	30	0.7	0.4	2
	Northeast	10.5	10.5	15	6.4	5.1	24	6.8	4.3	24
	Northwest	9.5	9	19	9.9	7.4	66	11.9	8.6	100
	Southeast	42.3	22.4	8	6.9	5.5	15	12.5	9	25
	Southsouth	20.3	20.2	15	5.2	3.6	13	9.4	4.7	14
	Southwest	8.2	4.5	2	9.8	5.1	23	4.7	2.4	10
States	Abia	100	43.5	1	4.9	4.1	2	9.7	7.5	2
	Abuja	0	0	0	0.5	0.3	0	8.7	4.6	1
	Adamawa	24.7	35.9	4	12.3	12.4	9	3.6	2.8	2
	Akwa Ibom	16.6	11.2	2	11.1	7.4	4	11.0	6.1	3
	Anambra	34.5	9.6	1	-2.2	-1.1	-1	42.1	25.9	17
	Bauchi	31.8	28.4	14	16.0	12.7	15	12.4	10.0	14
	Bayelsa	37.5	37.5	1	31.3	30.6	11	1.4	0.6	0
	Benue	2.9	3	1	19.0	17.9	15	1.9	1.3	1
	Borno	2.8	3	1	14.9	13.1	14	26.2	7.1	8
	Cross River	66.4	42.8	4	32.7	14.6	8	20.1	8.4	4
	Delta	3.8	5.1	1	2.2	1.8	1	22.5	13.4	7
	Ebonyi	32.0	56.5	3	5.2	3.9	2	4.6	3.9	3
	Edo	49.4	28.7	2	-31.9	-15.9	-14	2.0	0.6	0
	Ekiti	100.0	76.9	3	52.4	48.7	10	2.6	1.3	0
	Enugu	3.0	1.9	0	8.0	6.5	3	19.9	12.6	7
	Gombe	2.6	2	0	18.5	11.4	6	3.4	2.3	1
	Imo	100.0	8.8	1	11.3	12	7	17.9	12.8	7
	Jigawa	26.3	31.4	6	2.4	1.3	1	16.5	14.1	22
	Kaduna	6.6	6.7	2	7.9	5.6	7	16.7	6.1	9
	Kano	2.0	1.7	1	18.2	17	42	0.1	0.1	0
	Katsina	36.5	28.6	10	5.6	3.7	6	15.8	7.8	13
	Kebbi	58.7	50.4	12	10.3	6.4	5	9.8	8.7	11
	Kogi	51.6	32.6	6	50.1	27.7	14	49.1	18.6	7
	Kwara	0.0	0	0	29.4	9.8	4	6.1	3.2	1
	Lagos	36.1	18.8	4	9.2	4.7	7	20.6	11.8	15
	Nasarawa	10.4	19.7	2	21.9	13.4	4	19.0	11.3	5
	Niger	13.9	10.6	2	2.0	1.6	2	0.4	0.2	0
	Ogun	37.5	31.5	3	25.8	18	13	15.0	8.0	6
	Ondo	56.7	50.4	2	2.6	1.1	1	2.8	1.8	1
	Osun	100.0	35.7	1	56.3	17.1	8	1.4	0.5	0
	Oyo	100.0	9.9	1	22.2	12.7	13	18.1	7.6	8
	Plateau	40.9	38.4	4	0.7	0.5	0	2.3	1.6	1
	Rivers	41.8	52.8	11	7.3	4.5	4	0.9	0.5	0
	Sokoto	1.3	1	0	25.8	21.6	22	6.0	4.7	5
	Taraba	32.5	44.4	9	30.0	23.8	12	5.3	3.9	3
	Yobe	37.5	21.4	4	1.4	0.8	1	7.4	4.3	4
	Zamfara	20.7	25.5	7	0.1	0.1	0	22.4	24.1	39
National		8.7	7.8	47	8.4	6	172	8.6	5.5	173
Calculated by Author										

Table 4.51: PAF (%) in Infant Mortality by Mother's Education in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	51.2	34.7	60	12.1	6.7	57	17.0	8.7	96
	Rural	10.9	10.7	46	9.8	7.6	153	14.9	10.5	215
Regions	Northcentral	63.1	56.7	49	18.3	13.0	51	4.6	2.6	11
	Northeast	24.7	24.7	35	44.4	35.4	165	11.3	7.2	40
	Northwest	53.8	50.8	106	15.5	11.6	104	47.5	34.4	401
	Southeast	64.1	33.9	12	4.3	3.4	9	16.8	12.1	34
	Southsouth	43.4	43.1	33	1.6	1.1	4	3.6	1.8	5
	Southwest	40.0	21.9	11	22.1	11.5	53	40.6	20.8	90
States	Abia	100	43.5	1	100	83.2	40	100.0	77.6	25
	Abuja	0	0	0	9.4	5.8	2	-4.7	-2.5	-1
	Adamawa	50.9	73.9	9	39.4	39.8	30	23.8	18.7	14
	Akwa Ibom	10.7	7.2	1	100.0	66.6	40	26.2	14.6	7
	Anambra	100.0	27.8	3	100.0	50.3	40	39.8	24.5	16
	Bauchi	100.0	89.4	44	32.6	25.9	31	58.7	47.3	67
	Bayelsa	100.0	100	3	7.8	7.6	3	16.9	7.3	2
	Benue	80.4	83.6	17	13.1	12.4	11	17.1	11.8	11
	Borno	70.2	76	21	62.7	55.1	59	21.4	5.8	6
	Cross River	100.0	64.5	6	100.0	44.6	25	11.5	4.8	3
	Delta	100.0	135	22	7.1	5.9	4	24.7	14.7	8
	Ebonyi	16.1	28.4	1	11.6	8.6	5	45.6	38.3	28
	Edo	100.0	58.1	5	-13.2	-6.6	-6	36.8	11	4
	Ekiti	100.0	76.9	3	58.5	54.4	11	6.3	3.2	1
	Enugu	17.9	11.2	1	33.8	27.6	12	41.6	26.4	15
	Gombe	61.9	48.2	7	29.4	18.1	10	48.8	33.2	20
	Imo	100.0	8.8	1	100.0	105.9	65	19.4	13.9	8
	Jigawa	100.0	119.3	21	100.0	55	59	36.2	31	49
	Kaduna	61.2	62.2	21	14.3	10.1	13	21.6	7.9	11
	Kano	62.7	54.4	27	36.6	34.1	85	46.7	31.5	94
	Katsina	5.4	4.2	1	7.8	5.1	8	5.3	2.6	4
	Kebbi	100.0	85.8	20	15.6	9.7	7	5.8	5.1	6
	Kogi	100.0	63.2	11	19.2	10.6	5	45.9	17.4	7
	Kwara	0.0	0	0	52.9	17.6	7	13.3	7	3
	Lagos	100.0	52.1	10	60.6	31.1	46	17.8	10.2	13
	Nasarawa	64.8	122.8	12	38.8	23.8	8	7.4	4.4	2
	Niger	45.3	34.5	8	85.9	68.2	64	45.9	22.3	31
	Ogun	48.3	40.6	4	40.7	28.4	20	30.8	16.5	12
	Ondo	16.6	14.8	1	32.0	13.7	7	47.1	30.2	17
	Osun	100.0	35.7	1	28.9	8.8	4	100.0	36.4	16
	Oyo	100.0	9.9	1	56.1	32.1	32	89.0	37.4	41
	Plateau	100.0	94	11	20.9	15.5	10	31.7	22.2	11
	Rivers	8.8	11.1	2	100.0	61.8	59	33.8	19.7	14
	Sokoto	100.0	76.6	16	34.6	29	29	100.0	78.2	89
	Taraba	100.0	136.8	29	72.7	57.7	28	4.3	3.2	2
	Yobe	11.2	6.4	1	25.9	14.8	9	100.0	58.3	54
	Zamfara	100.0	122.9	36	62.0	41.8	35	100.0	107.6	172
National		32.9	29.4	177	17.3	12.3	352	22.8	14.5	457
Calculated by Author										

Table 4.52: PAF (%) in Infant Mortality by Mother's Age in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths Absolute	Avoidable Deaths Count	PAF (%)	Avoidable Deaths Absolute	Avoidable Deaths Count	PAF (%)	Avoidable Deaths Absolute	Avoidable Deaths Count
Residence	Urban	5.3	3.6	6	6.7	3.7	32	10.9	5.6	62
	Rural	3.9	3.8	16	6.0	4.7	95	3.8	2.7	55
Regions	Northcentral	34.5	31.0	27	2.1	1.5	6	9.7	5.5	24
	Northeast	3.3	3.3	5	6.3	5	23	7.2	4.6	25
	Northwest	4.9	4.6	10	8.3	6.2	56	5.7	4.1	48
	Southeast	100.0	52.9	19	39.3	31.4	87	9.0	6.5	18
	Southsouth	17.1	17.0	13	15.7	10.9	41	6.4	3.2	9
	Southwest	100.0	54.7	28	12.1	6.3	29	6.8	3.5	15
States	Abia	100	43.5	1	100	83.2	40	100.0	77.6	25
	Abuja	0	0	0	100	61.8	16	100.0	53.1	11
	Adamawa	37.4	54.4	6	9.9	10.0	7	8.0	6.3	5
	Akwa Ibom	100.0	67.4	12	11.7	7.8	5	49.7	27.7	13
	Anambra	100.0	27.8	3	11.7	5.9	5	24.6	15.1	10
	Bauchi	29.1	26	13	29.2	23.2	28	15.4	12.4	18
	Bayelsa	100.0	100	3	36.0	35.2	12	24.0	10.4	2
	Benue	43.5	45.2	9	5.4	5.1	4	100.0	69	66
	Borno	25.1	27.2	8	11.4	10.0	11	28.0	7.6	8
	Cross River	23.7	15.3	1	20.0	8.9	5	5.3	2.2	1
	Delta	9.0	12.2	2	100.0	83.3	58	21.3	12.7	7
	Ebonyi	31.3	55.3	3	100.0	74.3	41	21.9	18.4	14
	Edo	100.0	58.1	5	100.0	49.9	43	100.0	29.9	12
	Ekiti	10.3	7.9	0	48.3	44.9	9	100.0	50.8	10
	Enugu	100.0	62.5	4	17.5	14.3	6	21.1	13.4	7
	Gombe	100.0	77.9	12	14.1	8.7	5	21.6	14.7	9
	Imo	100.0	8.8	1	100.0	105.9	65	6.8	4.9	3
	Jigawa	37.9	45.2	8	13.1	7.2	8	9.6	8.2	13
	Kaduna	22.8	23.2	8	7.8	5.5	7	8.2	3	4
	Kano	13.5	11.7	6	13.1	12.2	30	6.7	4.5	13
	Katsina	51.9	40.6	14	7.3	4.8	8	25.4	12.5	21
	Kebbi	6.8	5.8	1	47.8	29.8	22	5.8	5.1	6
	Kogi	100.0	63.2	11	43.4	24.0	12	21.6	8.2	3
	Kwara	0.0	0	0	26.7	8.9	4	37.5	19.7	8
	Lagos	100.0	52.1	10	15.0	7.7	11	100.0	57.4	74
	Nasarawa	69.0	130.7	12	41.8	25.6	8	100.0	59.5	27
	Niger	100.0	76.2	17	42.7	33.9	32	12.3	6	8
	Ogun	100.0	84.1	9	20.3	14.2	10	100.0	53.5	39
	Ondo	100.0	88.9	4	100.0	42.8	23	29.6	19	11
	Osun	100.0	35.7	1	37.8	11.5	6	100.0	36.4	16
	Oyo	100.0	9.9	1	6.8	3.9	4	17.1	7.2	8
	Plateau	100.0	94	11	23.3	17.3	11	3.4	2.4	1
	Rivers	16.1	20.3	4	100.0	61.8	59	21.8	12.7	9
	Sokoto	100.0	76.6	16	37.2	31.2	31	10.1	7.9	9
	Taraba	18.8	25.7	5	14.1	11.2	6	52.9	39.2	30
	Yobe	62.0	35.4	6	31.3	17.9	11	28.5	16.6	15
	Zamfara	100.0	122.9	36	40.7	27.4	23	19.7	21.2	34
National		3.9	3.5	21	6.9	4.9	140	5.8	3.7	117
Calculated by Author										

Table 4.53: PAF (%) in Infant Mortality by Religion in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	22.3	15.1	26	3.2	1.8	15	5.7	2.9	32
	Rural	3.9	3.8	16	2.1	1.6	32	7.8	5.5	113
Regions	Northcentral	14.1	12.7	11	4.6	3.3	13	13.3	7.5	32
	Northeast	2.0	2	3	1.0	0.8	4	3.9	2.5	14
	Northwest	1.6	1.5	3	1.6	1.2	11	39.2	28.4	331
	Southeast	17.6	9.3	3	3.1	2.5	7	100.0	71.9	202
	Southsouth	100.0	99.4	76	43.4	30.1	112	1.4	0.7	2
	Southwest	37.8	20.7	11	5.0	2.6	12	5.9	3.0	13
States	Abia	100.0	43.5	1	1.6	1.3	1	100.0	77.6	25
	Abuja	0.0	0	0	-0.2	-0.1	0	39.9	21.2	4
	Adamawa	11.8	17.1	2	8.5	8.6	6	13.7	10.8	8
	Akwa Ibom	0.0	0	0	-1.5	-1	-1	100.0	55.7	26
	Anambra	0.0	0	0	100.0	50.3	40	100.0	61.5	40
	Bauchi	25.4	22.7	11	0.6	0.5	1	100.0	80.6	114
	Bayelsa	100.0	100	3	100.0	97.7	34	100.0	43.3	10
	Benue	13.1	13.6	3	0.53	0.5	0	100.0	69	66
	Borno	0.4	0.4	0	21.5	18.9	20	100.0	27.1	30
	Cross River	0.0	0	0	-0.4	-0.2	0	7.7	3.2	2
	Delta	14.4	19.4	3	100.0	83.3	58	5.2	3.1	2
	Ebonyi	12.9	22.7	1	100.0	74.3	41	100.0	83.9	62
	Edo	100.0	58.1	5	-1.4	-0.7	-1	100.0	29.9	12
	Ekiti	100.0	76.9	3	57.4	53.4	11	0.4	0.2	0
	Enugu	-6.7	-4.2	0	1.3	1.1	0	100.0	63.4	35
	Gombe	-6.9	-5.4	-1	44.0	27.1	15	1.3	0.9	1
	Imo	0.0	0	0	-0.3	-0.3	0	0	0	0
	Jigawa	0.0	0	0	-1.3	-0.7	-1	100.0	85.7	135
	Kaduna	4.1	4.2	1	14.0	9.9	12	1.1	0.4	1
	Kano	1.2	1	0	2.0	1.9	5	100.0	67.5	202
	Katsina	100.0	78.3	27	4.6	3	5	100.0	49.3	83
	Kebbi	9.2	7.9	2	100.0	62.3	45	50.8	44.9	55
	Kogi	100.0	63.2	11	11.0	6.1	3	19.0	7.2	3
	Kwara	0.0	0	0	4.8	1.6	1	42.3	22.2	9
	Lagos	46.6	24.3	5	9.2	4.7	7	-1.0	-0.6	-1
	Nasarawa	-9.9	-18.8	-2	7.8	4.8	2	32.8	19.5	9
	Niger	7.2	5.5	1	1.1	0.9	1	4.7	2.3	3
	Ogun	42.0	35.3	4	5.3	3.7	3	-0.7	-0.4	0
	Ondo	8.8	7.8	0	2.3	1	1	7.2	4.6	3
	Osun	100.0	35.7	1	35.9	10.9	5	10.7	3.9	2
	Oyo	100.0	9.9	1	22.4	12.8	13	12.4	5.2	6
	Plateau	7.0	6.6	1	17.6	13.1	8	10.8	7.6	4
	Rivers	100.0	126.2	27	100.0	61.8	59	1.9	1.1	1
	Sokoto	-1.8	-1.4	0	-1.7	-1.4	-1	0.3	0.2	0
	Taraba	-1.3	-1.8	0	15.7	12.5	6	2.4	1.8	1
	Yobe	100.0	57.1	10	100.0	57.1	36	100.0	58.3	54
	Zamfara	-0.3	-0.4	0	100.0	67.4	56	-0.9	-1	-2
National		7.6	6.8	41	2.4	1.7	49	6.1	3.9	123
Calculated by Author										

At the state level, PAF (%) indicate that the highest reduction in CMR by wealth could have been achieved in 24 states (100%) in 2003, 4 states (100%) – Abia, Abuja, Edo, Plateau - in 2008 and 13 states (100%) in 2013 while in absolute terms, the highest avoidable death count could have been in Jigawa state (19) in 2003, Kano state (76) in 2008 and Zamfara state (77) in 2013 (Table 4.54). In relative terms, the highest reduction in CMR by child's sex could have been in 10 states (100%) in 2003, Oyo state (100%) in 2008 and Osun state (100%) in 2013 while in absolute terms, the highest avoidable death count could have been in Sokoto state (18) in 2003, Bauchi (10) and Lagos (10) in 2008 and Katsina state (21) in 2013 (Table 4.55). In relative terms, the highest reduction in CMR by mother's education could have been in 29 states (100%) in 2003, 12 states (100%) in 2008 and 21 states (100%) in 2013 while in absolute terms, the highest avoidable death count could have been in Bauchi state (35) in 2003, Katsina state (97) in 2008 and Zamfara state (77) in 2013 (Table 4.56). In relative terms, the highest reduction in CMR by mother's age could have been in 25 states (100%) in 2003, 19 states (100%) in 2008 and 22 states (100%) in 2013 while in absolute terms, the PAF shows that the highest avoidable death count could have been in Jigawa state (19) in 2003, Kano state (126) in 2008 and Katsina state (56) in 2013 (Table 4.57). In relative terms, the highest reduction in CMR by religion could have been achieved in 14 states (100%) in 2003, 13 states (100%) in 2008 and 16 states (100%) in 2013 while in absolute terms, the highest avoidable death count could have been in Kano state (25) in 2003, Katsina state (97) in 2008 and Kano state (101) in 2013 (Table 4.58).

With regards to under 5 mortality, the PAF (%) indicates that in 2003, 2008 and 2013, respectively, U5MR could have been reduced nationally by: 36.9%, 28.6% and 31.5 % with the elimination of disparities by wealth; 4.9%, 5.5% and 6.7% without inequalities by child's sex; 44.8%, 28.1% and 33.6% without inequalities by mother's education, 5.8%, 6.8% and 5.2% without inequalities by mother's age and reduced by 89%, 13.5% and 17.7% without religion based inequalities in U5MRs. In absolute terms, the PAF estimates that in the same period 313, 911 and 898 under 5 deaths, respectively could have been prevented without inequalities by wealth; 42, 175 and 192 under 5 deaths, respectively could have been avoided without inequalities by child's sex; 380, 894 and 957 under 5 deaths, respectively could have been avoided without inequalities by mother's education; 49, 218 and 148 under 5 deaths, respectively could have been potentially avoided without inequalities by mother's age; and 754, 15 and 504 under 5 deaths,

Table 4.54: PAF (%) in Child Mortality by Wealth in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	24.4	7.8	13	21.7	5.6	45	22.6	3.3	34
	Rural	33.5	22.0	85	39.6	20.1	373	59.2	21.5	409
Regions	Northcentral	44.4	19.1	15	29.4	10.3	37	33.9	6.2	25
	Northeast	24.1	18.4	24	54.3	28.6	123	68.8	24.9	129
	Northwest	49.4	34.9	66	42.4	27.7	229	65.5	26.2	283
	Southeast	61.5	7.2	2	10.7	3.6	9	28.6	5.6	15
	Southsouth	27.0	9.8	7	7.4	2.2	8	27.1	4.6	13
	Southwest	100.0	20.7	10	16.3	2.4	10	15.7	2.0	8
States	Abia	0.0	0.0	0	100	34.0	15	50.5	5.1	2
	Abuja	100	52.6	1	100	20.6	5	100.0	10.2	2
	Adamawa	100	40.0	4	32.3	17.9	12	44.2	9.3	6
	Akwa Ibom	100	30.1	5	16.3	7.8	4	49.0	7.8	3
	Anambra	0.0	0.0	0	28.0	12.6	10	26.0	3.4	2
	Bauchi	45.5	35.5	16	67.0	41.4	46	52.5	29.0	38
	Bayelsa	100.0	111.1	3	31.9	10.1	3	100.0	13.6	3
	Benue	27.6	7.6	1	28.6	6.3	5	64.4	15.9	14
	Borno	38.1	26.2	6	42.6	18.8	18	36.8	8.2	9
	Cross River	100.0	11.5	1	33.7	6.3	3	45.8	10.0	5
	Delta	100.0	14.2	2	28.1	6.6	4	100.0	15.3	8
	Ebonyi	100.0	47.6	2	23.3	7.0	3	29.2	9.5	6
	Edo	100.0	49.4	4	100.0	22.4	12	11.2	1.7	1
	Ekiti	100.0	27.8	1	26.9	7.4	3	100.0	5.3	1
	Enugu	100.0	16.7	1	33.4	7.2	3	21.8	3.4	2
	Gombe	100.0	91.5	13	47.8	24.7	12	77.9	34.1	19
	Imo	100.0	8.9	1	14.9	4.3	2	100.0	17.8	9
	Jigawa	100.0	122.6	19	45.9	33.1	33	100.0	52.7	76
	Kaduna	39.2	16.5	5	63.1	29.4	34	37.1	3.2	4
	Kano	36.6	20.2	9	44.0	33.9	76	48.6	17.6	49
	Katsina	15.6	6.4	2	49.9	32.4	48	74.0	31.9	51
	Kebbi	100.0	56.3	12	23.5	9.4	6	100.0	37.4	42
	Kogi	100.0	67.5	11	10.9	3.5	2	49.9	9.2	3
	Kwara	0.0	0.0	0	8.8	1.1	0	53.3	8.4	3
	Lagos	100.0	16.5	3	16.4	2.1	3	22.5	1.5	2
	Nasarawa	100.0	39.0	3	30.5	7.0	2	26.2	6.8	3
	Niger	72.4	42.2	9	35.0	25.3	22	7.6	1.3	2
	Ogun	100.0	20.4	2	44.2	5.3	4	100.0	11.6	8
	Ondo	100.0	24.4	1	37.8	10.3	5	62.7	14.3	8
	Osun	100.0	37.0	1	4.4	0.6	0	100.0	4.7	2
	Oyo	100.0	20.0	2	18.5	1.8	2	55.5	11.1	12
	Plateau	100.0	18.9	2	100.0	26.2	15	100.0	10.8	5
	Rivers	100.0	53.5	10	11.9	4.0	4	20.3	3.3	2
	Sokoto	9.6	9.0	2	28.6	23.4	21	39.9	20.9	22
	Taraba	100.0	32.8	6	63.4	26.6	12	100.0	25.7	18
	Yobe	40.0	53.3	9	71.8	38.7	23	100.0	40.1	35
	Zamfara	34.8	46.1	12	24.7	13.4	10	100.0	54.0	77
National		43.1	23.9	131	44.3	19.1	509	57.3	16.4	482
Calculated by Author										

Table 4.55: PAF (%) in Child Mortality by Child's Sex in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	10.9	3.5	6	5.4	1.4	11	1.4	0.2	2
	Rural	0.6	0.4	2	2.8	1.4	26	2.8	1.0	19
Regions	Northcentral	10.9	4.7	4	6.9	2.4	9	3.3	0.6	2
	Northeast	7.6	5.8	7	3.4	1.8	8	3.0	1.1	6
	Northwest	2.5	1.8	3	2.3	1.5	12	4.5	1.8	19
	Southeast	10.3	1.2	0	6.5	2.2	6	26.0	5.1	13
	Southsouth	19.0	6.9	5	2.0	0.6	2	18.8	3.2	9
	Southwest	8.7	1.8	1	8.2	1.2	5	7.1	0.9	4
States	Abia	0.0	0.0	0	49.4	16.8	7	34.7	3.50	1
	Abuja	-58.3	-30.7	-1	20.3	4.2	1	0.0	0.00	0
	Adamawa	-16.3	-6.5	-1	7.2	4.0	3	5.0	1.06	1
	Akwa Ibom	19.0	5.7	1	1.7	0.8	0	18.1	2.87	1
	Anambra	0.0	0.0	0	8.2	3.7	3	51.2	6.71	4
	Bauchi	0.3	0.2	0	14.1	8.7	10	3.5	1.94	3
	Bayelsa	100.0	111.1	3	-2.7	-0.9	0	32.2	4.37	1
	Benue	60.5	16.7	3	11.9	2.6	2	-3.7	-0.91	-1
	Borno	9.8	6.7	2	1.6	0.7	1	33.2	7.40	8
	Cross River	100.0	11.5	1	17.6	3.3	2	16.0	3.48	2
	Delta	100.0	14.2	2	37.1	8.7	6	26.9	4.13	2
	Ebonyi	-5.0	-2.4	0	1.0	0.3	0	4.6	1.50	1
	Edo	38.6	19.1	2	11.6	2.6	1	31.9	4.92	2
	Ekiti	100.0	27.8	1	6.6	1.8	1	-94.5	-5.05	-1
	Enugu	100.0	16.7	1	33.4	7.2	3	45.7	7.07	4
	Gombe	36.6	33.5	5	17.2	8.9	4	28.5	12.50	7
	Imo	100.0	8.9	1	42.4	12.3	7	56.1	9.99	5
	Jigawa	19.6	24.0	4	3.4	2.5	2	2.7	1.44	2
	Kaduna	41.3	17.4	5	14.9	6.9	8	34.8	3.05	4
	Kano	36.2	20.0	9	4.0	3.1	7	18.3	6.61	18
	Katsina	11.0	4.5	1	1.9	1.2	2	31.1	13.40	21
	Kebbi	15.5	8.7	2	14.0	5.6	4	22.7	8.47	10
	Kogi	37.6	25.4	4	13.9	4.5	2	46.1	8.47	3
	Kwara	0.0	0.0	0	21.9	2.7	1	34.3	5.43	2
	Lagos	30.2	5.0	1	55.5	7.1	10	22.5	1.48	2
	Nasarawa	41.7	16.3	1	17.4	4.0	1	46.4	11.96	5
	Niger	84.9	49.5	10	0.6	0.4	0	30.3	5.08	7
	Ogun	9.4	1.9	0	21.7	2.6	2	27.6	3.19	2
	Ondo	100.0	24.4	1	9.5	2.6	1	48.3	11.01	6
	Osun	100.0	37.0	1	6.0	0.8	0	100.0	4.72	2
	Oyo	7.5	1.5	0	100.0	9.6	9	22.5	4.50	5
	Plateau	100.0	18.9	2	30.9	8.1	5	60.1	6.48	3
	Rivers	78.3	41.9	8	3.8	1.3	1	27.7	4.48	3
	Sokoto	100.0	93.3	18	8.3	6.8	6	5.4	2.83	3
	Taraba	59.4	19.5	4	3.2	1.3	1	17.9	4.61	3
	Yobe	10.8	14.3	2	1.6	0.9	1	8.5	3.39	3
	Zamfara	-3.4	-4.5	-1	12.5	6.8	5	-0.3	-0.14	0
National		0.9	0.5	3	1.2	0.5	13	2.4	0.70	21
Calculated by Author										

Table 4.56: PAF (%) in Child Mortality by Mother's education in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	57.2	18.3	30	33.7	8.7	70	30.8	4.5	47
	Rural	63.3	41.6	161	43.6	22.1	410	62.5	22.7	432
Regions	Northcentral	86.7	37.3	29	43.4	15.2	55	62.3	11.4	46
	Northeast	64.1	48.9	63	42.5	22.4	96	47.2	17.1	88
	Northwest	88.2	62.3	118	49.6	32.4	268	74.8	29.9	323
	Southeast	58.1	6.8	2	9.8	3.3	8	22.4	4.4	11
	Southsouth	59.0	21.4	15	20.1	6.0	21	17.6	3.0	8
	Southwest	16.9	3.5	2	46.3	6.8	30	36.2	4.6	19
States	Abia	0	0.0	0	100	34.0	15	100.0	10.10	3
	Abuja	100	52.6	1	17.9	3.7	1	100.0	10.20	2
	Adamawa	5.7	2.3	0	13.5	7.5	5	34.6	7.26	5
	Akwa Ibom	100.0	30.1	5	10.2	4.9	3	100.0	15.87	7
	Anambra	0.0	0.0	0	100.0	45.0	34	100.0	13.11	8
	Bauchi	100.0	78.1	35	69.4	42.9	47	37.7	20.84	27
	Bayelsa	100.0	111.1	3	27.5	8.7	3	100.0	13.57	3
	Benue	24.7	6.8	1	78.3	17.3	13	74.1	18.29	16
	Borno	52.3	36.0	9	61.7	27.2	27	100.0	22.30	24
	Cross River	100.0	11.5	1	42.2	7.9	4	47.2	10.28	5
	Delta	100.0	14.2	2	100.0	23.5	15	100.0	15.33	8
	Ebonyi	100.0	47.6	2	34.0	10.2	4	100.0	32.50	22
	Edo	100.0	49.4	4	15.6	3.5	2	24.8	3.82	1
	Ekiti	100.0	27.8	1	100.0	27.6	10	100.0	5.35	1
	Enugu	100.0	16.7	1	33.9	7.3	3	40.5	6.27	3
	Gombe	100.0	91.5	13	41.4	21.4	11	38.4	16.80	9
	Imo	100.0	8.9	1	100.0	29.1	16	13.4	2.39	1
	Jigawa	49.0	60.1	9	50.5	36.4	37	30.2	15.94	23
	Kaduna	100.0	42.1	13	63.8	29.7	34	52.0	4.55	6
	Kano	79.9	44.1	20	32.7	25.2	57	70.5	25.51	71
	Katsina	100.0	40.9	13	100.0	64.9	97	100.0	43.10	69
	Kebbi	100.0	56.3	12	9.0	3.6	2	100.0	37.37	42
	Kogi	100.0	67.5	11	10.3	3.3	2	100.0	18.37	7
	Kwara	0.0	0.0	0	100.0	12.3	5	100.0	15.83	6
	Lagos	100.0	16.5	3	26.6	3.4	5	21.0	1.38	2
	Nasarawa	100.0	39.0	3	43.2	9.9	3	100.0	25.76	11
	Niger	100.0	58.3	12	11.5	8.3	7	17.8	2.98	4
	Ogun	100.0	20.4	2	100.0	12.0	8	100.0	11.59	8
	Ondo	100.0	24.4	1	32.3	8.8	5	100.0	22.81	12
	Osun	100.0	37.0	1	100.0	12.6	6	100.0	4.72	2
	Oyo	100.0	20.0	2	100.0	9.6	9	49.0	9.80	10
	Plateau	100.0	18.9	2	32.8	8.6	5	49.9	5.38	2
	Rivers	100.0	53.5	10	30.7	10.3	9	100.0	16.18	11
	Sokoto	100.0	93.3	18	2.1	1.7	2	60.3	31.63	33
	Taraba	100.0	32.8	6	73.6	30.9	14	100.0	25.71	18
	Yobe	100.0	133.3	22	100.0	53.9	32	100.0	40.09	35
	Zamfara	100.0	132.3	34	100.0	54.2	42	100.0	53.96	77
National		65.0	36.0	198	48.0	20.7	551	59.8	17.10	503
Calculated by Author										

Table 4.57: PAF (%) in Child Mortality by Mother's age in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	61.6	19.7	32	7.0	1.8	15	11.6	1.7	18
	Rural	9.7	6.4	25	54.8	27.8	516	11.8	4.3	82
Regions	Northcentral	100.0	43.0	34	25.1	8.8	32	32.2	5.9	24
	Northeast	17.3	13.2	17	47.4	25	107	6.4	2.3	12
	Northwest	5.5	3.9	7	61.7	40.3	334	12.5	5.0	54
	Southeast	100.0	11.7	4	49.7	16.7	43	100.0	19.6	51
	Southsouth	100.0	36.3	25	73.9	22.1	77	100.0	17	47
	Southwest	100.0	20.7	10	15.0	2.2	10	27.6	3.5	14
States	Abia	0	0.0	0	11.5	3.9	2	100.0	10.10	3
	Abuja	100	52.6	1	100.0	20.6	5	100.0	10.20	2
	Adamawa	100	40.0	4	100.0	55.4	37	38.0	7.96	5
	Akwa Ibom	100	30.1	5	100.0	48.1	27	100.0	15.87	7
	Anambra	0	0.0	0	100.0	45.0	34	100.0	13.11	8
	Bauchi	17.4	13.6	6	55.0	34.0	37	13.6	7.54	10
	Bayelsa	100.0	111.1	3	16.2	5.1	2	100.0	13.57	3
	Benue	100.0	27.6	5	43.1	9.5	7	100.0	24.69	22
	Borno	5.3	3.6	1	11.6	5.1	5	29.2	6.50	7
	Cross River	100.0	11.5	1	100.0	18.7	10	100.0	21.78	11
	Delta	100.0	14.2	2	100.0	23.5	15	100.0	15.33	8
	Ebonyi	100.0	47.6	2	100.0	30.0	12	100.0	32.50	22
	Edo	100.0	49.4	4	100.0	22.4	12	100.0	15.42	6
	Ekiti	100.0	27.8	1	14.6	4.0	1	100.0	5.35	1
	Enugu	100.0	16.7	1	100.0	21.6	9	100.0	15.47	8
	Gombe	45.4	41.5	6	8.9	4.6	2	34.7	15.20	8
	Imo	100.0	8.9	1	100.0	29.1	16	100.0	17.79	9
	Jigawa	100.0	122.6	19	73.4	52.9	54	20.4	10.74	15
	Kaduna	25.6	10.8	3	73.6	34.3	40	30.3	2.65	4
	Kano	26.6	14.7	7	72.6	55.9	126	7.8	2.81	8
	Katsina	100.0	40.9	13	76.4	49.6	74	81.4	35.10	56
	Kebbi	61.5	34.6	7	32.3	12.9	9	10.6	3.97	4
	Kogi	100.0	67.5	11	10.9	3.5	2	100.0	18.37	7
	Kwara	0.0	0.0	0	100.0	12.3	5	100.0	15.83	6
	Lagos	100.0	16.5	3	100.0	12.8	18	100.0	6.58	8
	Nasarawa	100.0	39.0	3	100.0	22.9	7	100.0	25.76	11
	Niger	100.0	58.3	12	78.0	56.5	49	33.3	5.58	7
	Ogun	100.0	20.4	2	57.5	6.9	5	100.0	11.59	8
	Ondo	100.0	24.4	1	100.0	27.2	14	100.0	22.81	12
	Osun	100.0	37.0	1	100.0	12.6	6	100.0	4.72	2
	Oyo	100.0	20.0	2	100.0	9.6	9	26.5	5.30	6
	Plateau	100.0	18.9	2	100.0	26.2	15	100.0	10.78	5
	Rivers	100.0	53.5	10	100.0	33.5	30	100.0	16.18	11
	Sokoto	17.5	16.4	3	31.9	26.1	24	6.2	3.23	3
	Taraba	100.0	32.8	6	100.0	42.0	19	5.9	1.51	1
	Yobe	46.5	61.9	10	62.1	33.5	20	-1.8	-0.71	-1
	Zamfara	14.7	19.4	5	59.0	32.0	25	32.2	17.36	25
National		16.2	9.0	49	45.5	19.6	522	3.8	1.10	32
Calculated by Author										

Table 4.58: PAF (%) in Child Mortality by Religion in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	40.3	12.9	21	21.3	5.5	44	18.5	2.7	28
	Rural	51.8	34.0	131	33.5	17	316	47.1	17.1	326
Regions	Northcentral	27.7	11.9	9	18.9	6.6	24	5.5	1.0	4
	Northeast	67.9	51.8	67	2.1	1.1	5	46.4	16.8	87
	Northwest	58.4	41.2	78	61.1	39.9	331	63.0	25.2	272
	Southeast	-4.3	-0.5	0	100.0	33.6	86	100.0	19.6	51
	Southsouth	100.0	36.3	25	-0.7	-0.2	-1	1.8	0.3	1
	Southwest	30.4	6.3	3	26.5	3.9	17	21.3	2.7	11
States	Abia	0	0.0	0	-0.8	-0.3	0	100.0	10.1	3
	Abuja	-5.64	-3.0	0	46.5	9.6	2	4.9	0.5	0
	Adamawa	19.3	7.7	1	34.5	19.1	13	26.5	5.6	4
	Akwa Ibom	0.1	0.0	0	2.1	1.0	1	100.0	15.9	7
	Anambra	0.0	0.0	0	100.0	45.0	34	100.0	13.1	8
	Bauchi	8.6	6.7	3	41.1	25.4	28	100.0	55.3	72
	Bayelsa	-3.9	-4.3	0	100.0	31.8	10	100.0	13.6	3
	Benue	100.0	27.6	5	-1.6	-0.4	0	7.7	1.9	2
	Borno	100.0	68.8	17	100.0	44.1	43	100.0	22.3	24
	Cross River	-0.1	0.0	0	-0.6	-0.1	0	100.0	21.8	11
	Delta	-7.9	-1.1	0	100.0	23.5	15	9.3	1.4	1
	Ebonyi	-27.3	-13.0	-1	100.0	30.0	12	100.0	32.5	22
	Edo	100.0	49.4	4	16.5	3.7	2	7.3	1.1	0
	Ekiti	100.0	27.8	1	100.0	27.6	10	100.0	5.3	1
	Enugu	100.0	16.7	1	100.0	21.6	9	100.0	15.5	8
	Gombe	100.0	91.5	13	30.9	16.0	8	34.7	15.2	8
	Imo	0.3	0.0	0	-0.5	-0.2	0	-0.1	0.0	0
	Jigawa	0.0	0.0	0	0.2	0.2	0	100.0	52.7	76
	Kaduna	18.0	7.6	2	44.7	20.8	24	57.7	5.0	7
	Kano	100.0	55.2	25	-3.9	-3.0	-7	100.0	36.2	101
	Katsina	100.0	40.9	13	100.0	64.9	97	100.0	43.1	69
	Kebbi	0.1	0.0	0	100.0	39.9	27	3.7	1.4	2
	Kogi	47.1	31.8	5	16.7	5.4	3	30.9	5.7	2
	Kwara	0.0	0.0	0	100.0	12.3	5	100.0	15.8	6
	Lagos	-8.6	-1.4	0	17.2	2.2	3	25.6	1.7	2
	Nasarawa	100.0	39.0	3	-0.1	0.0	0	20.8	5.4	2
	Niger	50.9	29.7	6	0.6	0.4	0	-1.9	-0.3	0
	Ogun	100.0	20.4	2	5.1	0.6	0	11.2	1.3	1
	Ondo	100.0	24.4	1	11.7	3.2	2	38.2	8.7	5
	Osun	100.0	37.0	1	42.6	5.4	3	21.6	1.0	0
	Oyo	15.5	3.1	0	31.1	3.0	3	1.0	0.2	0
	Plateau	100.0	18.9	2	8.7	2.3	1	19.3	2.1	1
	Rivers	100.0	53.5	10	100.0	33.5	30	100.0	16.2	11
	Sokoto	-2.1	-1.9	0	-1.7	-1.4	-1	-0.9	-0.5	0
	Taraba	14.6	4.8	1	19.6	8.2	4	62.7	16.1	11
	Yobe	31.8	42.4	7	100.0	53.9	32	100.0	40.1	35
	Zamfara	-0.4	-0.5	0	100.0	54.2	42	8.8	4.8	7
National		50.2	27.8	153	33.2	14.3	381	45.1	12.9	380
Calculated by Author										

respectively could have been avoided without inequalities by religion. Similar reductions could also have been achieved in rural and urban areas in Nigeria.

Across regions, the PAF (%) indicates that the highest reduction in U5MR by wealth could have been achieved in the Southeast (72.5%) in 2003, Northeast (45%) in 2008 and Northwest (49.3%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northwest (106) in 2003, Northwest (394) in 2008 and Northwest (629) in 2013. In relative terms, the highest reduction in U5MR by child's sex could have been in the Southeast (36.7%) in 2003, Northcentral (9.5%) in 2008 and Southsouth (12.2%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northeast (23) in 2003, Northeast (75) in 2008 and Northeast (119) in 2013. In relative terms, the highest reduction in U5MR by mother's education could have been in the Northcentral (70%) in 2003, Northeast (42.7%) in 2008 and Northwest (56.5%) in 2013 while in absolute terms, the PAF shows that the highest avoidable death count could have been in the Northwest (216) in 2003, Northwest (347) in 2008 and Northwest (721) in 2013. In relative terms, the highest reduction in U5MR by mother's age could have been in the Southeast and Southwest (100%) in 2003, Southeast (41.7%) in 2008 and Southeast (13.2%) in 2013 while in absolute terms, the highest avoidable death count could have been in the Northcentral (61) in 2003, Southsouth (144) in 2008 and Northwest (51) in 2013. In relative terms, the highest reduction in U5MR by religion could have been in the Southsouth (100%) in 2003, Southeast (19.5%) in 2008 and Southeast (100%) in 2013 while in absolute terms, the highest avoidable death count could have been achieved in the Southsouth (101) in 2003, Northwest (140) in 2008 and Northwest (582) in 2013 (Table 4.59-4.63).

At the state level, the highest reduction in U5MR by wealth could have been achieved in 8 states (100%) – Abia, Abuja, Bayelsa, Kwara, Lagos, Ondo, Osun, Oyo - in 2003, Taraba state (73.9%) in 2008 and 3 states (100%) - Abuja, Bayelsa, Ekiti - in 2013 while in absolute terms, the highest avoidable death count could have been in Bauchi state (30) in 2003, Kano state (164) in 2008 and Zamfara state (144) in 2013 (Table 4.59). In relative terms, the highest reduction in U5MR by child's sex could have been in Abia and Kwara (100%) in 2003, Ekiti state (42.9%) in 2008 and Kogi state (47.8%) in 2013 while in absolute terms, the highest avoidable death count could have been in Bauchi (13) and Niger state (13) in 2003, Kano state (34) in 2008 and Zamfara state (36) in 2013 (Table 4.60). In relative terms, the highest reduction in U5MR by mother's education could have been in 17 states (100%) in 2003, 3 states (100%)- Abia, Anambra, Imo - in 2008 and 3 states (100%)- Abia, Osun, Yobe- in 2013 while in absolute terms, the highest avoidable death count could have been achieved in Bauchi state (79) in 2003, Katsina state (95) in 2008 and Zamfara state (230) in 2013 (Table 4.61).

In relative terms, the highest reduction in U5MR by mother's age could have been in 16 states (100%) in 2003, 7 states (100%)- Abuja, Delta, Ebonyi, Edo, Imo, Ondo, Rivers- in 2008 and 9 states (100%)- Abia, Abuja, Benue, Edo, Ekiti, Lagos, Nasarawa, Ogun, Osun- in 2013 while in absolute terms, the highest avoidable death count could have been achieved in Niger state (29) in 2003, Rivers state (89) in 2008 and Benue state (88) in 2013 (Table 4.62). In relative terms, the highest reduction in U5MR by religion could have been in 4 states (100%) – Edo, Katsina, Kwara, Rivers - in 2003, 6 states (100%) - Anambra, Bayelsa, Kebbi, Lagos, Rivers, Yobe, - in 2008 and 11 states (100%) in 2013 while in absolute terms, the PAF shows that the highest avoidable death count could have been achieved in Katsina (40) in 2003, Lagos state (93) in 2008 and Kano state (303) in 2013 (Table 4.63).

Table 4.59: PAF (%) in Under 5 Mortality by Wealth in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	22.0	21.5	37	12.8	10.2	87	10.5	6.8	75
	Rural	31.3	49.4	212	23.0	28.6	575	30.3	31.5	645
Regions	Northcentral	24.8	32.0	28	24.1	24.9	97	15.2	11.2	48
	Northeast	27.3	45.9	65	45.0	57.7	269	40.5	39.5	218
	Northwest	32.0	50.7	106	32.6	44.0	394	49.3	54	629
	Southeast	72.5	46.5	17	6.0	6.6	18	20.3	18.3	51
	Southsouth	29.5	39.0	30	8.6	8.4	31	6.4	4.2	12
	Southwest	10.0	7.4	4	12.6	8.3	38	27.2	17.2	74
States	Abia	100	43.5	1	7.9	9	4	25.9	22.5	7
	Abuja	100	52.6	1	56.0	45.4	12	100.0	62.8	13
	Adamawa	62.0	116.6	14	37.6	56.6	42	26.7	26.1	19
	Akwa Ibom	100.0	95.5	17	11.6	13.1	8	15.1	11	5
	Anambra	16.2	4.5	0	12.5	11.6	9	15.2	11.2	7
	Bauchi	37.7	60.6	30	43.6	59.5	71	61.2	80.4	114
	Bayelsa	100.0	233.3	7	9.6	12.1	4	100.0	56.3	13
	Benue	55.2	71	14	23.3	26.6	23	23.0	21.2	20
	Borno	15.8	26.8	7	12.9	16.6	18	23.8	11.6	13
	Cross River	51.5	44.3	4	23.4	14.6	8	24.5	14.9	8
	Delta	42.3	62.3	10	4.0	4.2	3	28.1	20.8	12
	Ebonyi	48.5	104.6	5	-0.7	-0.7	0	60.5	68.8	51
	Edo	31.4	29.2	3	-6.6	-5	-4	10.9	4.9	2
	Ekiti	2.5	2.6	0	65.3	78.5	19	100.0	60.9	12
	Enugu	58.6	45.8	3	20.7	21	10	18.2	14.5	8
	Gombe	67.6	109.7	17	30.2	33.2	18	26.6	29.4	17
	Imo	45.2	8	1	25.7	33.5	21	36.5	32.8	18
	Jigawa	45.0	102.3	18	11.9	14.7	16	63.7	85.7	135
	Kaduna	35.6	49.7	17	35.8	40.8	51	38.3	17.2	25
	Kano	18.4	25.2	12	40.7	66.3	164	37.9	38.4	115
	Katsina	10.3	11.9	4	28.0	35.4	57	45.1	40.7	69
	Kebbi	57.2	78.5	18	15.5	15.5	11	30.7	37.6	46
	Kogi	65.6	82.9	14	20.6	17.3	8	19.8	11	4
	Kwara	100.0	25	1	35.7	15.3	6	17.6	11.9	5
	Lagos	100.0	67.7	13	27.5	17.3	26	4.4	2.8	4
	Nasarawa	43.5	96.1	9	11.6	9.6	3	2.3	1.9	1
	Niger	63.9	83.1	19	29.2	42.6	40	2.5	1.6	2
	Ogun	36.1	33.8	4	15.9	12.9	9	26.2	16.9	12
	Ondo	100.0	133.3	6	50.5	33.8	18	15.2	13	7
	Osun	100.0	107.1	3	44.4	18.9	9	53.1	21.7	10
	Oyo	100.0	29.7	3	15.3	10.1	10	78.2	47.8	52
	Plateau	18.8	19.3	2	61.9	61	38	16.1	12.9	6
	Rivers	42.1	74.7	16	10.4	9.7	9	38.4	28.7	21
	Sokoto	23.2	37.7	8	21.0	33.6	34	36.8	46.5	53
	Taraba	49.5	81.8	17	73.9	87.3	43	31.0	29.9	23
	Yobe	28.4	51.9	9	46.2	49.9	31	90.0	86.4	80
	Zamfara	38.0	90.8	27	41.2	48.6	40	57.8	90.3	144
National		36.9	51.9	313	28.6	31.8	911	31.5	28.5	898
Calculated by Author										

Table 4.60: PAF (%) in Under 5 Mortality by Child's Sex in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	5.3	5.2	9	1.1	0.9	8	9.8	6.4	70
	Rural	7.1	11.2	48	7.3	9.1	183	5.7	5.9	121
Regions	Northcentral	1.9	2.5	2	9.5	9.8	38	0.3	0.2	1
	Northeast	2.1	3.5	5	4.8	6.1	28	5.0	4.9	27
	Northwest	6.9	10.9	23	6.2	8.4	75	9.3	10.2	119
	Southeast	36.7	23.5	8	2.9	3.2	9	3.7	3.3	9
	Southsouth	10.0	13.2	10	2.8	2.7	10	12.2	8.0	23
	Southwest	8.2	6.1	3	6.1	4.0	18	5.2	3.3	14
States	Abia	100.0	43.5	1	13.9	15.9	8	4.8	4.2	1
	Abuja	-46.2	-24.3	0	5.2	4.2	1	7.2	4.5	1
	Adamawa	16.9	31.7	4	9.9	14.9	11	1.9	1.9	1
	Akwa Ibom	4.8	4.6	1	4.0	4.5	3	20.2	14.7	7
	Anambra	34.5	9.6	1	2.5	2.3	2	29.7	21.9	14
	Bauchi	16.8	27	13	3.2	4.3	5	6.8	8.9	13
	Bayelsa	38.7	90.4	3	22.8	28.8	10	6.6	3.7	1
	Benue	9.5	12.2	2	17.3	19.8	17	2.6	2.4	2
	Borno	2.4	4.1	1	10.9	14.1	15	0.6	0.3	0
	Cross River	50.5	43.4	4	28.3	17.7	10	3.5	2.1	1
	Delta	11.8	17.3	3	9.1	9.5	7	27.7	20.5	11
	Ebonyi	25.8	55.7	3	-8.7	-8.3	-5	4.5	5.1	4
	Edo	68.4	63.6	5	-16.7	-12.7	-9	9.1	4.1	2
	Ekiti	55.7	57.1	2	42.9	51.6	12	2.5	1.5	0
	Enugu	22.4	17.5	1	12.8	13	6	10.7	8.5	5
	Gombe	18.9	30.7	5	1.8	2	1	14.5	16	9
	Imo	24.9	4.4	0	1.8	2.3	1	26.4	23.7	13
	Jigawa	0.5	1.1	0	0.1	0.1	0	9.4	12.6	20
	Kaduna	15.9	22.2	8	0.6	0.7	1	22.9	10.3	15
	Kano	12.1	16.6	8	8.5	13.8	34	6.1	6.2	19
	Katsina	19.6	22.7	8	2.6	3.3	5	22.6	20.4	34
	Kebbi	29.1	40	9	11.7	11.7	8	13.2	16.2	20
	Kogi	43.5	55	10	23.2	19.5	10	47.8	26.6	11
	Kwara	100.0	25	1	12.6	5.4	2	12.0	8.1	3
	Lagos	35.0	23.7	5	17.0	10.7	16	20.6	13.1	17
	Nasarawa	6.2	13.6	1	19.9	16.5	5	26.6	22.3	10
	Niger	43.2	56.2	13	1.2	1.8	2	5.0	3.2	4
	Ogun	24.9	23.3	2	17.2	13.9	10	16.9	10.9	8
	Ondo	71.1	94.8	4	0.3	0.2	0	10.0	8.5	5
	Osun	37.7	40.4	1	37.8	16.1	8	9.5	3.9	2
	Oyo	26.9	8	1	32.8	21.7	22	2.5	1.5	2
	Plateau	9.7	10	1	8.0	7.9	5	9.5	7.6	4
	Rivers	7.0	12.5	3	5.5	5.1	5	8.2	6.1	4
	Sokoto	6.3	10.2	2	15.8	25.2	25	5.7	7.2	8
	Taraba	23.0	38	8	17.1	20.2	10	6.9	6.7	5
	Yobe	-1.0	-1.9	0	1.5	1.6	1	-0.8	-0.8	-1
	Zamfara	13.0	31.1	9	5.3	6.2	5	14.3	22.3	36
National		4.9	6.9	42	5.5	6.1	175	6.7	6.1	192
Calculated by Author										

Table 4.61: PAF (%) in Under 5 Mortality by Mother's Education in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	52.5	51.3	89	19.0	15.2	130	19.5	12.7	140
	Rural	31.3	49.4	212	22.3	27.8	559	29.9	31.1	637
Regions	Northcentral	70.0	90.2	78	25.1	26.0	101	18.1	13.4	57
	Northeast	39.8	66.9	95	42.7	54.7	255	24.9	24.3	134
	Northwest	65.1	103.2	216	28.7	38.8	347	56.5	61.9	721
	Southeast	62.7	40.2	14	5.7	6.3	18	17.7	15.9	45
	Southsouth	46.7	61.8	47	6.6	6.4	24	6.5	4.3	12
	Southwest	32.6	24.2	12	20.5	13.5	62	20.9	13.2	57
States	Abia	100	43.5	1	100	114.3	55	100.0	87	28
	Abuja	100	52.6	1	11.2	9.1	2	10.8	6.8	1
	Adamawa	7.5	14.1	2	19.0	28.6	21	20.5	20.1	15
	Akwa Ibom	25.2	24.1	4	21.7	24.5	15	24.7	18	8
	Anambra	100	27.8	3	100.0	93	74	16.8	12.4	8
	Bauchi	100	160.6	79	47.7	65	78	49.7	65.3	92
	Bayelsa	38.7	90.4	3	5.2	6.6	2	11.2	6.3	1
	Benue	68.3	87.9	18	6.2	7.1	6	31.2	28.7	27
	Borno	61.3	104.1	29	61.9	79.9	85	42.6	20.8	23
	Cross River	5.7	4.9	0	61.9	38.7	22	20.9	12.7	7
	Delta	100.0	147.2	24	7.0	7.3	5	19.2	14.2	8
	Ebonyi	14.1	30.5	2	-1.1	-1	-1	34.1	38.8	29
	Edo	100.0	93	8	2.5	1.9	1	24.1	10.8	4
	Ekiti	100.0	102.6	4	48.6	58.4	14	12.0	7.3	1
	Enugu	34.3	26.8	2	33.1	33.6	15	3.8	3	2
	Gombe	14.6	23.7	4	46.6	51.3	27	44.9	49.6	29
	Imo	-6.8	-1.2	0	100.0	130.3	80	14.6	13.1	7
	Jigawa	100.0	227.3	40	71.0	87.4	94	33.4	44.9	71
	Kaduna	71.3	99.5	34	33.0	37.6	47	27.2	12.2	17
	Kano	68.9	94.5	47	23.3	38	94	54.3	55	165
	Katsina	36.1	41.8	14	47.2	59.6	95	48.3	43.6	73
	Kebbi	100.0	137.3	32	2.3	2.3	2	32.0	39.2	48
	Kogi	100.0	126.4	22	20.2	17	8	63.1	35.1	14
	Kwara	100.0	25	1	44.9	19.2	8	33.0	22.3	9
	Lagos	100.0	67.7	13	35.7	22.4	33	18.2	11.6	15
	Nasarawa	69.8	154.4	15	39.6	32.8	11	34.2	28.6	13
	Niger	67.9	88.3	20	45.5	66.5	63	28.6	18.5	25
	Ogun	28.7	26.8	3	35.3	28.6	20	28.2	18.2	13
	Ondo	16.7	22.2	1	28.8	19.3	10	40.5	34.6	19
	Osun	100.0	107.1	3	32.4	13.8	7	100.0	40.9	18
	Oyo	36.4	10.8	1	48.3	32	32	24.1	14.7	16
	Plateau	100.0	102.6	12	16.3	16.1	10	23.2	18.6	9
	Rivers	8.9	15.8	3	12.4	11.6	11	48.5	36.3	26
	Sokoto	100.0	162.7	34	3.7	5.9	6	63.2	80	91
	Taraba	100.0	165.1	35	72.1	85.1	42	14.3	13.8	10
	Yobe	21.9	40	7	47.8	51.6	33	100.0	96	89
	Zamfara	100.0	238.9	70	78.3	92.3	77	91.9	143.6	230
National		44.8	63	380	28.1	31.2	894	33.6	30.4	957
Calculated by Author										

Table 4.62: PAF (%) in Under 5 Mortality by Mother's Age in Nigeria

		2003 NDHS			2008 NDHS			2013 NDHS		
Location		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	5.1	5.0	9	6.8	5.4	46	10.8	7.0	77
	Rural	6.0	9.4	40	4.3	5.4	109	2.9	3.0	61
Regions	Northcentral	54.4	70.1	61	1.1	1.1	4	10.0	7.4	32
	Northeast	8.3	14.0	20	6.2	8.0	37	4.6	4.5	25
	Northwest	3.0	4.7	10	5.0	6.8	61	4.0	4.4	51
	Southeast	100.0	64.1	23	41.7	46.2	129	13.2	11.9	33
	Southsouth	12.0	15.9	12	39.6	38.6	144	6.5	4.3	12
	Southwest	100.0	74.2	38	12.6	8.3	38	11.4	7.2	31
States	Abia	100	43.5	1	54.0	61.7	30	100.0	87	28
	Abuja	-35.7	-18.8	0	100.0	81.1	21	100.0	62.8	13
	Adamawa	37.4	70.4	8	10.4	15.6	12	13.9	13.6	10
	Akwa Ibom	100.0	95.5	17	13.4	15.1	9	35.2	25.6	12
	Anambra	100.0	27.8	3	4.4	4.1	3	17.2	12.7	8
	Bauchi	22.9	36.7	18	8.4	11.4	14	12.2	16	23
	Bayelsa	100.0	233.3	7	30.8	38.9	14	18.7	10.5	2
	Benue	54.3	69.9	14	5.6	6.4	5	100.0	92	88
	Borno	5.7	9.7	3	12.9	16.7	18	17.4	8.5	9
	Cross River	22.4	19.3	2	42.9	26.8	15	25.0	15.2	8
	Delta	4.6	6.8	1	100.0	104.9	73	5.5	4.1	2
	Ebonyi	29.8	64.2	3	100.0	95.0	53	18.1	20.6	15
	Edo	100.0	93	8	100.0	76.1	55	100.0	44.9	18
	Ekiti	32.7	33.6	1	37.9	45.6	11	100.0	60.9	12
	Enugu	100.0	78.1	5	17.9	18.2	8	37.3	29.7	16
	Gombe	69.2	112.3	17	8.9	9.8	5	14.8	16.4	10
	Imo	100.0	17.7	2	100.0	130.3	80	25.8	23.2	13
	Jigawa	67.4	153.2	27	40.9	50.4	54	13.5	18.2	29
	Kaduna	40.3	56.2	19	12.7	14.5	18	12.2	5.5	8
	Kano	17.9	24.6	12	5.0	8.2	20	4.5	4.6	14
	Katsina	67.5	78.2	27	7.8	9.9	16	41.3	37.3	63
	Kebbi	27.2	37.3	9	15.3	15.3	11	6.9	8.4	10
	Kogi	100.0	126.4	22	8.7	7.3	4	35.8	19.9	8
	Kwara	100.0	25	1	9.8	4.2	2	39.3	26.5	11
	Lagos	100.0	67.7	13	12.4	7.8	12	100.0	63.6	82
	Nasarawa	35.4	78.2	7	42.5	35.2	11	100.0	83.7	38
	Niger	100.0	130	29	58.5	85.4	81	7.1	4.6	6
	Ogun	100.0	93.5	10	15.1	12.2	9	100.0	64.5	47
	Ondo	100.0	133.3	6	100.0	66.9	36	34.1	29.1	16
	Osun	100.0	107.1	3	17.8	7.6	4	100.0	40.9	18
	Oyo	100.0	29.7	3	11.2	7.4	7	19.6	12	13
	Plateau	100.0	102.6	12	3.7	3.6	2	1.6	1.3	1
	Rivers	7.3	12.9	3	100.0	93.2	89	20.6	15.4	11
	Sokoto	44.1	71.8	15	33.2	53.0	53	4.3	5.4	6
	Taraba	7.5	12.3	3	9.6	11.3	6	33.7	32.6	25
	Yobe	31.7	57.9	10	44.4	47.9	30	13.2	12.7	12
	Zamfara	-0.3	-0.7	0	31.8	37.5	31	9.5	14.9	24
National		5.8	8.1	49	-6.8	-7.6	-218	5.2	4.7	148
Calculated by Author										

Table 4.63: PAF (%) in Under 5 Mortality by Religion in Nigeria

Location		2003 NDHS			2008 NDHS			2013 NDHS		
		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths		PAF (%)	Avoidable Deaths	
			Absolute	Count		Absolute	Count		Absolute	Count
Residence	Urban	27.5	26.9	47	3.8	3.0	26	0.8	0.5	6
	Rural	21.0	33.2	142	13.9	17.3	348	20.5	21.3	436
Regions	Northcentral	15.9	20.5	18	3.9	4.0	16	7.8	5.8	25
	Northeast	19.2	32.3	46	1.6	2.0	9	0.1	0.1	1
	Northwest	9.8	15.6	33	11.5	15.6	140	45.6	50	582
	Southeast	9.4	6.0	2	2.3	2.5	7	100.0	90	253
	Southsouth	100.0	132.2	101	19.5	19.0	71	0.8	0.5	1
	Southwest	21.4	15.9	8	0.2	0.1	0	-0.2	-0.1	0
States	Abia	0.0	0.0	0	0.8	0.9	0	100.0	87.0	28
	Abuja	N/A	N/A	N/A	10.1	8.2	2	31.5	19.8	4
	Adamawa	4.5	8.5	1	16.9	25.4	19	16.1	15.8	11
	Akwa Ibom	0.0	0.0	0	-0.1	-0.1	0	100.0	72.8	34
	Anambra	0.0	0.0	0	100.0	93	74	100.0	73.8	48
	Bauchi	-0.5	-0.8	0	3.9	5.3	6	100.0	131.4	186
	Bayelsa	-3.5	-8.1	0	100.0	126.4	44	100.0	56.3	13
	Benue	9.1	11.7	2	0.2	0.2	0	2.7	2.5	2
	Borno	26.3	44.7	12	46.6	60.1	64	100.0	48.8	54
	Cross River	1.0	0.9	0	-0.3	-0.2	0	1.6	1.0	1
	Delta	12.8	18.8	3	-5.0	-5.2	-4	8.3	6.1	3
	Ebonyi	7.3	15.7	1	-20.8	-19.8	-11	100.0	113.7	84
	Edo	100.0	93.0	8	-30.0	-22.8	-16	38.1	17.1	7
	Ekiti	40.9	42.0	2	39.6	47.6	11	13.6	8.3	2
	Enugu	-6.7	-5.2	0	4.6	4.7	2	100.0	79.7	44
	Gombe	48.7	79.0	12	37.3	41.1	22	16.7	18.4	11
	Imo	0.0	0.0	0	-0.5	-0.6	0	0.2	0.2	0
	Jigawa	N/A	N/A	N/A	-0.4	-0.5	-1	0.5	0.7	1
	Kaduna	1.6	2.3	1	-0.3	-0.3	0	4.9	2.2	3
	Kano	0.3	0.4	0	1.1	1.8	4	100.0	101.3	303
	Katsina	100.0	115.9	40	1.7	2.2	4	100.0	90.3	152
	Kebbi	N/A	N/A	N/A	100.0	99.7	72	29.0	35.5	44
	Kogi	71.8	90.7	16	-0.8	-0.7	0	23.2	12.9	5
	Kwara	100.0	25.0	1	25.9	11.1	5	55.1	37.2	15
	Lagos	58.3	39.5	8	100.0	62.8	93	1.4	0.9	1
	Nasarawa	13.8	30.6	3	39.6	32.8	11	15.1	12.6	6
	Niger	-0.3	-0.4	0	0.8	1.2	1	3.1	2.0	3
	Ogun	-1.8	-1.7	0	2.6	2.1	2	0.8	0.5	0
	Ondo	18.9	25.2	1	3.0	2	1	14.9	12.7	7
	Osun	50.9	54.5	2	8.5	3.6	2	20.3	8.3	4
	Oyo	43.1	12.8	1	10.6	7	7	8.5	5.2	6
	Plateau	5.4	5.5	1	15.0	14.8	9	8.7	7.0	3
	Rivers	100.0	177.6	38	100.0	93.2	89	0.7	0.5	0
	Sokoto	N/A	N/A	N/A	-0.9	-1.4	-1	-0.2	-0.3	0
	Taraba	-2.2	-3.6	-1	16.7	19.7	10	11.5	11.1	8
	Yobe	50.3	92.0	16	100.0	107.9	68	100.0	96.0	89
	Zamfara	N/A	N/A	N/A	8.9	10.5	9	2.5	3.9	6
National		89.0	125.0	754	13.5	15	430	17.7	16.0	504
Calculated by Author										

4.28 Summary

This final section examined the socioeconomic inequalities in infant, child and overall under 5 mortality at multiple scales within Nigeria over space and time using a combination of relative and absolute measures. Both simple range measures (RR and RD) and more complex measures (PAF, SII and CI) are in agreement as they all identify significant inequalities or disparities in infant, child and under 5 mortality amongst socioeconomic groups over space and time in Nigeria. Although there are variations with regards to the extent/magnitude of socioeconomic inequality over space, it is clear that there is a socioeconomic gradient pattern in mortality amongst socioeconomic groups. Socioeconomic inequalities in mortality were mostly to the disadvantage of lower socioeconomic groups indicating unfair/unequal differences in child health/survival. However, the extent to which this was the case varied with the SES indicator across Nigeria. In addition, socioeconomic inequalities in mortality were consistently higher among groups stratified by wealth and the level of education of mothers. This suggests that a significant proportion of under 5 deaths can be attributed to unfair/unequal differences or disparities in wealth and the educational level of mothers in Nigeria. Findings also indicate that a significant proportion of deaths could have been avoided among children under 5 in Nigeria over the years examined if socioeconomic inequalities in mortality rates had been eliminated or significantly reduced by appropriate policy measures.

CHAPTER FIVE

SUMMARY OF RESEARCH FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The main objective of this study was to examine the spatiotemporal patterns of infant, child and under 5 mortality rates in Nigeria at multiple scales (national, regional, state and rural-urban level) using a combination of techniques/measures. These are descriptive, statistical and spatial pattern analysis. Furthermore, inequality measures and GIS mapping were also used in this study. This chapter presents a summary of the findings with respect to the study's objectives and offers appropriate recommendations based on these findings.

5.1 Summary of research findings

5.1.1 Objective 1: To analyze the spatiotemporal patternsof infant and child mortality in Nigeria

An examination of infant mortality in Nigeria revealed significant spatial and temporal variations in Nigeria. Nationally, IMRs fell by 28% between 2003 and 2013. However, more significant reductions were observed between 2003 and 2008 (20%) than between 2008 and 2013 (10%). National IMRs from the World Bank dataset over a larger time frame (1990-2015) further indicates that IMRs in Nigeria have been falling steadily over time. An overall decline of 45% occurred during this period, from 126 deaths per 1,000 live births in 1990 to 69 deaths per 1,000 live births in 2015.

IMRs in rural areas exceeded IMRs in urban areas by 31%, 28% and 27% in 2003, 2008 and 2013, respectively. Between 2003 and 2013, IMRs fell in both rural and urban areas by 29% and 24%, respectively. IMRs declined in all regions except in the Southeast where IMRs increased by 36%. IMRs fell in 25 states with the largest reductions in parts of the Northeast, Northcentral and Southsouth regions specifically in Borno and Nasarawa states. In spite of this general decrease, IMRs increased in 10 states during the same period. The increase was observed in parts of the Southwest, Southeast and Northwestern regions especially in Imo, Oyo and Anambra states although they still had relatively lower IMRs compared to some states in other regions where IMR decreased suggesting significant variations in the underlying factors of IMRs.

National, CMRs fell by 47% between 2003 and 2013. Unlike infant mortality, more significant reductions in CMRs were observed between 2008 and 2013 (34%) than between 2003 and 2008 (22%). CMRs in rural areas exceeded CMRs in urban areas by 51%, 49% and 60% in 2003, 2008 and 2013, respectively. In spite of that, CMRs fell in rural and urban areas by 45% and 54%, respectively between 2003 and 2013. In the same period, CMRs declined in all regions except in the Southeast where CMRs increased by 68%. CMRs fell in 30 states with the largest reductions in parts of the Southsouth specifically in Bayelsa and the Southwest specifically in Osun state. CMR remained unchanged in Oyo state but increased in Cross River, Delta, Imo and Katsina states although they still had relatively lower CMRs compared to some states where CMRs decreased suggesting significant variations in the underlying factors of CMRs.

U5MRs fell by 35% between 2003 and 2013 but fell more between 2003 and 2008 (21%) than between 2008 and 2013 (19%). National U5MRs from the World Bank dataset over a 25 year period (1990-2015) further indicates that U5MRs have been falling steadily in Nigeria. U5MRs fell from 213 deaths per 1,000 live births in 1990 to 109 deaths per 1,000 live births in 2015. The nearly 50% decline is worthy of note. U5MRs in rural areas exceeded U5MRs in urban areas by 38%, 36% and 38% in 2003, 2008 and 2013, respectively. All the same, U5MRs fell by 34% in both rural and urban areas between 2003 and 2013. Also, U5MRs declined in all regions except in the Southeast where U5MRs increased by 41%. U5MRs fell in 30 states with the largest reductions in parts of the Northeast, Northcentral, Southwest and Southsouth regions (specifically in Bayelsa and Borno states) while U5MRs increased in Abuja, Abia, Anambra, Enugu, Imo, Kwara and Oyo states.

There were significant ($P \leq 0.05$) differences in IMRs between 2003 and 2013. There were also significant differences in IMRs by child's sex and wealth index but only in 2008. With respect to CMRs, there were significant differences between 2003 and 2013 and between 2008 and 2013. In addition, there were significant differences in CMRs by mother's level of education and mother's age in 2003, by wealth index, mother's level of education and mother's age in 2008 and by wealth index and mother's level of education in 2013. Also, results showed significant differences in U5MRs between 2003 and 2013 and between 2008 and 2013. There were also significant differences in U5MRs by mother's level of education and by mother's age in 2003 and by wealth index and mother's education in 2008 and 2013.

The Global Moran's I showed a clustered pattern of IMRs in 2003, 2008 and 2013 though at the 90% confidence level. The Local Moran's I indicated significant Low-

Lowclusters in Kwara and oyo states in 2003 and in Osun, Ekiti and Kwara states in 2008 only while High-High clusters were in Taraba in 2003 and in Sokoto and Kebbi states in 2013 only. These spatial clusters had IMRs statistically similar to their neighbours suggesting similarities in underlying factors/conditions. Abuja and Cross River were spatial outliers (Low-High) in 2003 and 2008, respectively indicating that both had significantly lower IMRs than their neighbours. Further investigation using the Getis-Ord Gi* statistic indicated that Plateau, Benue, Taraba and Adamawa states were hot spots in 2003 while no hotspots were detected in 2008 suggesting no significant clustering of high IMRs among neighbouring states. Hot spots detected in 2003 were no longer identified as hot spots in 2013 with the exception of Taraba state while Kebbi and Sokoto states emerged as new hot spots indicating relatively high IMRs in this region. Oyo, Osun and Taraba states were cold spots in 2003 and 2008. In addition, Ekiti, Ogun and Ondo states emerged as new cold spots suggesting that IMRs fell significantly among Southwestern states. The same cold spots were also detected in 2013 though Osun and Ogun states were no longer cold spots while Abuja emerged as a new cold spot of significantly lower IMRs.

The Global Moran's I identified a clustered pattern of CMRs in 2003, 2008 and 2013 significant at the 99% confidence level. Also, the Local Moran's I indicated significant Low-Low clusters in Abia in 2003; Oyo, Ogun and Osun states in 2008 and none in 2013 suggesting no significant clustering of relatively low CMRs. Significant High-High clusters were in the Northeast (Yobe, Bauchi and Gombe) and Northwest (Zamfara, Katsina, Kano, Jigawa, Kebbi, Sokoto) over time across surveys. In addition, the Gi* statistic consistently identified hot spots in the Northeast and Northwest suggesting significant challenges to child health/survival in these regions. Cold spots identified in the Southeast in 2003 shifted to the Southwest in 2008 and 2013 extending to Anambra in the Southeast, Kwara in Northcentral and Rivers in the Southsouth in 2013 signifying much lower CMRs in these states.

The Global Moran's I identified a clustered pattern of U5MRs in 2003, 2008 and 2013 significant at the 99% confidence level. The Local Moran's I indicated significant Low-Low clusters in the Southeast (Imo, Anambra), Northcentral (Kwara) and Southwest (Oyo, Osun, Ekiti, Ondo, Ogun) over time and significant High-High clusters in the Northeast (Bauchi) and Northwest (Kano, Jigawa, Kebbi, Sokoto) over time except in 2003. Ebonyi and Kaduna were spatial outliers in 2003 and 2013, respectively signifying significant differences in U5MRs between them and their neighbours. In addition, the Gi* statistic consistently identified hot spots in the Northeast and Northwest while cold spotswere consistently in the Southwest and Northcentral region extending to Abia, Anambra and Imo in 2003 indicating much lower U5MRs in these states.

The spatial pattern of percentage change in mortality was also examined. Findings from the Global Moran's I, indicated an overall random pattern in the percentage changes in infant and child mortality across states between surveys (2003-2008, 2008-2013 and 2003-2013). This suggests that changes in infant and child mortality were generally random with no significant correlation amongst contiguous states. The spatial pattern of percentage changes in U5MRs were found to be clustered between 2003 and 2008 and between 2003 and 2013 indicating similarities in the factors/conditons responsible for changes in U5MRs among neighbouring states. In other words, geographical location had a significant impact on changes in U5MRs across states during these periods. Further investigation using the Local Moran's I showed significant clusters of changes in IMRs (Imo), CMRs (Abia) and U5MRs (Gombe) between 2003 and 2013.

Generally, the spatial pattern analysis showed a clear North-South clustering pattern of all three mortality rates with significantly higher mortality rates in the Northern states in spite of the much higher reductions in mortality in this region. This suggests persistent challenges to the improvement of under 5 health/survival in this region. The increase in mortality in some southern states is also a cause for major concern. Findings also suggest that being adjacent to areas with high (or low) mortality rates is an important predictor of high (or low) mortality especially under 5 mortality. This implies that mortality rates can significantly increase (or decrease) in a given area because of conditions in that area and/or conditions in neighbouring areas. This also suggests that future reductions in all three mortality rates is possible if both state and region specific measures are adopted in states/regions with statistically significant High-High concentrations of mortality.

5.1.2 Objective 2: To investigate bio-demographic, socioeconomic, macroeconomic, health care related and environmental factors that may explain infant and child mortality rates in Nigeria

Several key factors were found to be associated with observed spatial variations and trends in infant, child and under 5 mortality rates in Nigeria. The most noteworthy bivariate associations are those between IMRs and poverty, breastfeeding and healthcare delivery in 2003; birth interval and breastfeeding in 2008 and poverty and access to improved water sources in 2013. With regards to CMRs, the most notable bivariate associations are those between CMRs and healthcare delivery, ANC, PAB, full immunization and mother's age at first birth less than 20 in 2003; PAB, mother's age at first birth less than 20 and healthcare delivery in 2008 and poverty, mother's age at first birth, mothers with complete secondary education and higher, full immunization, healthcare delivery and PAB in 2013. With regards to U5MRs, the most notable bivariate associations are those between U5MRs and healthcare delivery, poverty, ANC, breastfeeding, mothers with complete secondary education and higher in 2003; ANC, full immunization and healthcare delivery in 2008 and poverty, mothers with complete secondary education and higher and mother's age at first birth less than 20 in 2013.

The Stepwise regression identified poverty and breastfeeding for 6 months or more as key predictors of IMRs in 2003; breastfeeding for 6 months or more and at least 4 ANC visits as key predictors in 2008 and poverty, breastfeeding for 6 months or more, 4 or more ANC visits, diarrhea prevalence and birth interval less than 24 months as key determinants in 2013 accounting for 54%, 46% and 64% of observed spatial variations in IMRs in each survey, respectively. With respect to CMRs, 4 or more ANC visits was identified as the key predictor of CMRs in 2003; PAB and birth interval less than 24 months as key determinants in 2008 and poverty as the significant predictor in 2013 accounting for 54%, 66% and 73% of observed spatial variations in CMRs in each survey, respectively. Results identified healthcare delivery, breastfeeding for 6 months or more and full knowledge of MTCT of HIV/AIDS as key predictors of U5MRs in 2003; 4 or more ANC visits, breastfeeding for 6 months or more, access to improved sanitation services and use of solid fuels in cooking as key predictors in 2008 and poverty, birth interval less than 24 months, 4 or more ANC visits, diarrhea prevalence and access to improved sanitation services as key determinants in 2013 accounting for 76%, 73% and 78% of observed spatial variations in U5MRs in each survey, respectively. Spatial autocorrelation analysis of residuals showed regression residuals for infant, child and under 5 mortality rates to be randomly distributed indicating an overall reliable regression model.

Analysis based on World Bank datasets identified important bivariate associations between national infant and under 5 mortality rates and urban population, access to improved sanitation, access to improved water sources, PAB, inflation and DPT over time (1990-2014). The stepwise regression identified urban population, DPT and inflation as key predictors of both infant and under 5 mortality rates accountingfor 99.7% of observed temporal variations in infant and under 5 mortality rates from 1990-2014. The bivariate correlation results suggested that the high level of correlation (r= .991; r2= .982, p< .01) between the 'urban population' variable and 'access to improved water sources' variable could be hiding the influence of a more relevant determinant of mortality (access to improved water sources). Hence, further regression analysis was carried out without the urban population variable. Results identified access to improved water sources as a major predictor. Results suggest that the increase in urban population over time most likely improved the proportion of households with access to improved water sources and health care. This could explain both the increase in access to improved water sources and DPT vaccinations as well as the decline in infant and under 5 mortality rates over time.

In general, findings indicated that breastfeeding duration, number of ANC visits, poverty and intervals between births explained significantly the spatial patterns of infant, child and under 5 mortality rates across states over time. Urbanization, DPT vaccinations and the fall in inflation explained the trends in annual infant and under 5 mortality rates in Nigeria.

5.1.3 Objective 3: To assess socioeconomic inequalities in infant and child mortality between and among socioeconomic groups over time in Nigeria based on multiple SES indicators.

5.1.3.1 Range measures (rate ratio and rate difference)

Range measures showed that both relative and absolute inequalities/gaps in mortality rates between poor-rich, male-female, uneducated-most educated, under 20-over 34 and Christian-Muslim groups increased in some states in spite of declines in overall state mortality rates. Between 2003 and 2013, both relative and absolute inequalities in IMRs increased by wealth groups in Bauchi, Yobe, Ebonyi, Kano and Kwara states; by child's sex in Borno, Abuja, Kwara, Anambra, Enugu, Imo and Delta states; by maternal education in AkwaIbom, Edo, Ekiti and Kogi states; by maternal age in Bauchi, Imo, Kwara, Niger, Zamfara and Oyo states and by religion in Borno, Delta, Kwara and Kaduna states. With respect to CMRs, relative and absolute inequalities increased by wealth groups in Abia, Anambra, Ebonyi, Benue, Kwara, Katsina and Zamfara states; by child's sex in Bauchi, Borno, Katsina, Kano and Oyo states; by maternal education in Anambra, Oyo, Lagos, Benue and Plateaustates; by maternal age in Bauchi, Borno, Kano, Katsina and Oyo states and by religion in Bauchi, Delta, Benue, Plateau and Ondo states. With respect to U5MRs, relative and absolute inequalities increased by wealth groups in Bauchi, Taraba, Ebonyi, Nasarawa, Katsina, Sokoto and Ondo states; by child's sex in

AkwaIbom, Delta, and Jigawa states; by maternal education in AkwaIbom, Edo, Gombe, Yobe and Ekiti states; by maternal age in Bauchi, Borno, Taraba, Kwara, Plateau, Oyo and Zamfara states and by religion in Delta, Kwara, Kano and Ondo states. Findings also showed that children in poor homes, male children, those with uneducated mothers, those with very young and old mothers and children in Muslim homes mostly bore the bulk of the mortality burden over the 15-year period covered by the three surveys.

5.1.3.2 Composite measures (slope index of iequality and concentration index)

Composite measures showed that between 2003 and 2013, both absolute and relative inequalities in IMRs increased by wealth groups in Borno, Yobe, Jigawa, Kano and Katsina states; by maternal education in AkwaIbom, Edo, Imo, Bauchi, Kano, Kogi, Lagos and Ondo states; and by maternal age in Bauchi, Benue, Abuja, Borno, CrossRiver, Delta, Lagos and Zamfara states. Absolute and relative inequalities in CMRs increased by wealth groups in Abia, Bauchi, Gombe, Benue, Kwara, Katsina, Kebbi, Zamfara, Rivers and Lagos states; by maternal education in Abia, Adamawa, Taraba, Benue, Kwara, Plateau, Abuja, Lagos and Oyo states; and by maternal age in Abia, Adamawa, Benue, Edo, Katsina and Zamfara states. With respect to U5MRs, absolute and relative inequalities increased by wealth groups in Bauchi, Kogi, Kano, Katsina, Kebbi, Sokoto, Lagos, Ondo and Oyo states; by maternal education in AkwaIbom, CrossRiver, Ebonyi, Bauchi, Yobe, Ekiti, Lagos, Ondo, Kogi, Kwara, Abuja, Sokoto and Zamfara states and by maternal age in Bauchi, Borno, Taraba, Kano, Zamfara, Lagos, Ogun, Ondo, Nasarawa and Rivers states. In addition, CI maps showing patterns of socioeconomic inequality across Nigeria, indicated that they were mainly to the disadvantage of children from the poorest homes, with uneducated mothers and mothers 35 or older thus supporting findings from range measures.

5.1.3.3 Population Attributable Fraction (PAF)

The PAFs indicated that a substantial proportion of infant, child and under 5 deaths reported during each survey could have been prevented if the socioeconomic inequalities identified had been eliminated or at least significantly reduced over time. Over the 15 year period covered by the three surveys, 1,013 infant deaths, 1,122 child deaths and 2,122 under 5 deaths could have been prevented without inequalities or disparities in mortality by wealth; 392 infant deaths, 37 child deaths and 409 under 5 deaths could have been prevented without inequalities in mortality by child’s sex; 986 infant deaths, 1,252 child deaths and 2,231 under 5 deaths could have been prevented without inequalities in mortality by mother's level of education; 278 infant deaths, 603 child deaths and 415 under 5 deaths could have been prevented if there were no inequalities in mortality by mother's age and 213 infant deaths, 914 child deaths and 1,273 under 5 deaths could have been prevented without inequalities in mortality by religion.

Each inequality measure displayed a different dimension of socioeconomic inequality in infant, child and under 5 mortality but were generally consistent with one another. Socioeconomic inequalities in mortality varied significantly over space and time as well as by the variables by which they were evaluated/assessed. Socioeconomic inequalities in all three mortality rates were generally larger in rural than in urban areas. They were also significantly higher amongst groups defined by wealth index and education levels of mothers. This implies that a significant proportion of deaths can be attributed to differences in wealth and the level of education of mothers. It also suggests that the largest reductions in mortality could have been achieved by addressing differences in wealth and level of education of mothers. In general, findings suggest that some states especially in the Northeast and Northwest had a more uneven distribution of mortality rates across sub groups such that mortality rates decreased substantially with an increase in socioeconomic status (SES) (i.e. a steep social gradient in mortality). This suggests that SES had more of an impact on mortality in these states leading to much larger disparities in mortality between socioeconomic groups.

5.2 Conclusion

This study has examined the spatiotemporal pattern and determinants of infant, child and under 5 mortality rates in Nigeria as well as the socioeconomic inequalities in mortality based on wealth, child's sex, level of mother's education, mother's age group and religion. This study was conducted based on nationally representative data from the 2003, 2008 and 2013 NDHS as well as data from the World Bank (1990-2015). The objectives of the study were achieved through a combination of techniques. Descriptive analysis, trend analysis and spatial autocorrelation techniques (Global and Local Moran's I, Getis-Ord Gi* statistic) were used to examine patterns, trends and pattern of change over time in infant, child and under 5 mortality rates; analysis of variance (ANOVA), bivariate analysis and stepwise regression were used to examine determinants and a suite of relative and absolute inequality measures (Range measures, SII and CI) were used to examine socioeconomic inequalities in all three mortality rates over time in Nigeria.

The results of these analyses revealed six main findings. First of all, results showed that mortality rates in children under the age of 5 declined in most states over time. However, mortality rates especially in infancy were still high with substantial variations at multiple spatial scales. In addition, trends analysis also revealed a steady decline in national infant and under 5 mortality rates based on World Bank datasets from 1990-2015.Secondly, a clustered pattern of all three mortality rates was identified along with significant local clusters (hot and cold spots) and outliers highlighting the impact of space on mortality rates. However, results showed that the reductions in mortality observed in most states did not significantly alter the North-South clustering of high and low mortality rates in Nigeria over time. Thirdly, significant disparities in mortality rates were identified among sub groups defined by wealth, child's sex, level of mother's education, mother's age and religion. In fact, there was a pattern of increasing mortality rates across subgroups with the highest death rates experienced by those in the lowest socioeconomic/non-reference group in most cases. In other words, findings generally showed a social gradient in the pattern of mortality rates in Nigeria. In addition, results also showed that even when mortality rates decreased in each sub group, the worse off groups mostly experienced the lowest percentage reduction suggesting that interventions that led to observed reductions most likely had more of an impact on better off groups.

Fourthly, results showed that poverty, breastfeeding for 6 months or more, birth interval less than 24 months and ANC visits are the most important factors that best explain observed spatial patterns in infant, child and under 5 mortality across states while urbanization, inflation and the proportion of children that received the DPT vaccination were identified as factors that best explained observed trends in national infant and under 5 mortality. This suggests that the reduction in poverty, promotion of exclusive breastfeeding, spacing of births, child vaccination and use of ANC as well as investments in related factors such as education and improvements in the standard of living will significantly help in reducing infant and child mortality and improving overall child health in Nigeria. Fifthly, results showed that both relative and absolute inequalities have varied nationally over time as well as among states, regions and place of residence but have generally narrowed in most areas in some degree over time. However, wide gaps in mortality rate between and amongst groups were still evident particularly in sub groups defined by wealth and level of mother's education in spite of the decline in overall state mortality rates. The high levels of socioeconomic inequalities in mortality therefore indicate that national and state averages are not representative of mortality rates amongstvarious sub groups. Finally, findings clearly show that a significant proportion of infant, child and under 5 deaths could have been averted if the socioeconomic inequalities or disparities in mortality that were identified had been addressed.

It is clear that some progress has been made in reducing infant, child and under 5 mortality rates in Nigeria. However, findings suggest that further reductions in mortality can be achieved by implementing a combination of policies/strategies that are place specific, group specific, and designed to tackle specific issues. However, it is important to note that there is a chance of bias in the reporting of infant and child deaths during each survey. This is because data on births and deaths were collected retrospectively for the 5 years preceding each survey. It must also be noted that those practicing other religions apart from Christianity and Islam were excluded due to their very small sample size.

5.2.1 Key Contributions to Knowledge

This study has addressed the research gaps identified in the literature and has contributed significantly to knowledge on infant and child mortality in Nigeria in 6 major ways:

1) Spatial pattern and trend analysis: This study comprehensively examined the spatial pattern, changes in pattern and trends in infant, child and under 5 mortality thus identifying the extent of the reductions (or increases) in mortality across Nigeria.
2) Changes in underlying determinants across states over time: A broad range of determinants were investigated and the most important determinants responsible for observed spatiotemporal variations in infant, child and under 5 mortality across states were identified.
3) Long term changes in socioeconomic inequalities based on multiple socioeconomic status (SES) indicators: This study investigated and mapped the magnitude of and changes in socioeconomic inequalities in infant, child and under 5 mortality across states. In addition, both relative and absolute inequalities were assessed based on several SES indicators (wealth, child's sex, level of mother's education, mother's age group and religion) thereby showing how different aspects of SES contributed to disparities in infant and child mortality across Nigeria.
4) Techniques/methodology: Both simple and composite relative and absolute inequality measures were adopted and their findings compared. These measures provided a much better view of socioeconomic inequalities/disparities in infant and child mortality across Nigeria. Inferential statistics and GIS mapping were also extensively used in analyzing spatiotemporal patterns in mortality.

5) Multi-scale analysis: Infant, child and under 5 mortality were examined at multiple geographical scales (national, regional, rural, urban and state level). State level analysis in particular, made it possible to assess and compare progress made in reducing infant and child mortality across Nigeria.
6) Useful information for state and regional level policy making and planning: Findings on the spatiotemporal patterns and socioeconomic inequalities in infant, child and under 5 mortality are useful for (1) designing effective state/regional and group specific policies/interventions, (2) setting future child health goals/targets, and (3) assessing the effectiveness of strategies aimed at reducing infant and child mortality in Nigeria.

The main strengths of this study therefore lie in its comprehensive examination of multiple dimensions of inequality (spatial, temporal and socioeconomic inequalities) in infant and child mortality especially at the state level, its assessment of a broad range of determinants, its use of both relative and absolute inequality measures and multiple SES indicators in the assessment of socioeconomic inequalities in infant and child mortality and its extensive use of inferential statistics and GIS mapping.

5.2.2 Recommendations

In view of the findings of this study, the following recommendations have been made with the aim of reducing mortality in children under 5 based on the following:

1) Targeting high priority areas and groups
2) Monitoring/evaluating past and present child health policies/strategies
3) Adopting specific policies/strategies that address identified key determinants of mortality
4) Adopting a health equity approach to the formulation and implementation of child health policies/interventions.

1) Targeting High priority Areas and groups

All three mortality ratesdeclined nationally and in most states and regions over time, however, mortality rates are still high especially in states in the Northeast, Northwest, Southeast and Southsouth regions where significant concentrations of high infant, child and under 5 mortality rates were identified in spite of some of these regions experiencing some of the largest declines in mortality over time. This suggests the need to focus on these high priority (hot spots) areas. However, it is important to ensure that other states/regions are not ignored. This is because findings clearly showed that most states in the Southwest and Northcentral region had relatively lower mortality rates (cold spots) but experienced an increase or much smaller decline in mortality compared to other areas. Findings therefore highlight the need to adopt a combination of well designed state specific, regional and federal level child health policies/strategies. In fact, states identified as having experienced the largest declines in mortality such as Borno and Bayelsa states should be thoroughly examined to identify the strategies/programmes that contributed the most to improvements in child health and survival between 2003 and 2013. Such strategies/programmes can then be improved, challenges addressed and perhaps their coverage extended to other states/regions.

Findings also showed that rural areas consistently had higher mortality rates than urban areas. Hence, the need to design and improve programmes/interventions geared towards directly and indirectly reducing under 5 mortality rates in rural areas. Findings also showed that in most states and regions the highest mortality rates occurred in infancy thus indicating the need to focus relevant strategies on improving the health and survival chances of infants.

2) Monitoring/Evaluating the impact of past and present child health policies/strategies

Findings showed large gaps in mortality rates between socioeconomic groups across states between 2003 and 2013. This indicates that differnces in SES significantly influenced access to resources including interventions aimed at improving child survival. This suggests that it is important for government health organizations and ministries to regularly review, evaluate, monitor and document child health policies/interventions to ensure that they are having the expected impact and achieving set goals/targets. Identifing socioeconomic groups that have benefitted the most from policies/interventions and those that have been left behind will aid in the redesigning of existing polices and designing of new cost effective polices. In addition, policy makers should examine the potential for modifying and adopting programmes/interventions that have been successful in addressing socioeconomic inequalities in under 5 mortality in other countries.

3) Adopting specific policies/strategies that address identified key determinants of mortality

Factors such as breastfeeding duration, poverty and antenatal care were consistently identified as some of the key factors responsible for a significant proportion of the spatiotemporal variations in infant and child mortality in Nigeria. In addition, findings showed that mortality gaps were highest between wealth and maternal education groups indicating that a significant proportion of deaths were due to these factors. These findings call for the following strategies to effectively address these factors.

i) Adopting an approach to Antenatal Care (ANC) that emphasizes both quality and number of visits by improving funding for ANC services, ensuring that health care workers are well trained and providing incentives to encourage the use of ANC services.
ii) Promoting immediate and continued breastfeeding: Encouraging exclusive breastfeeding in the first 6 months and continued breastfeeding up to at least two years through programmes/interventions that promote breastfeeding such as leave extension for mothers and enlightenment/awareness campaigns that informing mothers of the benefits of breastfeeding and appropriate complementary foods etc.
iii) Educating girls and empowering mothers to care for their families is perhaps the most important and long term cost effective approach to significantly reducing mortality among children under 5. Findings showed substantial variations in all three mortality rates between children born to uneducated mothers and those born to mothers with complete secondary education or higher. In fact, mortality rates fell drastically with the increase in the level of education of mothers. It is therefore important to scale up policies/programmes aimed at educating young girls/women especially where maternal education significantly influenced mortality such as AkwaIbom, Edo and Lagos states.
iv) Closely linked to the education of girls is the issue of poverty identified in this study as a major determinant of all three mortality rates in Nigeria. Addressing the education of girls will in the long run indirectly help in addressing the issue of poverty by ensuring that they have access to opportunities/jobs that they would otherwise not have access to. Intensifying poverty alleviation programmes for women especially young mothers could have major impact on under 5 mortality rates if they are well designed and properly implemented. Such programmes are urgently needed where

disparities in mortality between the poor and better-off increased over time such as in Katsina, Yobe and Ebonyi states. However, the issue of poverty also needs to be addressed at the macroeconomic level by making reducing disparities in wealth the key focus of economic policies.

4) Adopting a health equity approach to the formulation and implementation of child health policies/interventions

Substantial and persistent socioeconomic inequalities were found in all three mortality rates for all SES indicators especially wealth and maternal education. Thedistribution of mortality rates mostly followed a socioeconomic gradient pattern whereby mortality rates were highest among lower socioeconomic/non-reference groups but fell significantly among better off/reference groups in spite of declines in overall state mortality rates. These socioeconomic inequalities in mortality need to be addressed if significant reductions in under 5 mortality rates is to be achieved in the future. The WHO has recommended three approaches to addressing such socioeconomic inequalities: (1) Focusing on reducing mortality in the most socioeconomically disadvantaged groups through targeted programmes; (2) Narrowing mortality gaps between those in worse off and better off groups by raising the health/survival of worse off groups to the same high level of better off groups; and (3) Reducing the socioeconomic gradient in mortality by tackling mortality in all groups.

The findings of this study suggest that an integration of these three approaches is needed in order to significantly reduce mortality in worse off groups, narrow mortality gaps between groups and tackle mortality in all groups across states in Nigeria. Policies/programmes effective in reducing socioeconomic inequalities in mortality will benefit every child and bring about the largest benefit among those in disadvantaged groups. Such policies include those that tackle the inequitable distribution of wealth and resources and those focused on improving access to child health care and related services. The goal of such health equity approach to child health policy is to achieve as much as possible, similar high levels of improvements in health/survival among all children irrespective of their socioeconomic circumstances and geographical location.

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Appendix 1

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After unzipping, please print the file with the .DOC/DOCX extension (found in the Individual and Male Recode Zips). This file contains useful information on country specific variables and differences in the Standard Recode definition. You will also need the DHS Recode Manual: http://dhsprogram.com/publications/publication-dhsg4-dhs-questionnaires-and-manuals.cfm . This manual contains a general description of the recode data file, including the rationale for recoding., a description of coding standards and recode variables, and a listing of the standard dictionary, with basic information relating to each variable.

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Appendix 2: Number of households, women and men successfully interviewed in the 2003, 2008 and 2013 NDHS.

Survey Year	Period Covered	Number of Households (Response Rate)	Number of Women (Response Rate)	Number of Men (Response Rate)
2003	1999-2003	7,225 (98.6%)	7,620 (95.4%)	2,346 (91.2%)
2008	2004-2008	34,070 (98.3%)	33,385 (96.5%)	15,486 (92.6%)
2013	2009-2013	38,522 (99%)	38,948 (97.6%)	17,359 ((5.2%)
Source: NDHS final reports, 2003, 2008 and 2013.				

Appendix 3: Statistical Summary of Explanatory Variables (%) (World Bank, 1990-2014)

Year	Improved Water Sources	Improved Sanitation Services	Inflation (CPI)	Household Consumption Expenditure	PAB	GDP per Capita (Annual)	Urban Population	Vaccinated Against Measles	DPT
1990	39.9	38.1	7.4	22.6	32	9.9	29.7	54	56
1991	41.2	37.7	13	3.1	33	-3.1	30.2	57	39
1992	42.4	37.2	44.6	11.3	35	-2.1	30.7	43	43
1993	43.6	36.8	57.2	-1.9	35	-0.4	31.2	40	29
1994	44.8	36.4	57	-4.6	36	-1.6	31.7	41	44
1995	46	36	72.8	6.2	44	-2.8	32.2	44	34
1996	47.2	35.6	29.3	20.1	46	2.4	32.7	38	26
1997	48.3	35.2	8.5	-3.5	48	0.3	33.2	38	21
1998	49.5	34.8	10	0.7	48	0.2	33.7	38	32
1999	50.6	34.4	6.6	-6	49	-2	34.3	35	31
2000	51.8	34	6.9	1.8	57	2.7	34.8	33	29
2001	53	33.7	18.9	41.4	59	1.8	35.7	32	27
2002	54.2	33.3	12.9	0.6	60	1.2	36.5	30	25
2003	55.4	32.9	14	15.4	61	7.6	37.4	34	29
2004	56.6	32.6	15	7.8	61	30.3	38.2	37	33
2005	57.8	32.2	17.9	9.2	62	0.8	39.1	41	36
2006	59	31.9	8.2	-18.7	63	5.4	39.9	44	40
2007	60.1	31.5	5.4	37.6	63	4	40.8	41	42
2008	61.2	31.2	11.6	-19.4	64	3.5	41.7	53	53
2009	62.3	30.8	11.5	31.7	67	4.1	42.6	64	63
2010	63.4	30.5	13.7	-9	69	5	43.5	56	54
2011	64.5	30.2	10.8	-3.1	60	2.1	44.4	49	48
2012	65.5	29.9	12.2	0	60	1.5	45.2	42	42
2013	66.6	29.6	8.5	21.1	60	2.6	46.1	47	46
2014	67.6	29.3	8.1	2	55	3.5	46.9	51	49
Mean	54.10	33.43	19.28	6.66	53.08	3.08	37.30	43.28	38.84
SD	8.54	2.71	18.35	15.60	11.56	6.48	5.43	8.69	10.98
CV	15.79	8.09	95.18	234.39	21.78	210.82	14.55	20.07	28.26

Appendix 4a: Percentage Distribution of Geographical and Bio-Demographic Variables across States, NDHS 2003

State	Rural	Male	Birth Interval<24 months	Age at FirstBirth ≤20	Age at FirstBirth ≥34	Christian	Muslim
Abia	73.9	60.9	29.4	18.2	0	100	0
Abuja	73.7	63.2	17.6	73.7	0	0	100
Adamawa	81.2	45.3	30.6	66.7	0.9	31.9	67.2
Akwa Ibom	90.4	50	11.9	71.2	0	100	0
Anambra	77.8	49.5	31.6	32.1	0	100	0
Bauchi	83.3	49.9	26.3	80.1	0.2	3.1	96.9
Bayelsa	100	53.3	23.1	73.3	0	96.7	0
Benue	84.7	51	20.4	71.3	0	94	1.5
Borno	49.1	58.8	27.9	74.7	0	12	87.3
Cross River	78.7	50	7.7	72	0	100	0
Delta	56.1	47.2	18.6	55.8	0	90.2	0
Ebonyi	56.9	51	28.9	33.3	0	76.9	0
Edo	73.3	60	21.5	63.5	0	94.2	5.8
Ekiti	38.5	57.9	11.1	23.7	0	84.6	15.4
Enugu	39.1	48.4	15.4	42.2	3.1	93.8	0
Gombe	82.6	49	25.4	74.2	0	30.5	68.2
Imo	26.5	33.6	53.6	32.7	0	100	0
Jigawa	90.3	52	19	82.3	0	0	100
Kaduna	57.4	52	21.8	68.3	0	19.2	80.5
Kano	70.1	49.8	21.8	76	0	1	99
Katsina	79.1	53.2	28.1	84.9	0	1.7	98.3
Kebbi	73	51.7	25	77.8	0	0	99.1
Kogi	78.7	56.3	15.5	63.2	1.7	48.3	45.4
Kwara	50	37.5	9.7	32.5	0	27.5	72.5
Lagos	4.1	53.1	25.4	21.9	0	62.7	37.3
Nasarawa	74.7	55.8	26.4	71.6	0	67	25.5
Niger	84.2	45	23.4	51.1	3.1	17.1	82.9
Ogun	63.6	53.8	6.6	43	1.9	54.2	39.3
Ondo	53.3	60	13.2	51.1	0	82.2	17.8
Osun	41.4	55.2	20	24.1	0	32.1	67.9
Oyo	31.7	53.9	6.3	37.3	0	41.6	58.4
Plateau	80.3	46.2	21.3	46.2	0	88	9.4
Rivers	75.2	49.3	34.9	44.7	0.5	98.1	1.4
Sokoto	90	56.5	19.4	80.9	0	0	99
Taraba	85.4	56.1	34.3	87.7	0	19.3	78.3
Yobe	76	52.3	26.2	73.1	0	5.7	94.3
Zamfara	87	47.4	34.4	83.6	0	0	99.3
National	71.1	51.2	24.2	66.5	0.3	35.4	63.1

Appendix 4b: Percentage Distribution of Geographical and Bio-Demographic Variables Across States, NDHS 2008

State	Rural	Male	Birth Interval<24 months	Age at FirstBirth ≤20	Age at FirstBirth ≥34	Christian	Muslim
Abia	52.2	47.4	34.9	26.4	2.7	99	0
Abuja	32.8	49.8	20.9	34	0.8	62.3	37.7
Adamawa	80.1	48.5	26.1	63.9	0	37.4	61.9
Akwa Ibom	91.7	50.6	27.6	44.5	1	99.7	0
Anambra	19.6	51.1	40.1	34.5	2	97.2	0.3
Bauchi	72.9	51.3	23	81.4	0	5.2	94.6
Bayelsa	74.7	52.9	23.3	67	0.3	96.8	0.3
Benue	87.3	47.5	22.8	65.3	0	98.3	0
Borno	68.5	48.7	33	77.3	0.1	2.7	95.8
Cross River	82.5	52.2	15.2	57.5	0.9	99.6	0
Delta	67.8	52.9	25.1	43.7	0	94.4	1.2
Ebonyi	70.2	51.8	27.1	42.5	0.9	81.1	0.2
Edo	52.8	47.5	23.7	32.8	0.3	80.6	13.5
Ekiti	63.5	53.5	16.4	35.4	0.8	79.5	19.7
Enugu	71.5	49.9	22.8	30.5	2	96.4	1.6
Gombe	78.4	51.7	21	75.4	0.4	16.3	82.2
Imo	79.4	54.7	40.7	24.6	2.1	99.7	0
Jigawa	92.1	50.3	23.5	71.6	0.4	0	99.2
Kaduna	71.8	51.8	23	67.9	0.5	31.1	67.9
Kano	77.9	49.2	26.4	77.2	0.1	1.3	98.5
Katsina	84.6	49.6	28.1	78.1	0	0.3	99.2
Kebbi	81.3	52.8	24.4	74.6	0	1.1	89.4
Kogi	63.4	55.4	14.9	54.5	0.6	50.1	48.5
Kwara	66.7	50.8	11.6	51.7	0	15	77.6
Lagos	9.4	49.3	17.9	18.4	1.3	67.7	32.1
Nasarawa	82.8	48.8	16.5	57.1	1.2	54.6	43.2
Niger	81.5	53.8	26.2	70.3	0.5	18.1	81
Ogun	78.9	48.7	17.8	37.4	0.1	65.8	31.9
Ondo	65.6	55.2	16.5	39.6	0.7	89.2	8.8
Osun	34.7	54.2	11.1	32.7	0.4	41.7	58.1
Oyo	59.5	50.6	15.3	43.8	0.9	33.8	65.4
Plateau	79.6	51.9	15.3	54.1	0.6	79.2	18.9
Rivers	70.2	51.1	31.7	44.8	0.6	97.5	1.5
Sokoto	89.4	50.3	18.6	79.7	0.1	0	99.5
Taraba	83.5	52.1	16.7	61.9	0.4	51.5	44.8
Yobe	70	50.8	23.6	79.8	0.2	0.3	99.4
Zamfara	90.6	53.7	23.5	70.3	0	0.8	99.2
National	70.3	50.8	23.8	58	0.5	43	55.3

Appendix 4c: Percentage Distribution of Geographical and Bio-Demographic Variables Across States, NDHS 2013

State	Rural	Male	Birth Interval<24 months	Age at FirstBirth ≤20	Age at FirstBirth ≥34	Christian	Muslim
Abia	76.4	51.2	30.9	21.1	2.8	99.4	0.3
Abuja	44	50.2	21.9	39.6	2.4	53.9	46.1
Adamawa	74	54.7	23.4	67.8	0	32.6	67.4
Akwa Ibom	96.4	48.3	23.8	53.2	0.4	99.4	0.6
Anambra	15.4	52.5	35.8	35.8	1.4	97.4	1.7
Bauchi	88.2	51	28.2	82.4	0	0.9	98.6
Bayelsa	75.3	50.6	21	66.7	0	99.1	0.4
Benue	93.5	47.5	22.3	66.8	0.3	95.1	0.9
Borno	51	50.4	27.1	63.8	0.7	0.7	98.7
Cross River	86.3	54.5	17.3	45.9	2.5	98.5	1.3
Delta	50.7	49.4	25.9	48.5	1.3	95.8	2.2
Ebonyi	11.8	52.7	21.2	45.4	1.4	95.2	0.3
Edo	45.1	50.9	22.4	34.9	0.7	90.3	9
Ekiti	24.4	51	18.1	27.3	0.5	90.4	9.6
Enugu	30.4	46.7	29.3	35.5	1.6	99.1	0.2
Gombe	70.2	53.4	25.4	75.5	0	12.9	86.4
Imo	46	49.8	38.2	25.3	2.4	100	0
Jigawa	92	49.5	26.9	79.1	0.1	0.1	99.8
Kaduna	61	49.2	17.4	66.7	0.1	39.4	60.4
Kano	65.1	49.6	23.3	72.8	0.3	0.3	99.7
Katsina	83.1	49.9	22.9	82	0.2	0.4	99.6
Kebbi	85.8	48.2	24.7	75.3	0.1	1.9	94
Kogi	57.9	52.1	15.2	43.8	0.3	41.2	58.6
Kwara	36.4	49.4	12.5	31.3	0.3	16.8	83.3
Lagos	0	52.4	25.1	17.3	1.9	67.4	32.2
Nasarawa	85.5	49.8	19.8	51.1	0.2	46.9	49.6
Niger	84.8	52	21	61.2	0.2	16.8	82.5
Ogun	49	48.7	15.6	40	1	70.7	28
Ondo	57.6	48.6	17.5	41.5	0.2	81	19
Osun	19.3	50.8	12.9	26.1	0.2	63	37
Oyo	36.6	50.5	13.7	42	0	31.9	67
Plateau	82.4	50.3	16.8	40.9	1.4	74.5	20.6
Rivers	47.9	49.7	27	36	1.5	98.9	0.8
Sokoto	82.9	52.2	23.5	82.7	0.2	0	99.9
Taraba	86.7	52.9	23.7	66.8	0	45	53.2
Yobe	80.9	49.9	25.4	69.1	0.1	0.1	99.6
Zamfara	84.9	50.6	24.9	77.1	0.1	2.2	95.8
National	65	50.4	23.2	59.6	0.5	36.8	62.2

Appendix 5: Percentage Distribution of Socioeconomic Variables across States in Nigeria

	Percentage Poor			Completed Secondary education and Higher		
STATE	2003	2008	2013	2003	2008	2013
Abia	26.1	4	9.9	27.3	43.5	54.3
Abuja	0	10.8	6.8	0	41.2	48.8
Adamawa	74.4	67.2	51.9	9.3	7.3	16.3
Akwa Ibom	47.8	23.4	14.8	16.9	25.5	39.1
Anambra	2.8	3.4	7.7	33.9	43.6	57.8
Bauchi	73.6	77.6	79.4	1.4	3.1	5.4
Bayelsa	63.3	30.3	3.5	10.3	25.9	32
Benue	55.9	65.8	56.3	10.9	9.9	9.5
Borno	38.3	69.5	51.1	15.8	3.6	9.4
Cross River	42.6	41.6	19.8	23.4	26.5	27.3
Delta	20.9	19	7.9	26.8	25.3	36.2
Ebonyi	82.4	56.5	43	2	15.2	21.1
Edo	55.3	14.2	10.2	7.1	29.3	40.3
Ekiti	46.2	26.8	0.5	13.2	46.2	66.7
Enugu	37.5	27.7	16.7	12.5	27.2	40.1
Gombe	60	67.5	66	3.9	7.3	11.4
Imo	4.5	5.1	10.8	72.6	59.4	56.5
Jigawa	89.8	80.4	82.9	0	1.8	1.5
Kaduna	25.9	35.6	39.3	15.2	14	22.7
Kano	28.4	57.3	61.1	9.7	7.8	8.8
Katsina	34.9	74.4	74.5	6.7	1.2	4.5
Kebbi	69.1	67.3	75.9	5.2	4.3	2.8
Kogi	17.2	21.6	11.1	14.9	25.5	37.9
Kwara	0	43.3	4.8	27.5	25.7	38.9
Lagos	0	3	0	33.9	61.9	64.6
Nasarawa	56.4	41.7	26.4	4.3	10.7	17.1
Niger	44.1	51.9	34.6	5.4	4.8	12.1
Ogun	29.9	23.3	5.8	19.6	25.5	30.8
Ondo	37	33.7	22.6	4.4	30.5	38.3
Osun	3.3	16.6	3.6	20.7	32.5	54.9
Oyo	20.6	16.9	20.6	33.7	30.5	34.1
Plateau	50.4	63.7	61.2	12.1	10.7	21.5
Rivers	15.9	20.1	9.6	29.8	43.7	52.8
Sokoto	85.7	78.8	77.2	0	0.6	2.4
Taraba	68.9	67.6	69.3	1.4	9.4	10.6
Yobe	36	75.1	84.2	6.9	3.8	6
Zamfara	56.4	80.9	84.6	1	4	2.9
National	44.6	46	46.7	12.4	19	20.8

Appendix 6: Percentage Distribution of Child health and Infant feeding Variables Across States, NDHS

	Birth Size (Small)			Breastfeeding (≥6 months)			Prevalence of Diarrhea		
STATE	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	13.6	6.3	8.7	94.7	78.9	57.3	4.5	4.5	2.4
Abuja	15	7.9	19.3	89.5	85.9	64.4	27.8	1.3	5.6
Adamawa	5.2	14.4	12.3	72.6	80.8	63.4	33.7	9.1	16.7
Akwa Ibom	8.4	5.4	10	82	80.1	63.2	7.5	4.1	5.5
Anambra	14.8	9.8	9.5	82.2	79.2	50.9	15.2	3.2	5.8
Bauchi	29.4	15	22	84.1	80.5	62.3	37.4	32	25.9
Bayelsa	13.3	11.3	16.2	72.4	77.3	55.1	12.5	3.3	1.9
Benue	12.9	7.5	9.6	83	81	58.8	13.6	7.3	9.5
Borno	20.2	40	30.5	77.7	82.5	73.8	40.4	23.1	10.9
Cross River	14.1	8.5	12.4	81.3	82.7	59.1	9.6	6.7	7.9
Delta	16.7	11.8	6.3	81.6	79	57.6	8.6	2.4	3
Ebonyi	14.3	11.8	14.2	71.7	81.6	59.8	7.5	8.5	13.1
Edo	16.3	6	14.3	81.2	83.2	60.9	5.2	2.7	2.1
Ekiti	10.5	8.8	6.7	81.6	84.4	55.4	2.9	9.2	6.5
Enugu	27.4	29.4	14.7	83.3	81.8	57.5	14	7.4	14.8
Gombe	11	17.2	13.9	76.6	82.8	66.7	23.8	15.4	16.8
Imo	7.1	4.6	10.8	81.8	81.8	63.3	1.8	3.2	12.1
Jigawa	12	14.4	18.6	81.7	85.9	73.4	23	8.2	14.8
Kaduna	3.2	10.5	17.5	83.4	84.3	77.9	8.1	7.9	13.5
Kano	5.4	7.7	20	83.8	82.6	69.1	18.4	17.5	6.5
Katsina	13.7	24.3	11	82.3	83.5	72.4	21	18.3	7.8
Kebbi	27	13.4	35.8	82.1	85.4	69.5	27.5	8.8	13.6
Kogi	20.2	8.6	6.7	77.6	83.1	77.1	12.4	2.9	3.2
Kwara	15	19.8	9	82.9	85.1	64	5.1	3.5	5.4
Lagos	11.9	15.5	7.6	81.8	81.7	59.1	3.9	6.1	7.6
Nasarawa	18.1	13.6	15	76.3	84.2	65.2	17.8	7.5	8.2
Niger	16.1	33.1	2.4	84.9	78.6	61.7	10.4	9.8	8.3
Ogun	12.3	8.6	8.4	78.3	81.3	61.6	13.5	8.1	1.9
Ondo	15.9	15	9.3	80	84.6	61.8	12.5	6.6	5.5
Osun	3.6	11.6	3.6	82.1	84.7	65.7	3.8	4.9	4
Oyo	6.9	4.5	18.6	85.1	83.7	65.6	4.1	4.3	9.2
Plateau	15.4	11.7	21.7	83.9	81.9	64.5	28.6	2.3	5.7
Rivers	8.9	10.2	15.1	79	82.5	53	8.5	3.8	5
Sokoto	22	22.6	2.5	78.4	83.1	71.4	14.9	14.1	4.7
Taraba	7.6	13.4	21.3	80.3	81.9	62.5	36.4	15.9	19.8
Yobe	17.7	14.6	22.7	83.9	82.1	69.4	30.1	18.8	34.7
Zamfara	19.1	22.1	15	75.5	85	73.6	25.2	14.1	6
National	14.6	14.4	15.1	81.3	82.4	66.3	18.9	10.2	10.3

Appendix 7: Percentage Distribution of Environmental Variables Across States, NDHS

	Improved Water Access			Improved Sanitation Access			Use of Solid Fuels		
STATE	2003	2008	2013	2003	2008	2013	2003	2008	2013
Abia	69.6	82.2	68.2	18.2	80.8	72.7	81.8	61.2	71.7
Abuja	63.2	70.6	78.2	36.8	62.2	69.4	94.7	60	46.9
Adamawa	9.4	20.6	58.8	0	29.5	49.6	96.6	99.6	96.3
Akwa Ibom	27.1	62.5	70.1	7.7	64.6	60.2	90.6	76.4	64.8
Anambra	78.7	69.1	71.9	42.6	78.4	83.5	26.9	54.2	39.6
Bauchi	10.5	35.6	34.7	2.7	28.7	18.8	99	99.9	99.1
Bayelsa	13.3	26.1	42.1	0	11	16.8	73.3	60	40
Benue	17.1	44.6	36.7	9	27.3	24.3	92	97.5	98.2
Borno	42	35.6	59	7.8	37.1	61.8	91.8	99.1	98
Cross River	21.7	20.8	64.2	2.2	28.4	41.2	94.6	91	81.7
Delta	77.2	68.7	64.6	52.5	56.7	40.4	42	62.5	55.9
Ebonyi	72	53.7	67.6	0	29.2	26	100	90.3	89
Edo	20	63.6	72.4	20.9	72.4	77.1	79.1	66.4	57
Ekiti	11.1	61	76.9	19.4	36.6	54.4	47.2	74.6	51.8
Enugu	46.8	59	47.5	25.8	28.7	37.4	56.5	88.4	77.1
Gombe	18.1	21.6	54	2.6	55.7	81.8	94.2	97.4	98.3
Imo	91.1	71.2	80.9	78.6	78.8	37.3	17.9	87.3	70.1
Jigawa	49.1	78.5	73.8	0	25.8	58.4	100	99.4	98.2
Kaduna	44.3	43	61.1	7.9	51.7	73.3	76.6	93.5	85.8
Kano	33.4	53.2	67	9.6	81.9	73.2	78.9	89.8	86.9
Katsina	37.1	35	48.4	4.6	68.9	45.4	95.7	99.1	98.8
Kebbi	16.9	72.2	20	2.6	49	56.2	100	98.9	99.3
Kogi	15.9	44.1	72.7	6.4	31.3	38	84.7	82.8	74.4
Kwara	55	58.7	80.3	7.5	30.1	49.6	45	81.6	73.7
Lagos	86.3	88.9	62.1	60.5	85	84.7	5.3	7.2	6.7
Nasarawa	14.9	48.9	58.2	3.2	49.8	44.4	98.9	97.5	93.2
Niger	45.6	45	48.5	10.6	39.6	34	90.8	96.9	97
Ogun	67.3	64.8	77.2	12.5	51.3	68.3	41.3	58.3	39.3
Ondo	27.3	61	50.7	9.3	33.6	36	70.5	78.5	62.9
Osun	48.3	80.9	82.3	20.7	45.1	54.5	25	59.4	45.5
Oyo	37	77.6	69.9	22	45.6	43.5	35.6	51.2	54.4
Plateau	32.1	28.7	34.5	5.3	25.9	25.7	90.3	96.4	88.3
Rivers	78.9	70.4	71.9	37.4	36.6	53.1	51.8	53.4	47.8
Sokoto	31.3	23.3	62.9	1	74.5	53.9	99	100	99.4
Taraba	0	19.1	32.5	0	15.4	28.8	100	99.2	94.6
Yobe	41.6	50	43.6	16.2	50.8	41.4	98.8	99.8	99.8
Zamfara	18.8	25.8	31.6	3.8	60.5	6.9	96.2	99.4	99.8
National	36.1	52.3	56.6	12.8	51.7	50.4	80.7	81.6	81.1

Appendix 8a: Percentage Distribution of Health Care Variables Across States, NDHS 2003

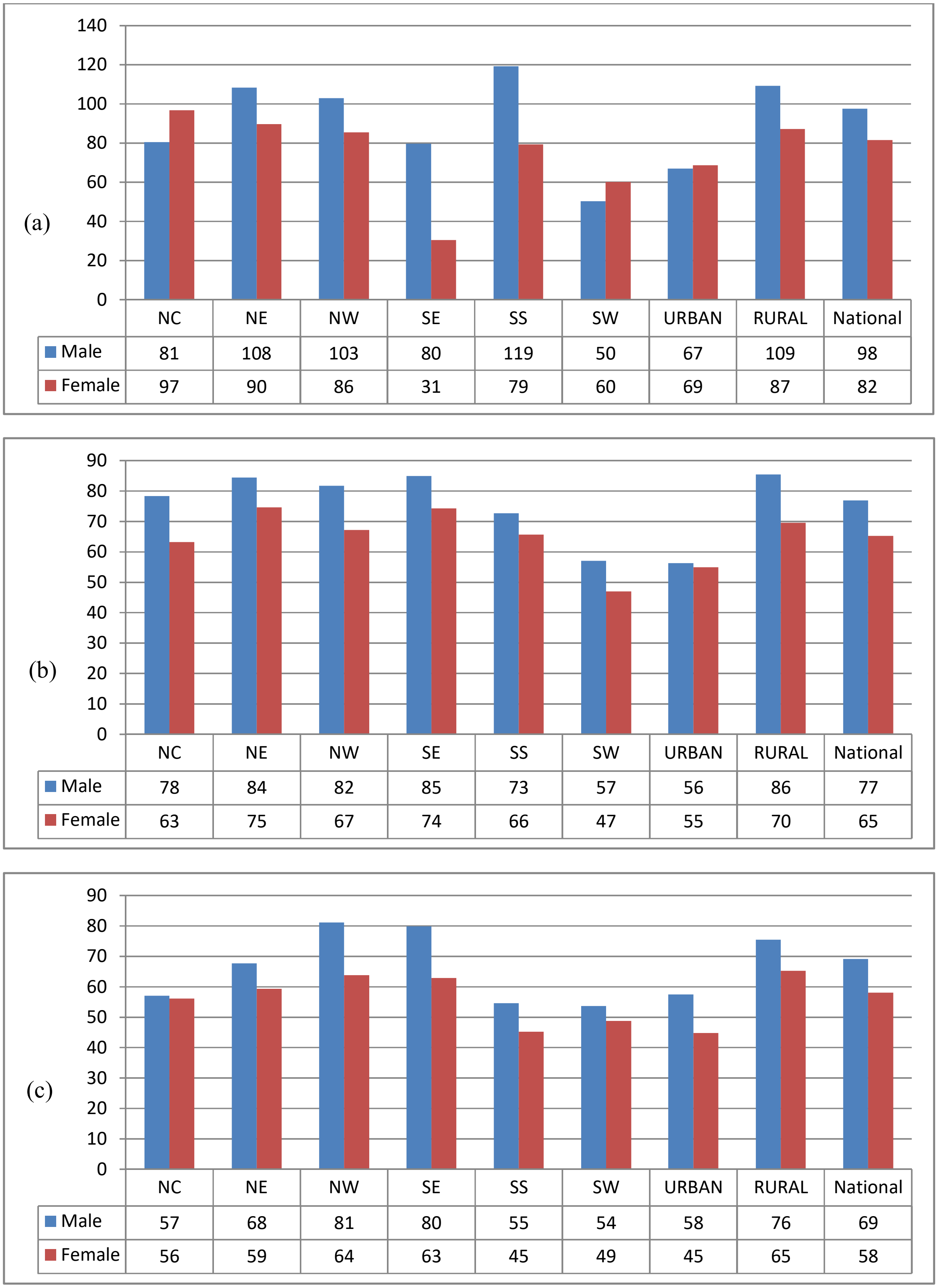
State	ANC (≥ 4visits)	PAB	Fully Immunized	HCF Delivery	Did not sleep under ITN	Full knowledge of MTCT
Abia	92.9	86.7	21.7	95.5	91.3	0
Abuja	63.6	63.6	5.3	36.8	89.5	11.1
Adamawa	53	57.6	8.5	29.3	90.6	3.7
Akwa Ibom	62.1	62.3	7.3	52.8	100	1.8
Anambra	60.9	89.4	36.1	97.2	100	3.6
Bauchi	24	31.7	1.6	10.6	91	4.4
Bayelsa	17.6	44.4	0	13.3	65.5	9.7
Benue	45.8	63.4	6.4	48.5	96	4
Borno	44.2	50.6	9.7	21.6	90.2	5.1
Cross River	58.2	64.7	7.4	34.8	83.9	4.1
Delta	85.3	81.6	23.9	68.7	90.3	1.8
Ebonyi	60.7	82.1	7.8	37.5	71.1	0
Edo	60.4	51.9	8.2	38.8	48.2	4.8
Ekiti	92.6	96.4	15.8	78.9	100	2.7
Enugu	59.5	88.1	26.6	78.7	87.1	8.7
Gombe	41.9	58.7	13	24.5	98	1.7
Imo	96.8	98.4	13.3	100	100	5.8
Jigawa	6.5	5.6	0	0	80.2	1.1
Kaduna	57.1	62.3	9	21.5	98.8	7.2
Kano	38.1	30.2	3.4	15.5	99.2	5.8
Katsina	36.7	25.9	2.3	17	96.9	13.2
Kebbi	15.3	19.4	1.3	2.6	81.2	0
Kogi	72.4	79.3	12.6	67.2	91.9	12
Kwara	76.9	84	22	77.5	90	12
Lagos	96.1	89.1	29.5	80.8	100	3.8
Nasarawa	52.6	54.4	4.2	28.7	92.3	2.8
Niger	47.9	46.4	10.4	30.6	74.9	3.8
Ogun	91.8	77	18.7	68.9	100	2.6
Ondo	74.2	80.6	15.6	66.7	100	1.1
Osun	100	100	13.8	92.9	100	1.1
Oyo	96	86.5	13.7	81.2	100	1.9
Plateau	54.5	64.9	21.4	38.5	99.1	8.7
Rivers	75.5	85.7	24.2	61.4	98.9	6.1
Sokoto	3.6	2.1	0	1	94.2	3
Taraba	24.2	35.5	2.8	13	82.5	2.9
Yobe	26.9	48.5	6.3	19.9	98.8	4.5
Zamfara	11.6	15.2	0	1	98.2	3.3
National	47.5	51	9	33	92.5	4.8

Appendix 8b: Percentage Distribution of Health Care Variables Across States, NDHS 2008

State	ANC (≥ 4visits)	PAB	Fully Immunized	HCF Delivery	Did not sleep under ITN	Full knowledge of MTCT
Abia	79.1	92.3	23.7	74.7	96.5	12.8
Abuja	82.1	83.5	44.8	55.1	89.2	32.8
Adamawa	42.2	55.1	12.2	10.8	93.4	23.9
Akwa Ibom	63.5	67.4	24.6	37	78.3	23.7
Anambra	79.2	95.8	39.2	88.8	80.6	29.7
Bauchi	35.3	34.2	1.1	13.1	83.9	12.6
Bayelsa	42.1	57.9	18.2	18.4	76.5	31
Benue	37.1	62.4	14.9	51.2	80	20.1
Borno	20.5	26.9	1.9	12	76	5.8
Cross River	56.7	73.9	28.8	38.9	67.7	23.8
Delta	46.7	75.7	22.6	57.4	87.8	9.3
Ebonyi	56	71.2	31.4	41.3	71.9	18.1
Edo	75.5	84.7	27.1	77.2	83.6	31
Ekiti	70.9	93.7	43	75.9	82.6	16.2
Enugu	49	68.8	15.9	54.4	87.8	14.1
Gombe	47.4	51.8	9.7	17.3	76.7	21.3
Imo	39.5	93.1	29	94.4	78.5	19.6
Jigawa	12.5	15.6	0.5	4.5	77.5	12.5
Kaduna	44.3	52.7	17	18.7	84.4	31.1
Kano	31.8	35.7	3.7	11.3	93.2	12.9
Katsina	9	13.1	1.4	4.3	96.4	11.6
Kebbi	10.1	14.5	4.2	5	86.4	26
Kogi	72.7	77	27.7	77.4	86.7	8.6
Kwara	45	52	23.3	48.9	86.9	25.5
Lagos	96.2	88.4	42	77.9	89.5	29.7
Nasarawa	55.8	47.1	10.8	33	87	17.2
Niger	30.3	35.6	9.2	16.5	97.1	15.8
Ogun	79.4	85.4	22.9	64.1	88.7	13.6
Ondo	58.7	68.8	25.8	47.5	83.1	12.8
Osun	97.5	95.8	36.1	85.4	94.1	7.4
Oyo	68.3	82.8	21.5	67.2	96.4	19.7
Plateau	54.6	75.7	20.9	30.3	86.1	27.8
Rivers	41.4	79.4	23.6	48	80.7	19.9
Sokoto	10.2	9.5	0.4	4.4	61.2	7.9
Taraba	32.1	47.6	9.8	21.2	89.5	35.6
Yobe	22.8	32.6	2.5	6.1	92.2	9.5
Zamfara	8.8	10.7	5.1	6.6	90.6	12.4
National	45.2	54.7	16	35.4	85.6	18.9

Appendix 8c: Percentage Distribution of Health Care Variables Across States, NDHS 2013

State	ANC (≥ 4visits)	PAB	Fully Immunized	HCF Delivery	Did not sleep under ITN	Full knowledge of MTCT
Abia	86.7	92.8	38.5	75.1	70.2	42.7
Abuja	86.4	80.1	46.4	69.1	72	27.3
Admawa	64.9	75.9	26.8	33.7	83.4	29.5
Akwa Ibom	55.5	74.2	31.4	43.5	81.7	38.9
Anambra	77.4	90.2	34.6	88	82.4	45.3
Bauchi	42.5	52.2	5.8	17.1	91.5	14.3
Bayelsa	34	65.6	35.5	28.7	70.7	28.3
Benue	37	55.7	16.1	51.2	67.9	54.6
Borno	26.1	34.8	8.2	17.1	86.4	21.2
Cross River	76.2	83.2	30.6	40.6	62.8	34.7
Delta	74.9	75.7	36.4	59.3	85.2	52
Ebonyi	76.1	88.3	38.2	59.7	63.4	28.8
Edo	69.7	82.8	39.7	75	73.2	35.6
Ekiti	86.6	93.5	34	86.3	73.9	39
Enugu	93.4	97.4	34.4	86.1	64.7	46
Gombe	53.7	65.9	12.4	27.8	83.9	31.3
Imo	88.6	97.7	42.7	92	62.3	33
Jigawa	34.7	44.2	2.9	6.9	62.9	24.1
Kaduna	44.1	56.3	22.6	32.4	93.1	28.9
Kano	41.3	49.3	11	12.9	88.5	32.3
Katsina	23.3	28	8.9	9.2	67.1	43
Kebbi	18.1	18.8	2.8	8.5	71.1	11.3
Kogi	85.3	90.5	23.9	80.5	85.3	43.3
Kwara	85	88.3	30.8	76.9	62.6	28.2
Lagos	92.9	92.1	38.6	78	76.9	44.9
Nasarawa	58.4	63.2	13.7	40.2	79.5	42.3
Niger	50.3	63.2	15.7	25.9	88.1	33.1
Ogun	91.7	80	16.6	75	78.5	34.3
Ondo	80.4	75.3	35.9	56.5	67.6	24.4
Osun	95	96.4	45.2	89.3	90.1	60.7
Oyo	80.1	81.4	21.9	74.7	74.2	33
Plateau	40.9	57.4	17.6	36.2	78.3	26.7
Rivers	54.5	86.5	40.4	49.7	79.3	40.6
Sokoto	16.5	16.7	0.8	4.8	85.5	46.2
Taraba	40.1	53.2	12.8	23.5	82.5	28.3
Yobe	19.7	31.6	4.8	7.7	77.5	24.6
Zamfara	18.1	22.7	2.3	5	88.9	22.1
National	51.4	59.2	18.3	36.1	79	34.1



(a)

	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Male	81	108	103	80	119	50	67	109	98
Female	97	90	86	31	79	60	69	87	82

(b)

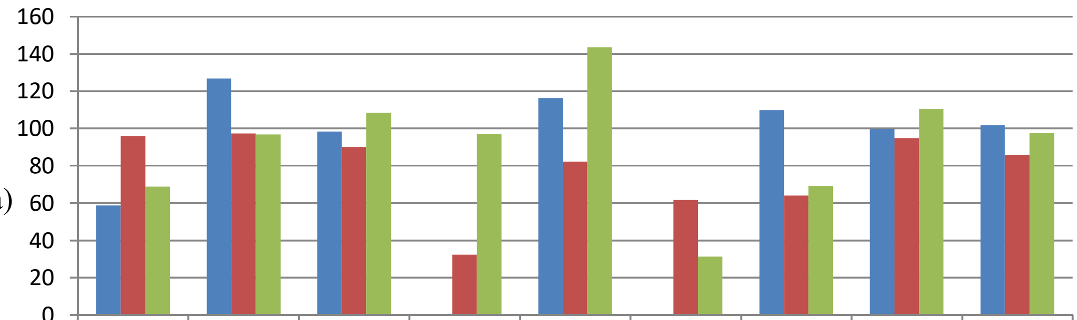
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Male	78	84	82	85	73	57	56	86	77
Female	63	75	67	74	66	47	55	70	65

(c)

	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Male	57	68	81	80	55	54	58	76	69
Female	56	59	64	63	45	49	45	65	58

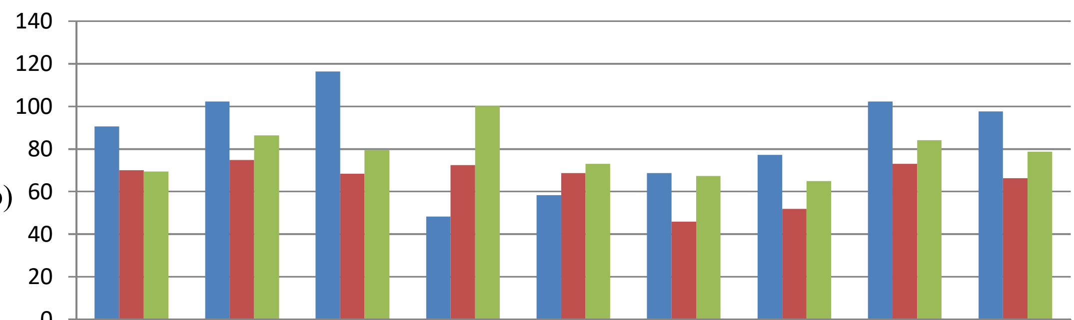
Appendix 9a-c: Distribution of IMRs by Child's Sex acrossregions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively.

(a)



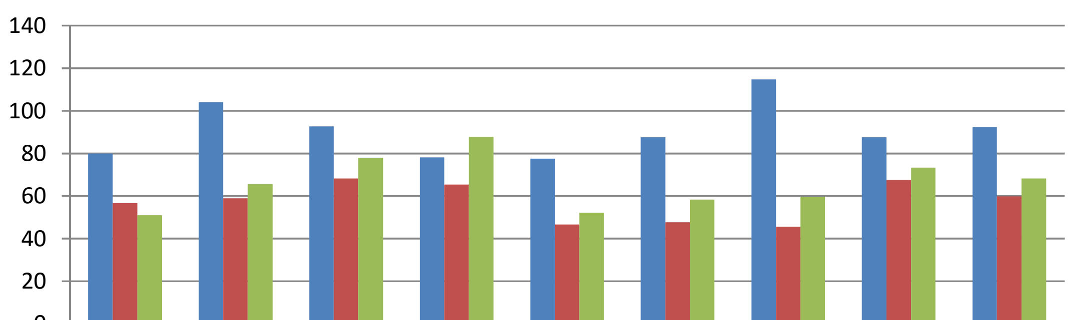
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	59	127	98	0	116	0	110	100	102
20-34	96	97	90	32	82	62	64	95	86
35-49	69	97	109	97	144	32	69	111	98

(b)



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	91	102	117	48	58	69	77	102	98
20-34	70	75	68	72	69	46	52	73	66
35-49	70	86	80	100	73	67	65	84	79

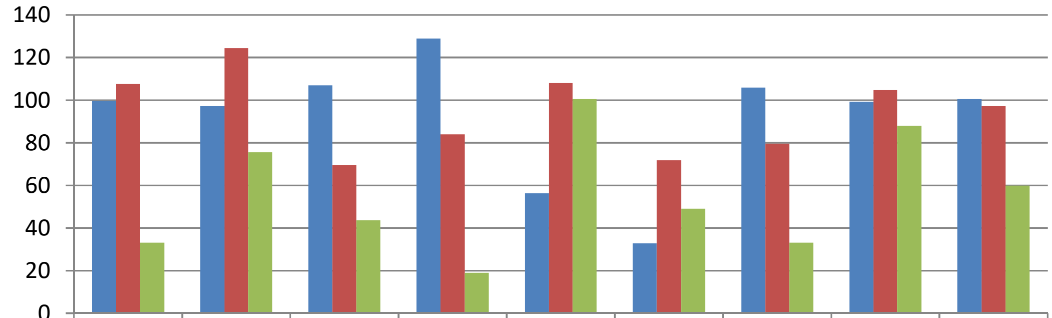
(c)



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	80	104	93	78	78	88	115	88	92
20-34	57	59	68	65	47	48	46	68	60
35-49	51	66	78	88	52	58	60	73	68

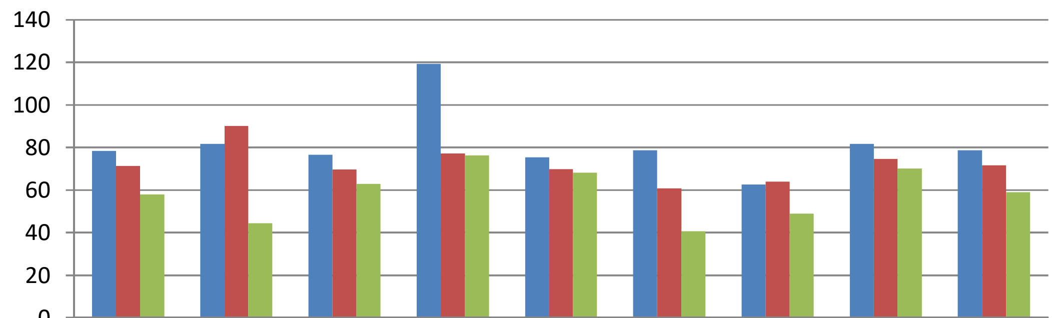
Appendix 10a-c: Distribution of IMRs by Mother's Age group across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively)

(a)



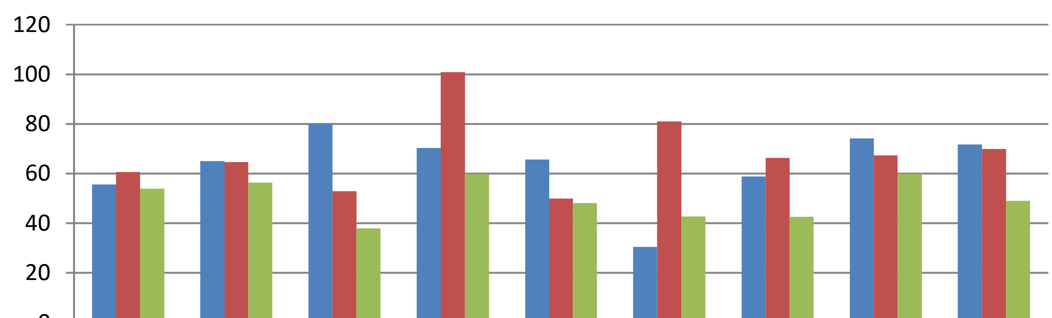
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	100	97	107	129	56	33	106	99	101
Primary	108	125	70	84	108	72	80	105	97
Higher	33	76	44	19	101	49	33	88	60

(b)



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	78	82	77	119	75	79	63	82	79
Primary	71	90	70	77	70	61	64	75	72
Higher	58	44	63	76	68	41	49	70	59

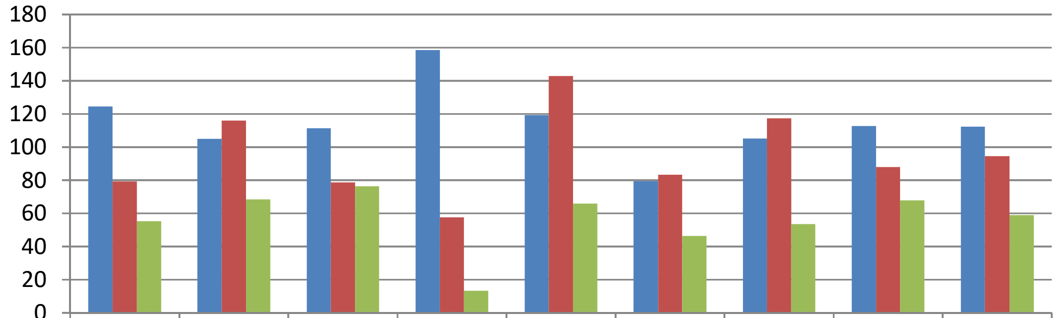
(c)



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	56	65	80	70	66	30	59	74	72
Primary	61	65	53	101	50	81	66	67	70
Higher	54	56	38	60	48	43	43	60	49

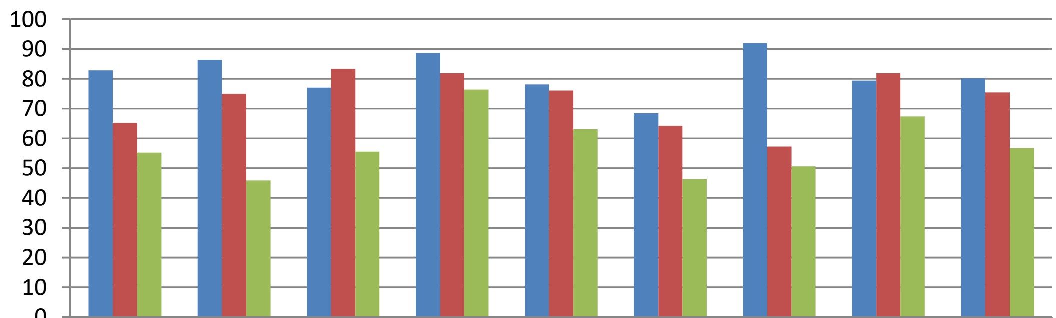
Appendix 11a-c: Distribution of IMRs by Mother's educational level across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively)

(a)



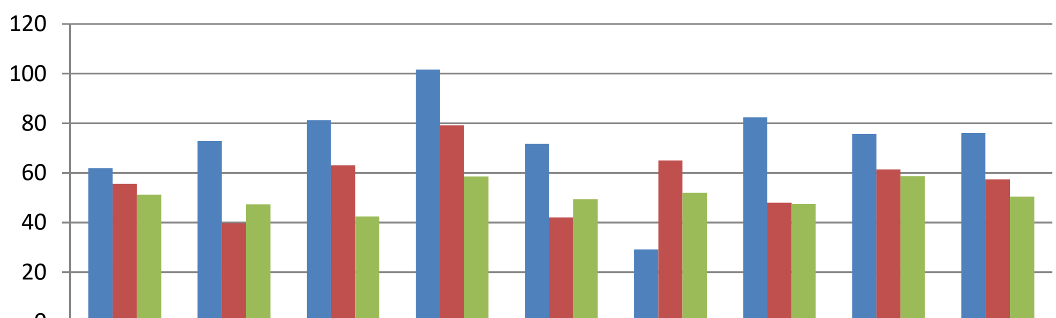
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	125	105	111	159	119	80	105	113	112
Middle	79	116	79	58	143	83	117	88	95
Rich	55	68	76	13	66	46	53	68	59

(b)



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	83	86	77	89	78	69	92	79	80
Middle	65	75	83	82	76	64	57	82	76
Rich	55	46	56	76	63	46	51	67	57

(c)



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	62	73	81	102	72	29	82	76	76
Middle	56	40	63	79	42	65	48	61	57
Rich	51	47	42	59	49	52	48	59	50

Appendix 12a-c: Distribution of IMRs by Wealth Index across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively)

Appendix 13: Global Moran's I values for Infant Mortality Rate in Nigeria.

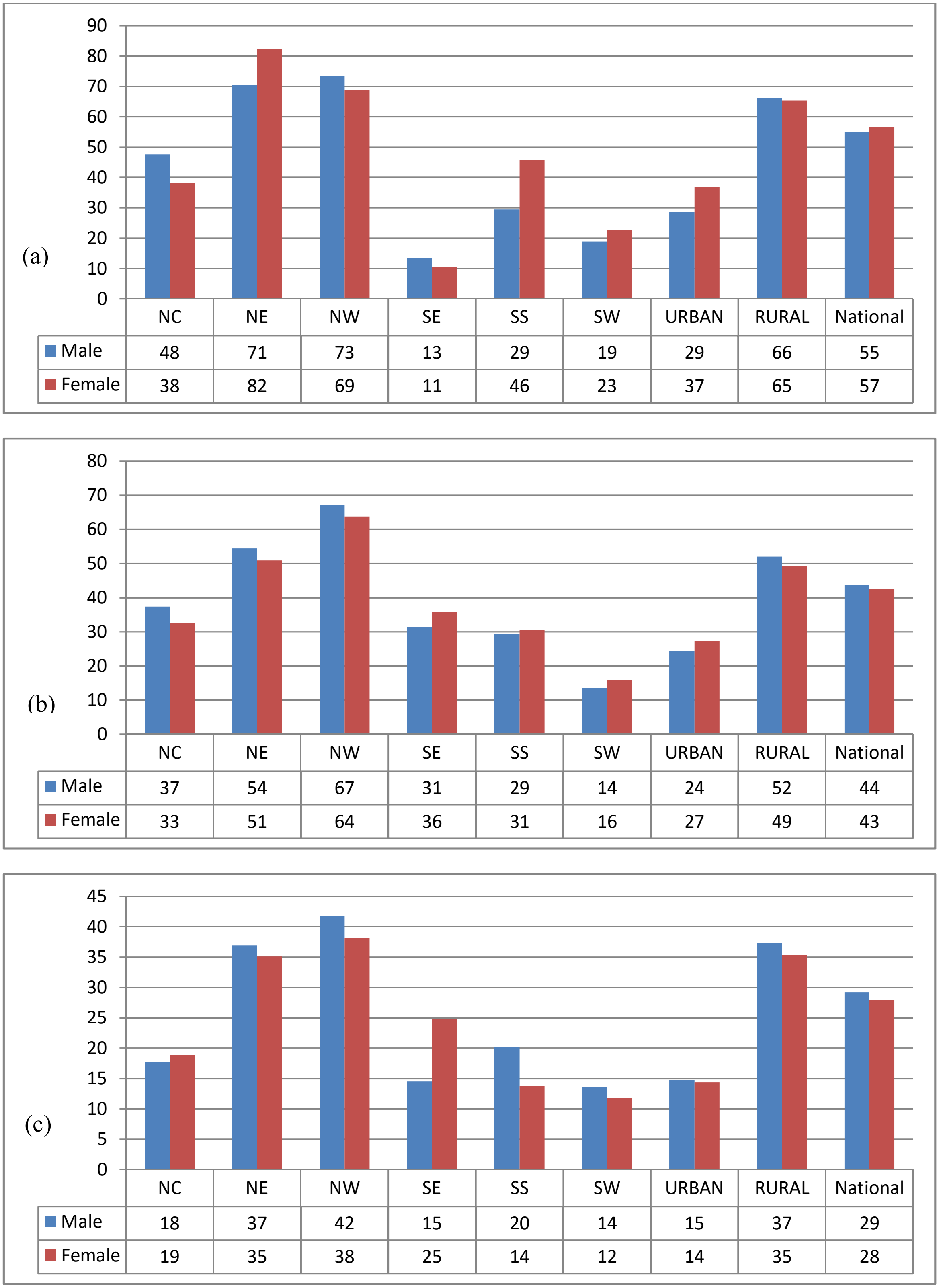
Survey Year	Moran's I	Z scores	P value	Remark
2003	0.147123	1.65	0.098	Clustered
2008	0.151406	1.68	0.094	Clustered
2013	0.166218	1.83	0.067	Clustered
All index values are significant only at the 0.10 significance level. Calculated by Author				

Appendix 14: Local Moran's I values for IMRs by states in Nigeria

Survey Year	State	LmiIndex	LmiZscore	LmiPvalue	COType
2003	Oyo	1.52015	2.83	0.005	Low-Low
	Kwara	1.21987	3.04	0.002	Low-Low
	Abuja	-1.06329	-2.22	0.026	Low-High
	Taraba	0.96067	2.68	0.007	High-High
2008	Kwara	1.57753	3.88	0.000	Low-Low
	Osun	2.11263	5.17	0.000	Low-Low
	Ekiti	1.61266	3.49	0.000	Low-Low
	Cross River	-1.03579	-2.15	0.032	Low-High
2013	Sokoto	2.03195	3.03	0.003	High-High
	Kebbi	1.51617	2.82	0.005	High-High
Note: only states with statistically significant index values ($p<0.05$) are shown above. Calculated by Author					

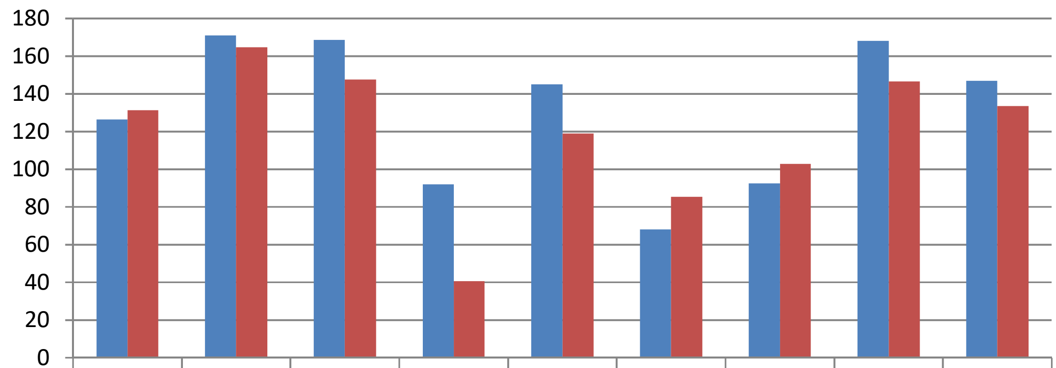
Appendix 15

Gi* Statistic values for IMR in Nigeria, 2003			
State	GiZscore	GiPvalue	Remark
Oyo	-2.350260	0.019	Cold Spots
Kwara	-2.299530	0.021	
Osun	-1.959360	0.050	
Taraba	2.478180	0.013	Hot Spots
Benue	2.120370	0.034	
Plateau	2.180500	0.029	
Adamawa	1.663990	0.096	
Gi* Statistic values for IMR in Nigeria, 2008			
State	GiZscore	GiPvalue	Remark
Kwara	-2.676470	0.007	Cold Spots
Ekiti	-3.492920	0.000	
Osun	-3.177100	0.001	
Oyo	-2.476530	0.013	
Ogun	-2.464770	0.014	
Ondo	-1.809430	0.070	
Gi* Statistic values for IMR in Nigeria, 2013			
State	GiZscore	GiPvalue	Remark
Kwara	-2.376550	0.017	Cold Spots
Ondo	-2.158410	0.031	
Oyo	-1.712550	0.087	
Ekiti	-1.654580	0.098	
Abuja	-1.789370	0.074	
Taraba	1.794650	0.073	Hot Spots
Kebbi	2.383130	0.017	
Sokoto	3.105230	0.002	
Calculated by Author			



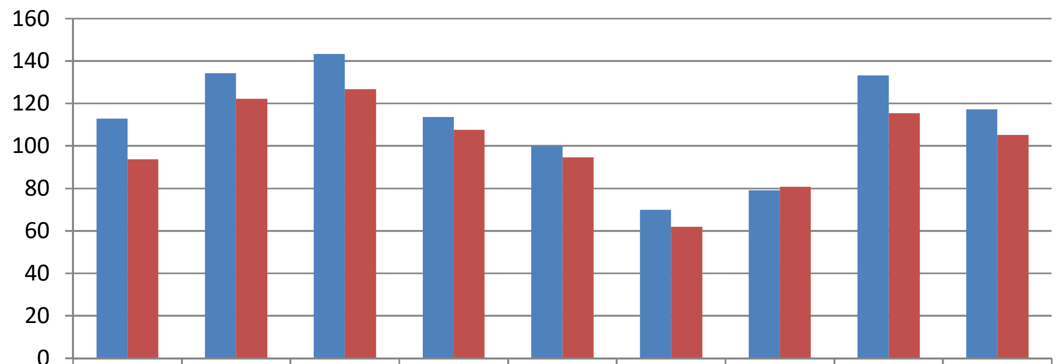
Appendix 16a-c: Distribution of CMRs by Child's Sex across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

(a)



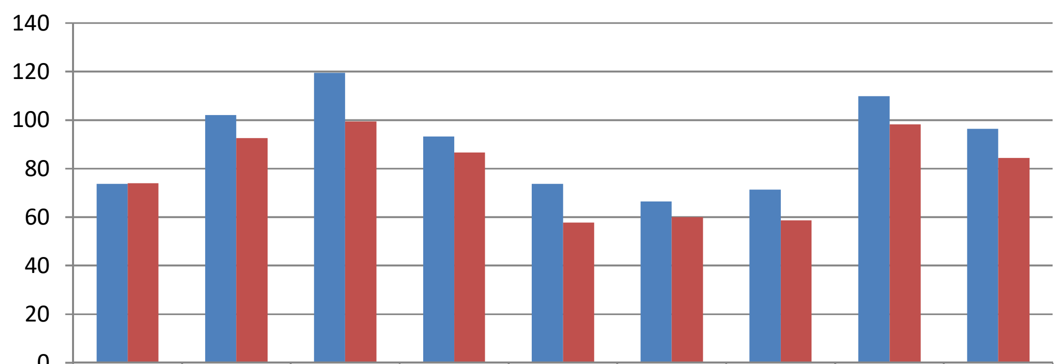
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Male	126	171	169	92	145	68	93	168	147
Female	131	165	148	41	119	86	103	147	134

(b)



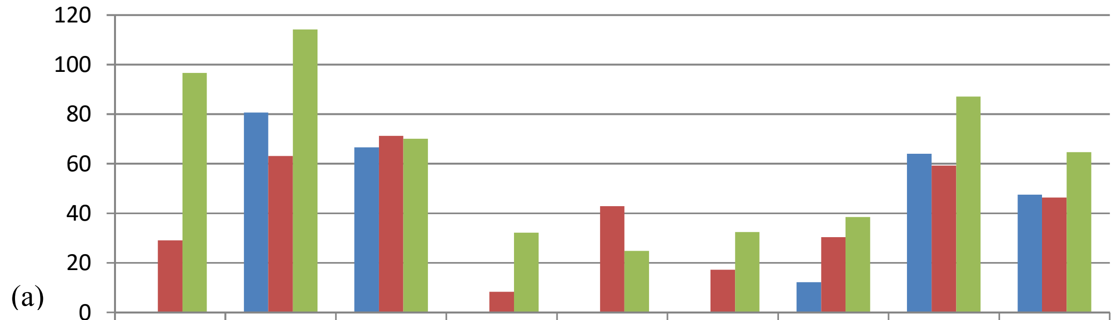
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Male	113	134	143	114	100	70	79	133	117
Female	94	122	127	108	95	62	81	115	105

(c)

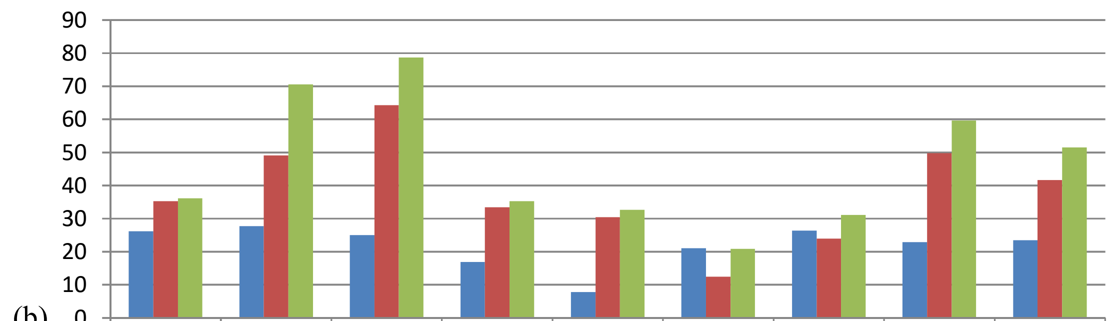


	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Male	74	102	120	93	74	67	71	110	96
Female	74	93	99	87	58	60	59	98	84

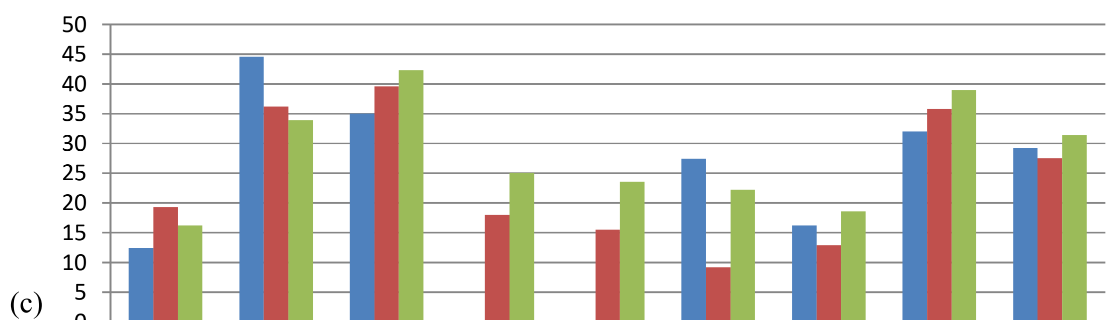
Appendix 17a-c: Distribution of U5MRs by Child's Sex across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	0	81	67	0	0	0	12	64	48
20-34	29	63	71	8	43	17	30	59	46
35-49	97	114	70	32	25	33	39	87	65



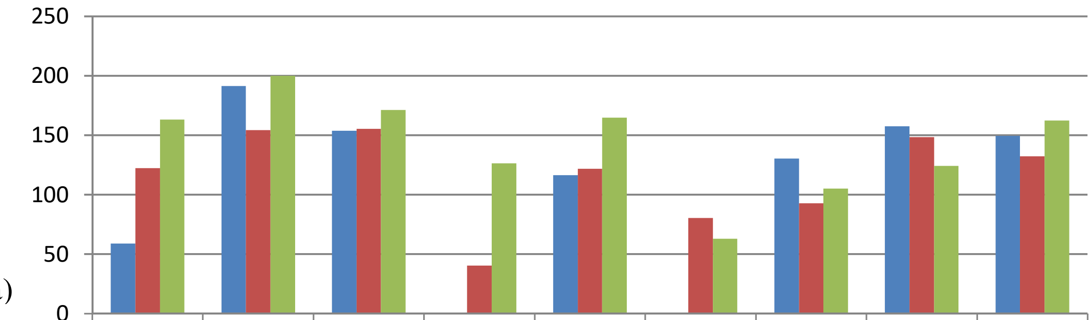
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	26	28	25	17	8	21	26	23	24
20-34	35	49	64	34	31	13	24	50	42
35-49	36	71	79	35	33	21	31	60	52



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	12	45	35	0	0	27	16	32	29
20-34	19	36	40	18	16	9	13	36	28
35-49	16	34	42	25	24	22	19	39	31

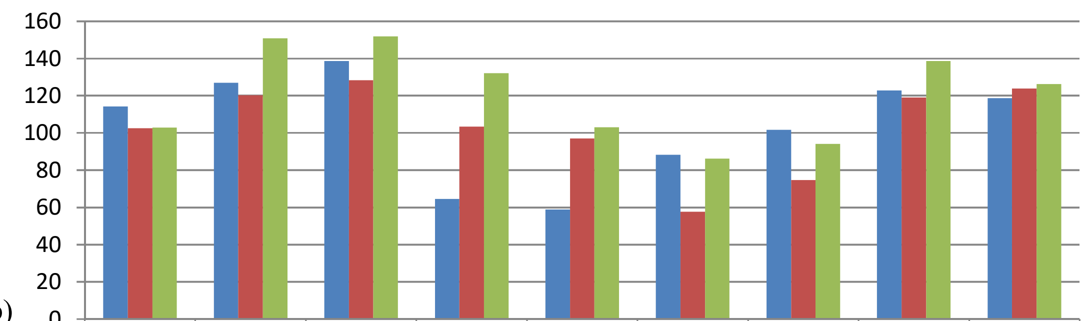
Appendix 18a-c: Distribution of CMRs by Mother's age group across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

(a)



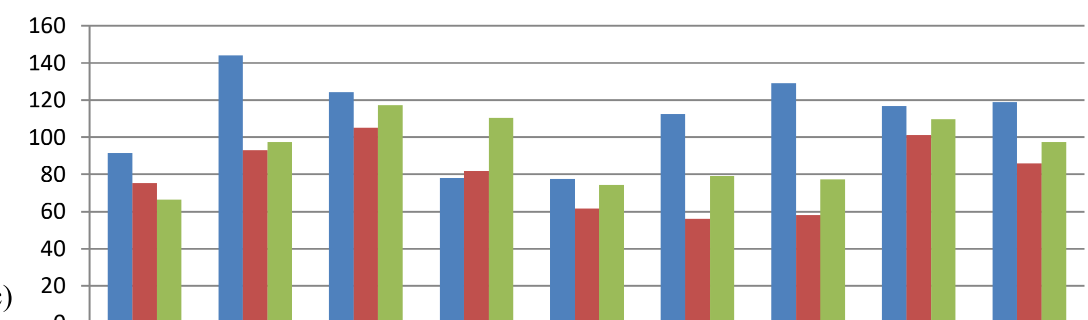
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	59	192	154	0	116	0	130	158	150
20-34	122	154	155	41	122	80	93	149	132
35-49	163	200	171	126	165	63	105	124	162

(b)



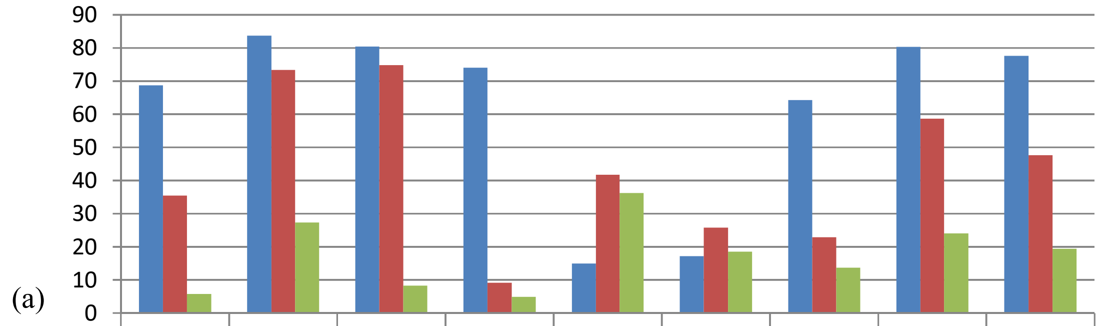
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	114	127	139	65	59	88	102	123	119
20-34	102	120	128	104	97	58	75	119	124
35-49	103	151	152	132	103	86	94	139	126

(c)

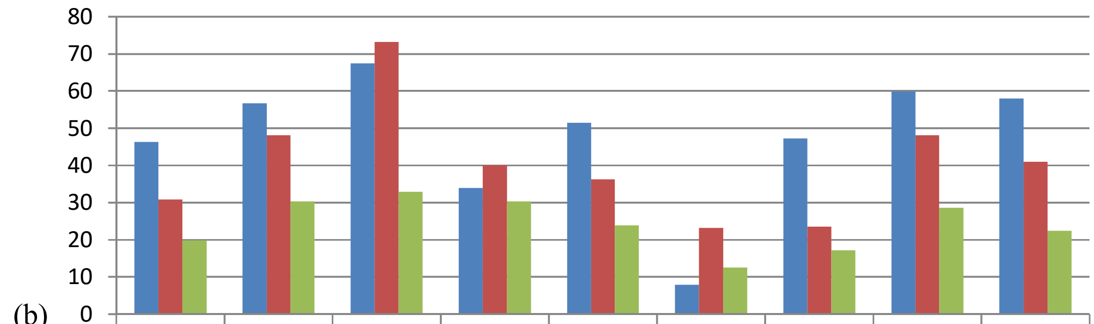


	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
15-19	91	144	124	78	78	113	129	117	119
20-34	75	93	105	82	62	56	58	101	86
35-49	67	97	117	111	74	79	77	110	98

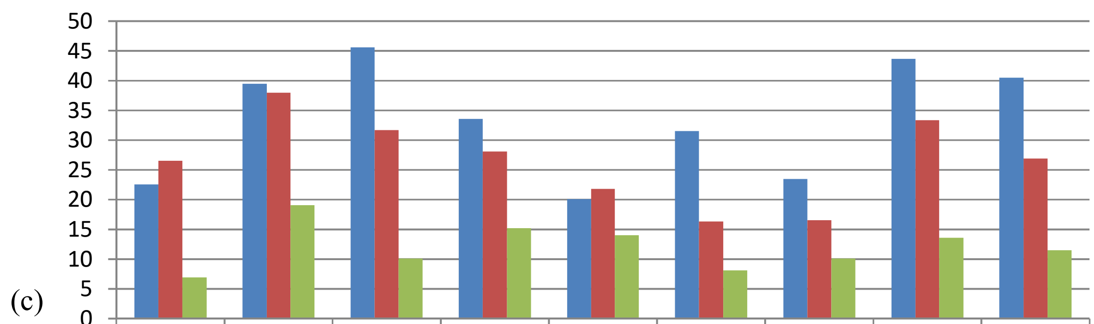
Appendix 19a-c: Distribution of U5MRs by Mother's age group across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	69	84	81	74	15	17	64	80	78
Primary	36	73	75	9	42	26	23	59	48
Higher	6	27	8	5	36	19	14	24	19

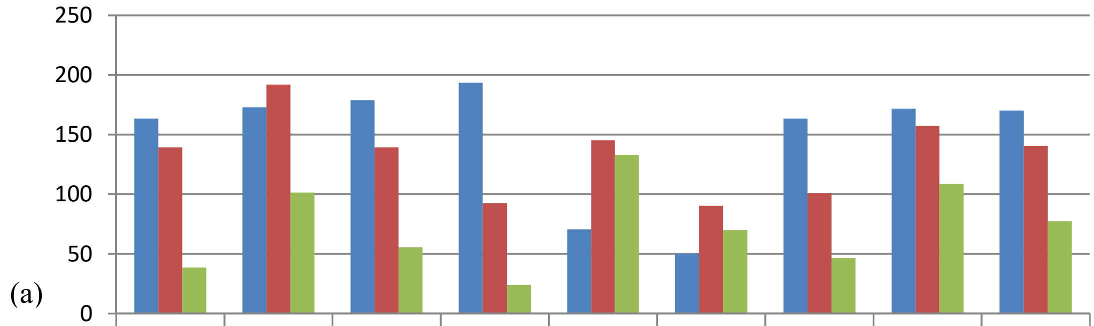


	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	46	57	68	34	52	8	47	60	58
Primary	31	48	73	40	36	23	24	48	41
Higher	20	30	33	30	24	13	17	29	22

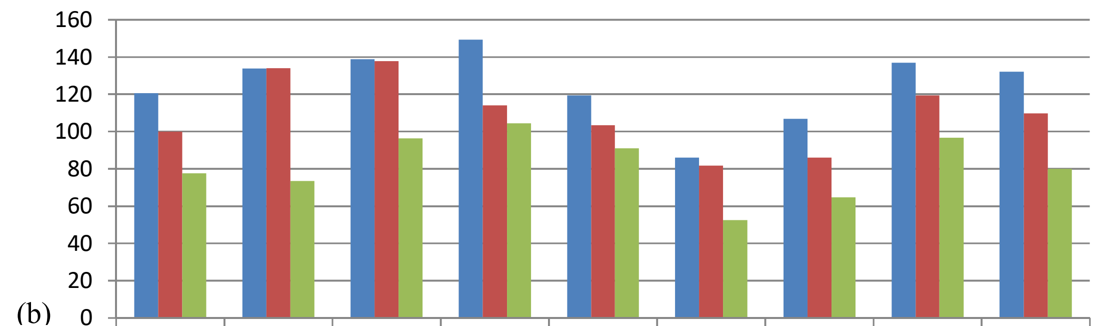


	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	23	40	46	34	20	32	24	44	41
Primary	27	38	32	28	22	16	17	33	27
Higher	7	19	10	15	14	8	10	14	12

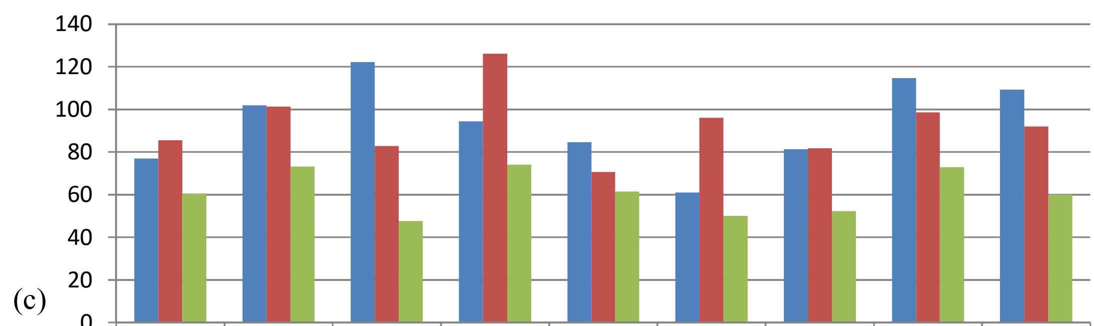
Appendix 20a-c: Distribution of CMRs by Mother's educational level across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	164	173	179	194	70	50	163	172	170
Primary	139	192	139	92	145	90	101	157	141
Higher	39	101	55	24	133	70	46	109	78



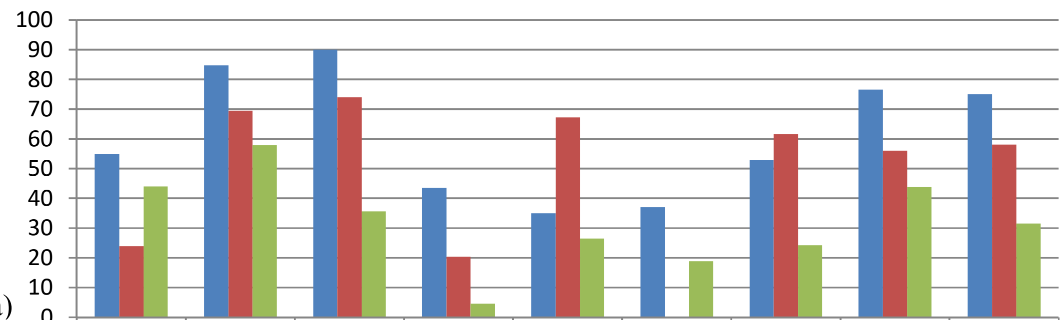
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	121	134	139	149	120	86	107	137	132
Primary	100	134	138	114	104	82	86	119	110
Higher	78	74	96	104	91	53	65	97	80



	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
No Edu	77	102	122	95	85	61	81	115	109
Primary	86	101	83	126	71	96	82	99	92
Higher	61	73	48	74	62	50	52	73	60

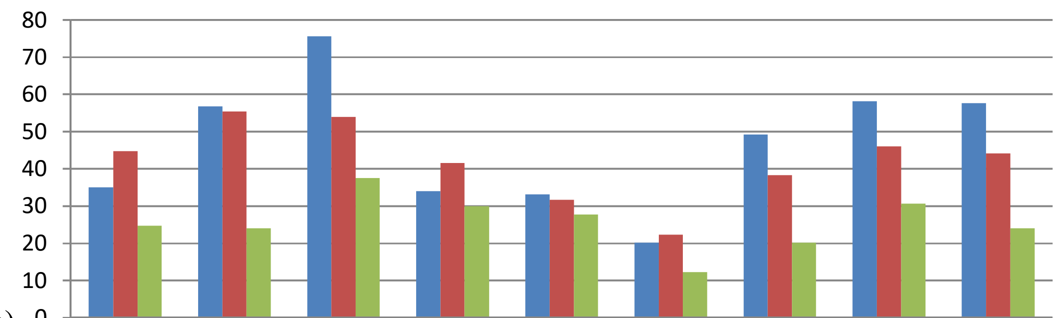
Appendix 21a-c: Distribution of U5MRs by Mother's educational level across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

(a)



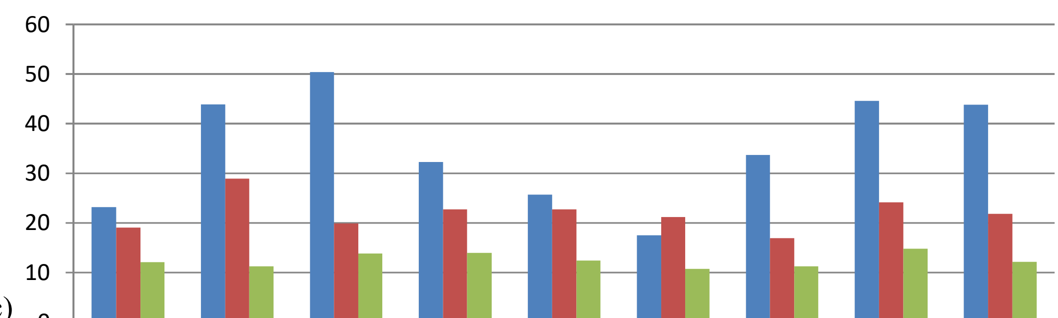
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	55	85	90	44	35	37	53	77	75
Middle	24	70	74	20	67	0	62	56	58
Rich	44	58	36	5	27	19	24	44	32

(b)



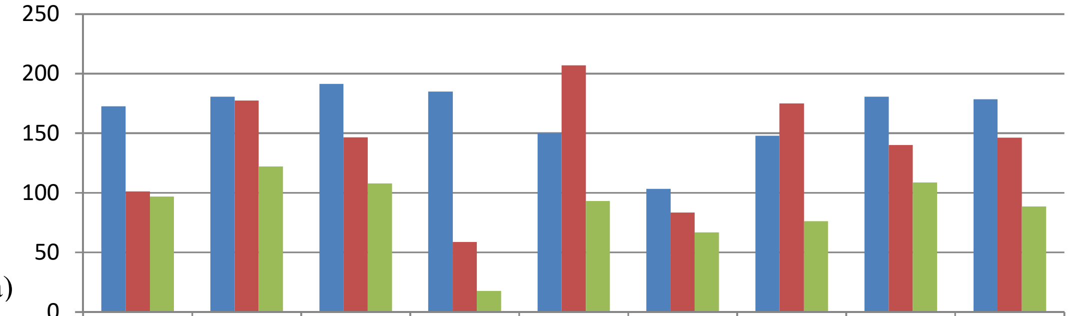
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	35	57	76	34	33	20	49	58	58
Middle	45	55	54	42	32	22	38	46	44
Rich	25	24	38	30	28	12	20	31	24

(c)



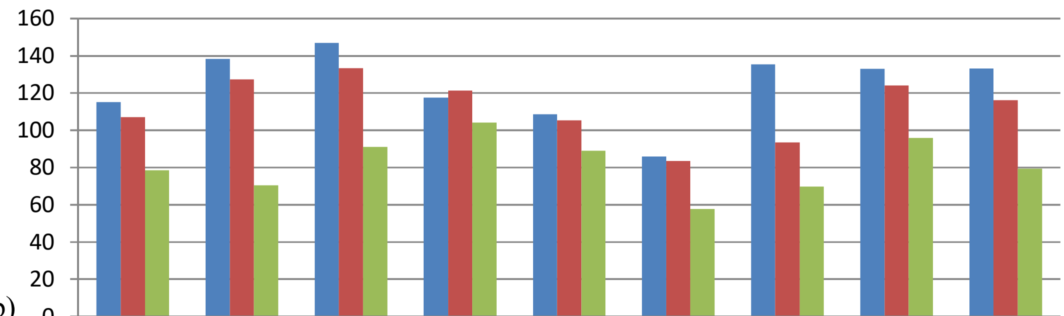
	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	23	44	50	32	26	18	34	45	44
Middle	19	29	20	23	23	21	17	24	22
Rich	12	11	14	14	12	11	11	15	12

Appendix 22a-c: Distribution of CMRs by Wealth Index across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively



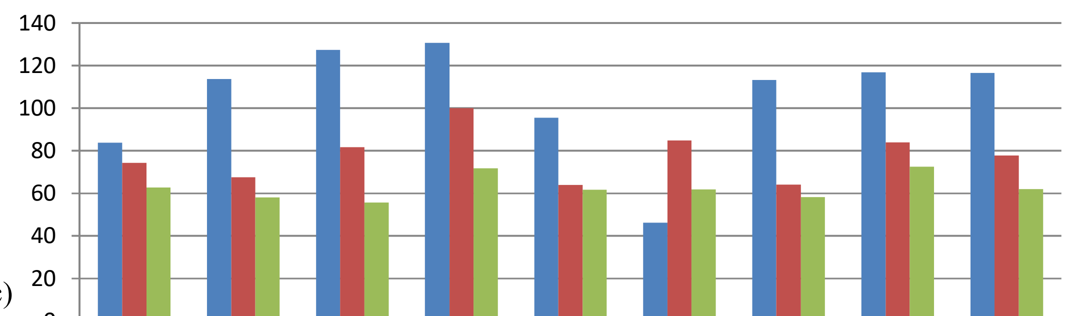
(a)

	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	173	181	191	185	150	103	148	181	179
Middle	101	178	147	59	207	83	175	140	146
Rich	97	122	108	18	93	67	76	109	89



(b)

	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	115	138	147	118	109	86	135	133	133
Middle	107	127	133	121	105	84	93	124	116
Rich	79	71	91	104	89	58	70	96	79



(c)

	NC	NE	NW	SE	SS	SW	URBAN	RURAL	National
Poor	84	114	127	131	96	46	113	117	117
Middle	74	68	82	100	64	85	64	84	78
Rich	63	58	56	72	62	62	58	73	62

Appendix 23a-c: Distribution of U5MRs by Wealth Index across regions and by place of residence in Nigeria for (a) 2003, (b) 2008 and (c) 2013, respectively

Appendix 24

Global Moran's I values for Child Mortality Rates in Nigeria.				
Year	Moran's I	Z scores	P value	Remark
2003	0.397221	4.02	0.000	Clustered
2008	0.555644	5.46	0.000	Clustered
2013	0.534281	5.28	0.000	Clustered
All index values are significant at the 0.01 significance level.				
Global Moran's I values for Under 5 Mortality Rates in Nigeria.				
Year	Moran's I	Z scores	P value	Remark
2003	0.278265	2.86	0.004	Clustered
2008	0.412345	4.13	0.000	Clustered
2013	0.374421	3.80	0.000	Clustered
All index values are significant at the 0.01 significance level. Calculated by Author				

Appendix 25: Local Moran's I values for CMRs by states in Nigeria

Year	State	LmiIndex	LmiZscore	LmiPvalue	COType
2003	Abia	0.816615	2.51	0.012	Low-Low
	Yobe	2.83852	6.16	0.000	High-High
	Jigawa	1.71386	3.74	0.000	High-High
	Gombe	0.803842	2.03	0.043	High-High
	Sokoto	1.63932	2.46	0.014	High-High
2008	Oyo	1.7912	3.30	0.000	Low-Low
	Katsina	1.71102	3.70	0.000	High-High
	Zamfara	0.966564	2.40	0.016	High-High
	Ogun	1.43876	3.12	0.002	Low-Low
	Osun	1.25408	3.10	0.002	Low-Low
	Kano	2.36508	5.09	0.000	High-High
	Jigawa	2.3245	5.01	0.000	High-High
	Bauchi	0.929221	2.82	0.005	High-High
2013	Kebbi	1.09212	2.04	0.041	High-High
	Sokoto	2.92055	4.33	0.000	High-High
	Zamfara	1.13771	2.82	0.005	High-High
	Katsina	1.30923	2.86	0.004	High-High
	Kano	0.952095	2.09	0.036	High-High
	Jigawa	2.74682	5.92	0.000	High-High
	Bauchi	1.12874	3.42	0.001	High-High
	Yobe	1.53023	3.33	0.001	High-High
	Gombe	0.877992	2.20	0.028	High-High

Note: only states with statistically significant index values ($p<0.05$) are shown above (Calculated by Author)

Appendix 26: Local Moran's I values for U5MRsby states in Nigeria

Year	State	LmiIndex	LmiZscore	LmiPvalue	COType
2003	Oyo	1.37613	2.55	0.011	Low-Low
	Kwara	0.787965	1.97	0.049	Low-Low
	Imo	1.30928	2.42	0.015	Low-Low
	Anambra	0.804759	2.45	0.014	Low-Low
	Ebonyi	-1.03092	-2.13	0.033	High-Low
2008	Kano	1.35826	2.96	0.003	High-High
	Kwara	1.46148	3.61	0.000	Low-Low
	Oyo	2.08781	3.85	0.000	Low-Low
	Ogun	1.16166	2.54	0.011	Low-Low
	Osun	2.59119	6.34	0.000	Low-Low
	Ekiti	1.42772	3.11	0.002	Low-Low
	Ondo	0.986216	2.73	0.006	Low-Low
2013	Osun	0.830943	2.09	0.037	Low-Low
	Kebbi	1.72737	3.21	0.001	High-High
	Sokoto	3.25583	4.84	0.000	High-High
	Jigawa	1.4622	3.19	0.001	High-High
	Bauchi	0.751766	2.31	0.021	High-High
	Kaduna	-0.6591	-2.04	0.042	Low-High
Note: only states with statistically significant index values ($p<0.05$) are shown above (Calculated by Author)					

Appendix 27a-b

Gi* Statistic values for CMR in Nigeria, 2003			
State	GiZscore	GiPvalue	Remark
Abia	-2.276420	0.023	Cold Spots
Osun	-1.888320	0.059	
Anambra	-1.824760	0.068	
Imo	-1.830250	0.067	
Ebonyi	-1.729810	0.083	
Zamfara	1.716420	0.086	Hot Spots
Kebbi	2.200490	0.028	
Sokoto	2.321860	0.020	
Katsina	2.090470	0.037	
Bauchi	2.185010	0.029	
Gombe	1.999380	0.046	
Borno	2.127470	0.033	
Jigawa	2.581270	0.010	
Yobe	3.443490	0.000	
Gi* Statistic values for U5MR in Nigeria, 2003			
State	GiZscore	GiPvalue	Remark
Oyo	-2.212550	0.027	Cold Spots
Osun	-2.006530	0.045	
Anambra	-2.029030	0.042	
Imo	-2.108450	0.035	
Kwara	-1.794570	0.073	
Kogi	-1.687600	0.091	
Abia	-1.819620	0.069	
Katsina	1.735340	0.083	Hot Spots
Bauchi	1.674940	0.094	
Gombe	1.918230	0.055	
Borno	1.665510	0.096	
Bayelsa	1.724490	0.085	
Yobe	2.082060	0.037	
Calculated by Author			

Appendix 28a-b

Gi* Statistic values for CMR in Nigeria, 2008			
State	GiZscore	GiPvalue	Remark
Oyo	-2.774790	0.006	Cold Spots
Ogun	-2.756710	0.006	
Osun	-2.798500	0.005	
Ondo	-2.226790	0.026	
Lagos	-1.850250	0.064	
Ekiti	-1.836060	0.066	
Gombe	1.852910	0.064	Hot Spots
Sokoto	1.903460	0.057	
Kaduna	2.069290	0.039	
Yobe	2.306860	0.021	
Kebbi	2.586630	0.010	
Zamfara	2.998910	0.003	
Katsina	3.057920	0.002	
Kano	3.251740	0.001	
Jigawa	3.421330	0.001	
Bauchi	2.614510	0.009	
Gi* Statistic values for U5MR in Nigeria, 2008			
State	GiZscore	GiPvalue	Remark
Oyo	-3.265440	0.001	Cold Spots
Ogun	-3.243700	0.001	
Osun	-3.729840	0.000	
Ekiti	-3.356620	0.001	
Kwara	-2.503010	0.012	
Ondo	-2.513570	0.012	
Kogi	-1.959180	0.050	
Kebbi	1.902720	0.057	Hot Spots
Bauchi	1.838920	0.066	
Gombe	1.895650	0.058	
Zamfara	2.075190	0.038	
Katsina	1.982840	0.047	
Kano	2.273210	0.023	
Jigawa	2.176420	0.030	
Calculated by Author			

Appendix 29a-b

Gi* Statistic values for CMR in Nigeria, 2013			
State	GiZscore	GiPvalue	Remark
Ondo	-2.090630	0.037	Cold Spots
Kwara	-1.864700	0.062	
Ogun	-1.691930	0.091	
Osun	-1.864700	0.062	
Ekiti	-1.691930	0.091	
Kogi	-1.880220	0.060	
Anambra	-1.869730	0.062	
Rivers	-1.831250	0.067	
Kebbi	2.377570	0.017	Hot Spots
Zamfara	2.146930	0.032	
Katsina	2.534330	0.011	
Kano	2.567350	0.010	
Bauchi	2.325490	0.020	
Gombe	2.024440	0.043	
Sokoto	2.979650	0.003	
Jigawa	3.590900	0.000	
Yobe	3.161670	0.002	
Gi* Statistic values for U5MR in Nigeria, 2013			
State	GiZscore	GiPvalue	Remark
Kwara	-2.364370	0.018	Cold Spots
Ondo	-2.347650	0.019	
Oyo	-1.864690	0.062	
Ogun	-1.729480	0.084	
Osun	-1.895780	0.058	
Ekiti	-1.816590	0.069	
Abuja	-1.781740	0.075	
Kogi	-1.832070	0.067	
Zamfara	1.739870	0.082	Hot Spots
Katsina	1.946550	0.052	
Bauchi	1.903530	0.057	
Yobe	1.859440	0.063	
Taraba	1.697440	0.090	
Jigawa	2.399520	0.016	
Sokoto	3.422210	0.001	
Kebbi	2.662000	0.008	
Calculated by Author			

Descriptives (a)								
IMR								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2003	37	81.918	44.5646	7.3264	67.060	96.777	.0	189.5
2008	37	69.402	18.6750	3.0702	63.175	75.628	30.4	105.9
2013	37	60.566	17.7918	2.9250	54.633	66.498	27.1	107.6
Total	111	70.629	30.7431	2.9180	64.846	76.411	.0	189.5

ANOVA (b)					
IMR					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8518.390	2	4259.195	4.819	.010
Within Groups	95447.069	108	883.769		
Total	103965.459	110			

Multiple Comparisons (c)						
IMR Tukey HSD						
(I) SAMPLE	(J) SAMPLE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2003	2008	12.5164	6.9117	.171	-3.909	28.942
	2013	21.3527*	6.9117	.007	4.927	37.778
2008	2003	-12.5164	6.9117	.171	-28.942	3.909
	2013	8.8363	6.9117	.410	-7.589	25.262
2013	2003	-21.3527*	6.9117	.007	-37.778	-4.927
	2008	-8.8363	6.9117	.410	-25.262	7.589

*. The mean difference is significant at the 0.05 level.

Measures of Association (d)		
	Eta	Eta Squared
IMR * SAMPLE	.286	.082

Appendix 30a-d: Analysis of Variance (ANOVA) of Infant Mortality Rates in Nigeria

Appendix 31: Analysis of Variance of Infant Mortality Rates by selected variables in Nigeria.

2003 NDHS							
Variables	BSS	WSS	TSS	SB	SW	F	Sig. Level
Wealth Index	36801.39	750716.58	787517.97	18400.69	6951.07	2.647	.075
Child's Sex	613.09	238713.93	239327.02	613.09	3315.47	0.185	.668
Mother's Education	11801.43	649150.15	660951.58	5900.71	6010.65	0.982	.378
Mother's Age	2615.57	725428.70	728044.28	1307.78	6716.93	0.195	.823
2008 NDHS							
Wealth Index	6522.12	67163.65	73685.78	3261.06	621.88	5.244	.007* (Eta^2=.089)
Child's Sex	3129.10	33523.94	36653.04	3129.10	465.61	6.720	.012* (Eta^2=.085)
Mother's Education	6193.27	113834.54	120027.82	3096.63	1054.02	2.938	.057
Mother's Age	5642.05	194688.61	200330.67	2821.02	1802.67	1.565	.214
2013 NDHS							
Wealth Index	2412.59	87448.67	89861.26	1206.30	809.71	1.490	.230
Child's Sex	1502.10	28414.65	29916.76	1502.10	394.64	3.806	.055
Mother's Education	5620.75	124823.81	130444.57	2810.37	1155.77	2.432	.093
Mother's Age	7748.52	189221.20	196969.72	3874.26	1752.04	2.211	.114

*Significant variation at 95% level of significance
BSS (Between sum of squares), WSS (Within sum of squares), TSS (Total sum of squares),
SB (Between mean square), SW (within mean square)
Calculated by Author

Runs Test (a)	
	IMR
Test Value[a]	104
Cases < Test Value	13
Cases >= Test Value	13
Total Cases	26
Number of Runs	2
Z	-4.604
Asymp. Sig. (2-tailed)	.000
a. Median	

Correlations (b)			
		Year	IMR
Year	Pearson Correlation	1	-.989**
	Sig. (1-tailed)		.000
	N	26	26
IMR	Pearson Correlation	-.989**	1
	Sig. (1-tailed)	.000	
	N	26	26
**Correlation is significant at the 0.01 level (1-tailed).			

Model Summary[b](c)									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.989[a]	.977	.977	3.010	.977	1039.952	1	24	.000
a. Predictors: (Constant), Year									
b. Dependent Variable: IMR									

Appendix 32a-c: Trend Analysis, (a) Run's Test, (b) Correlation and (c) Regression Results (World Bank IMR, 1964-2015)

Appendix 33: Global Moran's I values for % Changes in IMR in Nigeria.

% Change	Moran's I	Z scores	P value	Remark
2003-2008	0.034725	0.99	0.323	Random
2008-2013	-0.097348	-0.66	0.511	Random
2003-2013	0.091089	1.67	0.095	Clustered*
* Significant at the 0.10 significance level. Calculated by Author				

Appendix 34: Local Moran's I values for % Changes in IMR in Nigeria

Year	State	LmiIndex	LmiZscore	LmiPvalue	COType
2003-2013	Imo	1.53188	3.94	0.000	High-High

Note: only states with statistically significant index values ($p<0.05$) are shown above.
No statistically significant Local Clusters for 2003-2008 and 2008-2013.
Calculated by Author

Descriptives (a)								
CMR								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2003	37	47.031	36.2906	5.9661	34.931	59.131	.0	133.3
2008	37	37.672	19.9067	3.2726	31.035	44.309	9.6	81.7
2013	37	23.604	14.6231	2.4040	18.729	28.480	4.7	55.3
Total	111	36.102	26.9116	2.5543	31.040	41.164	.0	133.3

ANOVA (b)					
CMR					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10289.402	2	5144.701	8.009	.001
Within Groups	69376.345	108	642.374		
Total	79665.747	110			

Multiple Comparisons (c)						
CMR Tukey HSD						
(I) SAMPLE	(J) SAMPLE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2003	2008	9.3589	5.8926	.255	-4.645	23.362
	2013	23.4263*	5.8926	.000	9.423	37.430
2008	2003	-9.3589	5.8926	.255	-23.362	4.645
	2013	14.0675*	5.8926	.049	.064	28.071
2013	2003	-23.4263*	5.8926	.000	-37.430	-9.423
	2008	-14.0675*	5.8926	.049	-28.071	-.064
*. The mean difference is significant at the 0.05 level.						

Measures of Association (d)		
	Eta	Eta Squared
CMR * SAMPLE	.359	.129

Appendix 35: Analysis of Variance (ANOVA) of Child Mortality Rates in Nigeria

Appendix 36: Analysis of Variance of Child Mortality Rates by selected variables in Nigeria.

2003 NDHS							
Variables	BSS	WSS	TSS	SB	SW	F	Sig. Level
Wealth Index	5757.48	423769.36	429526.84	2878.74	3923.79	0.734	.483
Child's Sex	177.16	156048.50	156225.67	177.16	2167.34	0.082	.776
Mother's Education	33130.16	266210.11	299340.27	16565.08	2464.90	6.720	.002* (Eta^2=.111)
Mother's Age	34525.68	309247.96	343773.64	17262.84	2863.40	6.029	.003* (Eta^2=.100)
2008 NDHS							
Wealth Index	7173.84	57133.41	64307.25	3586.92	529.01	6.780	.002* (Eta^2=.112)
Child's Sex	29.22	31344.74	31373.96	29.22	435.34	0.067	.796
Mother's Education	6672.35	67760.73	74433.09	3336.17	627.41	5.317	.006* (Eta^2=.090)
Mother's Age	12140.22	67787.06	79927.29	6070.11	627.65	9.671	.000* (Eta^2=.152)
2013 NDHS							
Wealth Index	5434.57	26159.24	31593.81	2717.28	242.21	11.218	.000* (Eta^2=.172)
Child's Sex	40.28	17710.56	17750.85	40.28	245.98	0.164	.687
Mother's Education	5927.27	38787.04	44714.31	2963.63	359.13	8.252	.000* (Eta^2=.133)
Mother's Age	1199.80	46539.92	47739.72	599.90	430.92	1.392	.253

*Significant variation at 95% level of significance
BSS (Between sum of squares), WSS (Within sum of squares), TSS (Total sum of squares), SB (Between mean square), SW (within mean square)
Calculated by Author

Descriptives (a)								
U5MR								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2003	37	127.653	61.1161	10.0474	107.276	148.030	17.7	238.9
2008	37	104.213	29.8993	4.9154	94.244	114.182	42.6	163.0
2013	37	82.915	27.6288	4.5421	73.703	92.127	40.9	156.3
Total	111	104.927	45.8442	4.3513	96.303	113.550	17.7	238.9

ANOVA (b)					
U5MR					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	37055.644	2	18527.822	10.308	.000
Within Groups	194130.004	108	1797.500		
Total	231185.648	110			

Multiple Comparisons (c)						
U5MR Tukey HSD						
(I) SAMPLE	(J) SAMPLE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2003	2008	23.4400*	9.8571	.050	.015	46.865
	2013	44.7379*	9.8571	.000	21.313	68.163
2008	2003	-23.4400*	9.8571	.050	-46.865	-.015
	2013	21.2979	9.8571	.083	-2.127	44.723
2013	2003	-44.7379*	9.8571	.000	-68.163	-21.313
	2008	-21.2979	9.8571	.083	-44.723	2.127

*. The mean difference is significant at the 0.05 level.

Measures of Association (d)		
	Eta	Eta Squared
U5MR * SAMPLE	.400	.160

Appendix 37: Analysis of Variance (ANOVA) of Under 5 Mortality Rates in Nigeria

Appendix 38: Analysis of Variance of Under 5 Mortality Rates by selected variables in Nigeria.

Variables	BSS	WSS	TSS	SB	SW	F	Sig. Level
2003 NDHS							
Wealth Index	41495.72	1089173.37	1130669.09	20747.86	10084.93	2.057	.133
Child's Sex	769.96	356424.85	357194.82	769.96	4950.34	0.156	.694
Mother's Education	66825.95	844305.99	911131.95	33412.98	7817.64	4.274	.016* (Eta^2=.073)
Mother's Age	58267.17	964482.66	1022749.83	29133.58	8930.39	3.262	.042* (Eta^2=.057)
2008 NDHS							
Wealth Index	23811.20	112205.04	136016.24	11905.60	1038.93	11.459	.000* (Eta^2=.175)
Child's Sex	2988.94	75009.88	77998.83	2988.94	1041.80	2.869	.095
Mother's Education	23691.94	182590.29	206282.24	11845.97	1690.65	7.007	.001* (Eta^2=.115)
Mother's Age	6587.22	270931.38	277518.61	3293.61	2508.62	1.313	.273
2013 NDHS							
Wealth Index	11646.34	131094.94	142741.28	5823.17	1213.84	4.797	.010* (Eta^2=.082)
Child's Sex	2016.59	64011.75	66028.35	2016.59	889.05	2.268	.136
Mother's Education	20880.35	160761.69	181642.05	10440.18	1488.53	7.014	.001* (Eta^2=.115)
Mother's Age	4582.60	291332.54	295915.15	2291.30	2697.52	0.849	.431

*Significant variation at 95% level of significance
BSS (Between sum of squares), WSS (Within sum of squares), TSS (Total sum of squares), SB (Between mean square), SW (within mean square)
Calculated by Author

Runs Test (a)	
	U5MR
Test Value[a]	173
Cases < Test Value	13
Cases >= Test Value	13
Total Cases	26
Number of Runs	2
Z	-4.604
Asymp. Sig. (2-tailed)	.000
a. Median	

Correlations (b)			
		U5MR	Year
U5MR	Pearson Correlation	1	-.989**
	Sig. (1-tailed)		.000
	N	26	26
Year	Pearson Correlation	-.989**	1
	Sig. (1-tailed)	.000	
	N	26	26
** Correlation is significant at the 0.01 level (1-tailed).			

Model Summary[b] (c)									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.989[a]	.977	.976	5.564	.977	1035.270	1	24	.000
a. Predictors: (Constant), Year									
b. Dependent Variable: U5MR									

Appendix 39a-c: Trend Analysis, (a) Run's Test, (b) Correlation and (c) Regression Results (World Bank U5MR, 1964-2015)

Appendix 40: Global Moran's I values for % Changes in CMR in Nigeria.

% Change	Moran's I	Z scores	P value	Remark
2003-2008	-0.020420	0.08	0.939	Random
2008-2013	0.061580	0.89	0.374	Random
2003-2013	0.073968	0.99	0.319	Random
Calculated by Author				

Appendix 41: Local Moran's I values for % Changes in CMR in Nigeria

Year	State	LmiIndex	LmiZscore	LmiPvalue	COType
2008-2013	Oyo	1.82723	3.55	0.000	High-High
	Osun	-0.852536	-2.09	0.036	Low-High
2003-2013	Abia	0.759711	2.40	0.016	High-High
Note: only states with statistically significant index values (p<0.05) are shown above. No statistically significant Local Clusters for 2003-2008. (Calculated by Author)					

Appendix 42: Global Moran's I values for % Changes in U5MR in Nigeria (NDHS).

% Change	Moran's I	Z scores	P value	Remark
2003-2008	0.206240	3.18	0.001	Clustered*
2008-2013	-0.075507	-0.46	0.649	Random
2003-2013	0.186372	2.43	0.015	Clustered**

*Significant at the 0.01 significance level
**Significant at the 0.05 significance level
Calculated by Author

Appendix 43: Local Moran's I values for % Changes in U5MR in Nigeria (NDHS)

Year	State	LmiIndex	LmiZscore	LmiPvalue	COType
2003-2008	Anambra	1.28001	4.91	0.000	High-High
	Imo	4.20498	10.42	0.000	High-High
	Abia	0.969925	3.75	0.000	High-High
	Rivers	-0.633999	-2.11	0.035	Low-High
2008-2013	Zamfara	-0.852929	-2.03	0.043	High-Low
	Niger	-0.935425	-2.48	0.013	Low-High
2003-2013	Anambra	1.00011	3.46	0.001	High-High
	Imo	3.75405	8.08	0.000	High-High
	Abia	0.842837	2.93	0.003	High-High
Note: only states with statistically significant index values ($p<0.05$) are shown above. Calculated by Author					

Appendix 44a: Correlation Matrix (2003, NDHS)

		1	2	3	4	5	6	7	8	9	10	11	12
1	IMR	1											
2	CMR	.277	1										
3	U5MR	.831**	.741**	1									
4	Rural %	.342*	.495**	.500**	1								
5	% Male	.066	.135	.116	.095	1							
6	Less than 24 Months	.210	.163	.210	.050	-.307	1						
7	Less than 20 years old	.379*	.621**	.583**	.680**	.139	.062	1					
8	34 or older	-.019	-.068	-.072	-.016	-.159	-.175	-.146	1				
9	Prevalence of Diarrhea	.331*	.462**	.454**	.447**	.108	.242	.668**	-.056	1			
10	Religion Christianity	-.017	-.556**	-.308	-.179	-.087	-.033	-.531**	.026	-.575**	1		
11	Religion Islam	-.040	.545**	.264	.178	.086	.033	.528**	-.041	.569**	-.995**	1	
12	At Least Completed Sec. Sch	-.475**	-.561**	-.633**	-.582**	-.464**	.245	-.620**	-.059	-.540**	.491**	-.459**	1
13	% Poor	.642**	.503**	.696**	.566**	.101	.049	.557**	-.046	.437**	-.202	.169	-.666**
14	Birth Size (Small)	.057	.240	.139	.174	.106	-.068	.235	.257	.346*	-.128	.107	-.345*
15	6 Months or More	-.601**	-.349*	-.641**	-.154	.143	-.146	-.242	-.006	-.145	-.024	.071	.206
16	Access to Improved Water	-.303	-.350*	-.420**	-.494**	-.238	.220	-.607**	.053	-.426**	.242	-.251	.623**
17	Access to Improved Sanitation	-.433**	-.410*	-.547**	-.620**	-.236	.320	-.542**	-.015	-.424**	.381*	-.358*	.767**
18	4 or more ANCVisits	-.390*	-.735**	-.658**	-.707**	-.028	-.188	-.831**	.100	-.662**	.536**	-.527**	.675**
19	PAB (At least 1)	-.344*	-.691**	-.586**	-.650**	-.104	-.116	-.849**	.131	-.601**	.659**	-.657**	.652**
20	Fully Immunized	-.324	-.640**	-.581**	-.527**	-.183	-.071	-.784**	.229	-.419**	.548**	-.534**	.581**
21	Health Care Delivery	-.508**	-.726**	-.729**	-.638**	-.117	-.108	-.879**	.149	-.663**	.623**	-.605**	.740**
22	Did not sleep under ITN	-.190	-.199	-.244	-.286	-.149	-.009	-.196	-.123	.001	-.082	.107	.322
23	Full Knowledge of MTCT	-.296	-.005	-.193	.058	-.150	-.037	.142	.185	.076	-.098	.110	.045
24	Cooking Fuel	.473**	.526**	.587**	.750**	.241	.031	.763**	-.049	.619**	-.401*	.377*	-.776**

Note: N=37, *p< .05; **p< .01 (Calculated by Author)

Appendix 44b: Correlation Matrix (2003, NDHS)

		13	14	15	16	17	18	19	20	21	22	23	24
1	IMR												
2	CMR												
3	U5MR												
4	Rural %												
5	% Male												
6	Less than 24 Months												
7	Less than 20 years old												
8	34 or older												
9	Prevalence of Diarrhea												
10	Religion Christianity												
11	Religion Islam												
12	At Least Completed Sec Sch												
13	% Poor	1											
14	Birth Size (Small)	.278	1										
15	6 Months or More	-.438**	.012	1									
16	Access to Improved Water	-.606**	-.167	.278	1								
17	Access to Improved Sanitation	-.688**	-.167	.300	.737**	1							
18	4 or more ANC Visits	-.718**	-.394*	.268	.524**	.603**	1						
19	PAB (At least 1)	-.673**	-.310	.157	.494**	.576**	.920**	1					
20	Fully Immunized	-.639**	-.080	.239	.616**	.600**	.699**	.776**	1				
21	Health Care Delivery	-.720**	-.249	.313	.558**	.658**	.904**	.919**	.811**	1			
22	Did not sleep under ITN	-.428**	-.253	.198	.202	.242	.298	.266	.313	.321	1		
23	Full Knowledge of MTCT	-.355*	.094	.060	-.007	.036	-.040	.007	.022	-.030	-.019	1	
24	Cooking Fuel	.721**	.320	-.135	-.612**	-.763**	-.746**	-.719**	-.729**	-.812**	-.324	.001	1

Note: N=37, *p< .05; **p< .01 (Calculated by Author)

Appendix 45a: Correlation Matrix (2008, NDHS)

		1	2	3	4	5	6	7	8	9	10	11	12
1	IMR	1											
2	CMR	.306	1										
3	U5MR	.802**	.814**	1									
4	Rural %	.382*	.445**	.513**	1								
5	% Male	-.258	-.017	-.177	.058	1							
6	Less than 24 Months	.523**	.351*	.542**	-.015	-.177	1						
7	Less than 20 years old	.198	.718**	.572**	.628**	-.014	-.037	1					
8	34 or older	.001	-.289	-.179	-.399*	-.030	.378*	-.674**	1				
9	Prevalence of Diarrhea	.196	.600**	.497**	.316	-.126	.076	.688**	-.411*	1			
10	Religion Christianity	.101	-.607**	-.314	-.260	.030	.161	-.735**	.581**	-.659**	1		
11	Religion Islam	-.110	.618**	.316	.255	-.033	-.161	.734**	-.568**	.663**	-.996**	1	
12	At Least Completed Sec Sch	-.223	-.628**	-.533**	-.674**	.114	.133	-.894**	.656**	-.618**	.688**	-.671**	1
13	% Poor	.201	.641**	.526**	.665**	-.060	-.111	.876**	-.632**	.707**	-.691**	.676**	-.907**
14	Birth Size (Small)	.071	.366*	.272	.177	-.009	.047	.415*	-.231	.486**	-.486**	.483**	-.461**
15	6 Months or More	-.540**	-.083	-.384*	.025	.105	-.443**	.076	-.241	.018	-.427**	.421**	-.107
16	Access to Improved Water	-.319	-.407*	-.449**	-.564**	-.077	.150	-.673**	.437**	-.469**	.269	-.272	.634**
17	Access to Improved Sanitation	.011	.155	.105	-.359*	-.260	.410*	-.259	.320	-.058	-.046	.065	.314
18	4 or more ANC Visits	-.356*	-.688**	-.648**	-.734**	-.043	-.225	-.810**	.482**	-.557**	.588**	-.579**	.734**
19	PAB (At least 1)	-.160	-.736**	-.560**	-.610**	.058	-.012	-.880**	.572**	-.657**	.796**	-.787**	.848**
20	Fully Immunized	-.341*	-.697**	-.646**	-.702**	.178	-.097	-.860**	.488**	-.689**	.694**	-.694**	.862**
21	Health Care Delivery	-.240	-.711**	-.595**	-.650**	.085	.021	-.899**	.591**	-.627**	.668**	-.661**	.867**
22	Did not sleep under ITN	-.108	-.091	-.130	-.238	-.083	-.075	-.127	.015	-.008	-.196	.212	.037
23	Full Knowledge of MTCT	.002	-.275	-.169	-.232	-.106	-.027	-.220	.135	-.386*	.325*	-.337*	.273
24	Cooking Fuel	.291	.564**	.529**	.778**	.084	.024	.734**	-.361*	.522**	-.476**	.463**	-.805**
Note: N=37, *p< .05; **p< .01 (Calculated by Author)													

Appendix 45b: Correlation Matrix (2008, NDHS)

		13	14	15	16	17	18	19	20	21	22	23	24
1	IMR												
2	CMR												
3	U5MR												
4	Rural %												
5	% Male												
6	Less than 24 Months												
7	Less than 20 years old												
8	34 or older												
9	Prevalence of Diarrhea in												
10	Religion Christianity												
11	Religion Islam												
12	At Least Completed Sec Sch												
13	% Poor	1											
14	Birth Size (Small)	.479**	1										
15	6 Months or More	.192	.015	1									
16	Access to Improved Water	-.658**	-.344*	.133	1								
17	Access to Improved Sanitation	-.341*	-.164	-.002	.391*	1							
18	4 or more ANC Visits	-.814**	-.496**	-.105	.497**	.179	1						
19	PAB (At least 1)	-.866**	-.580**	-.229	.490**	.103	.892**	1					
20	Fully Immunized	-.825**	-.497**	-.021	.500**	.144	.860**	.893**	1				
21	Health Care Delivery	-.876**	-.482**	-.095	.626**	.258	.819**	.905**	.842**	1			
22	Did not sleep under ITN	-.150	.005	.004	.282	.144	.169	.076	-.013	.100	1		
23	Full Knowledge of MTCT	-.247	-.360*	-.058	-.046	-.055	.249	.276	.362*	.109	-.052	1	
24	Cooking Fuel	.809**	.368*	.185	-.656**	-.339*	-.743**	-.692**	-.717**	-.688**	-.180	-.248	1

Note: N=37, *p< .05; **p< .01 (Calculated by Author)

Appendix 46a: Correlation Matrix (2013, NDHS)

		1	2	3	4	5	6	7	8	9	10	11	12
1	IMR	1											
2	CMR	.591**	1										
3	U5MR	.920**	.858**	1									
4	Rural %	.317	.529**	.451**	1								
5	% Male	.010	.061	.026	-.068	1							
6	Less than 24 Months	.415*	.236	.386*	.042	-.007	1						
7	Less than 20 years old	.343*	.799**	.600**	.708**	.023	.082	1					
8	34 or older	-.022	-.441**	-.229	-.359*	.082	.359*	-.650**	1				
9	Prevalence of Diarrhea	.287	.477**	.415*	.248	.083	.277	.447**	-.276	1			
10	Religion Christianity	-.193	-.679**	-.446**	-.367*	-.082	.099	-.696**	.600**	-.426**	1		
11	Religion Islam	.179	.673**	.435**	.361*	.087	-.096	.689**	-.596**	.423**	-.999**	1	
12	At Least Completed Sec Sch	-.368*	-.789**	-.606**	-.711**	-.002	.033	-.914**	.579**	-.468**	.716**	-.701**	1
13	% Poor	.556**	.853**	.761**	.627**	.047	.165	.854**	-.491**	.606**	-.722**	.709**	-.897**
14	Birth Size (Small)	.155	.306	.241	.253	-.193	.157	.390*	-.143	.484**	-.373*	.360*	-.445**
15	6 Months or More	.011	.469**	.228	.347*	-.073	-.228	.535**	-.458**	.216	-.753**	.752**	-.578**
16	Access to Improved Water	-.422**	-.436**	-.471**	-.560**	.103	-.109	-.585**	.360*	-.426**	.298	-.279	.624**
17	Access to Improved Sanitation	-.304	-.278	-.322	-.355*	.082	.130	-.263	.225	-.188	-.004	.017	.342*
18	4 or more ANC Visits	-.308	-.681**	-.521**	-.699**	.083	-.150	-.866**	.534**	-.358*	.601**	-.590**	.821**
19	PAB (At least 1)	-.344*	-.737**	-.569**	-.657**	.123	-.075	-.863**	.529**	-.339*	.731**	-.720**	.857**
20	Fully Immunized	-.358*	-.768**	-.596**	-.647**	.046	-.007	-.824**	.598**	-.440**	.798**	-.787**	.884**
21	Health Care Delivery	-.356*	-.746**	-.580**	-.746**	-.056	-.079	-.910**	.511**	-.419**	.687**	-.680**	.884**
22	Did not sleep under ITN	-.079	.074	-.019	.115	.209	-.054	.308	-.397*	.062	-.364*	.366*	-.201
23	Full Knowledge of MTCT	-.298	-.408*	-.383*	-.311	-.023	-.040	-.416*	.228	-.451**	.469**	-.464**	.456**
24	Solid Fuel Use	.407*	.694**	.592**	.690**	.034	.087	.736**	-.411*	.524**	-.593**	.581**	-.851**

Note: N=37, *p< .05; **p< .01 (Calculated by Author)

Appendix 46b: Correlation Matrix (2013, NDHS)

		13	14	15	16	17	18	19	20	21	22	23	24
1	IMR												
2	CMR												
3	U5MR												
4	Rural %												
5	% Male												
6	Less than 24 Months												
7	Less than 20 years old												
8	34 or older												
9	Prevalence of Diarrhea												
10	Religion Christianity												
11	Religion Islam												
12	At Least Completed Sec Sch												
13	% Poor	1											
14	Birth Size (Small)	.487**	1										
15	6 Months or More	.561**	.299	1									
16	Access to Improved Water	-.647**	-.484**	-.123	1								
17	Access to Improved Sanitation	-.281	-.057	.005	.527**	1							
18	4 or more ANC Visits	-.831**	-.500**	-.474**	.662**	.273	1						
19	PAB (At least 1)	-.862**	-.484**	-.606**	.635**	.209	.940**	1					
20	Fully Immunized	-.863**	-.414*	-.613**	.569**	.196	.795**	.873**	1				
21	Health Care Delivery	-.857**	-.478**	-.511**	.622**	.242	.925**	.909**	.811**	1			
22	Did not sleep under ITN	.198	-.010	.298	-.124	.113	-.263	-.266	-.301	-.283	1		
23	Full Knowledge of MTCT	-.473**	-.721**	-.316	.407*	.190	.414*	.434**	.415*	.509**	.037	1	
24	Solid Fuel Use	.831**	.362*	.544**	-.522**	-.372*	-.670**	-.674**	-.736**	-.713**	.095	-.387*	1

Note: N=37, *p< .05; **p< .01 (Calculated by Author)

Appendix 47: Regression Residuals for IMR

STATES	2003 NDHS			2008 NDHS			2013 NDHS		
	IMR	Predicted	Residuals	IMR	Predicted	Residuals	IMR	Predicted	Residuals
Abia	43.5	15.67926	27.82074	83.2	77.54637	5.65363	77.6	71.25481	6.34519
Abuja	0	15.35037	-15.35037	61.8	40.99718	20.80282	53.1	49.95417	3.14583
Adamawa	145.3	143.36279	1.93721	100.9	79.59544	21.30456	78.6	72.10635	6.49365
Akwa Ibom	67.4	84.14436	-16.74436	66.6	76.39506	-9.79506	55.7	45.59897	10.10103
Anambra	27.8	46.86238	-19.06238	50.3	75.98904	-25.68904	61.5	72.16761	-10.66761
Bauchi	89.4	96.64792	-7.24792	79.5	83.31092	-3.81092	80.6	82.77095	-2.17095
Bayelsa	100	135.16534	-35.16534	97.7	97.42571	0.27429	43.3	34.15139	9.14861
Benue	104	86.70514	17.29486	94.3	80.19699	14.10301	69	73.63454	-4.63454
Borno	108	93.66765	14.33235	87.9	77.83747	10.06253	27.1	51.89811	-24.79811
Cross River	64.5	82.73284	-18.23284	44.6	65.33144	-20.73144	41.7	55.72604	-14.02604
Delta	135	63.93924	71.06076	83.3	87.32079	-4.02079	59.5	58.42012	1.07988
Ebonyi	176.5	153.45346	23.04654	93	71.14743	21.85257	83.9	74.46094	9.43906
Edo	58.1	93.42911	-35.32911	74.3	56.82215	17.47785	29.9	52.53936	-22.63936
Ekiti	76.9	84.44957	-7.54957	49.9	52.17972	-2.27972	50.8	48.82823	1.97177
Enugu	62.5	70.58681	-8.08681	81.7	72.352	9.348	63.4	66.57125	-3.17125
Gombe	77.9	115.66586	-37.76586	61.6	67.7745	-6.1745	68	78.11146	-10.11146
Imo	8.8	49.84285	-41.04285	105.9	75.36706	30.53294	71.6	63.95817	7.64183
Jigawa	119.3	119.39486	-0.09486	55	63.08647	-8.08647	85.7	81.27496	4.42504
Kaduna	101.7	60.78229	40.91771	70.6	61.13042	9.46958	36.5	34.26215	2.23785
Kano	86.7	61.20669	25.49331	93.2	73.74261	19.45739	67.5	73.81707	-6.31707
Katsina	78.3	72.48479	5.81521	65.7	76.40199	-10.70199	49.3	72.58866	-23.28866
Kebbi	85.8	101.01137	-15.21137	62.3	66.39082	-4.09082	88.4	70.07531	18.32469
Kogi	63.2	76.96277	-13.76277	55.3	58.21933	-2.91933	37.9	37.19462	0.70538
Kwara	0	41.78843	-41.78843	33.3	56.84002	-23.54002	52.5	39.56105	12.93895
Lagos	52.1	46.19477	5.90523	51.3	57.88043	-6.58043	57.4	52.94487	4.45513
Nasarawa	189.5	113.94912	75.55088	61.3	57.98914	3.31086	59.5	49.26	10.24
Niger	76.2	69.5281	6.6719	79.4	94.55985	-15.15985	48.6	57.32669	-8.72669
Ogun	84.1	84.45444	-0.35444	69.8	65.24645	4.55355	53.5	52.31928	1.18072
Ondo	88.9	83.4005	5.4995	42.8	55.03463	-12.23463	64.1	60.19561	3.90439
Osun	35.7	47.6683	-11.9683	30.4	42.21196	-11.81196	36.4	43.29745	-6.89745
Oyo	9.9	49.67585	-39.77585	57.2	56.5646	0.6354	42	47.34815	-5.34815
Plateau	94	78.64118	15.35882	74.3	70.06617	4.23383	70.1	73.17048	-3.07048
Rivers	126.2	70.30081	55.89919	61.8	71.20434	-9.40434	58.2	53.82	4.38
Sokoto	76.6	129.29008	-52.69008	83.3	78.05526	5.24474	78.2	76.45758	1.74242
Taraba	136.8	108.05962	28.74038	79.4	77.2071	2.1929	74.1	74.26665	-0.16665
Yobe	57.1	66.96732	-9.86732	57.1	79.14163	-22.04163	58.3	58.00583	0.29417
Zamfara	122.9	117.15374	5.74626	67.4	68.83752	-1.43752	107.6	81.76111	25.83889
Calculated by Author									

Appendix 48

Global Moran's I values for IMR Residuals				
Year	Moran's I	Z scores	P value	Remark
2003	-0.021162	0.06	0.950	Random
2008	-0.061695	-0.32	0.750	Random
2013	-0.071694	-0.42	0.675	Random
Global Moran's I values for CMR Residuals				
2003	0.074383	0.96	0.338	Random
2008	-0.150824	-1.15	0.250	Random
2013	-0.007786	0.19	0.847	Random
Global Moran's I values for U5MR Residuals				
2003	0.005737	0.31	0.755	Random
2008	-0.089154	-0.58	0.562	Random
2013	-0.063986	-0.34	0.733	Random
Calculated by Author				

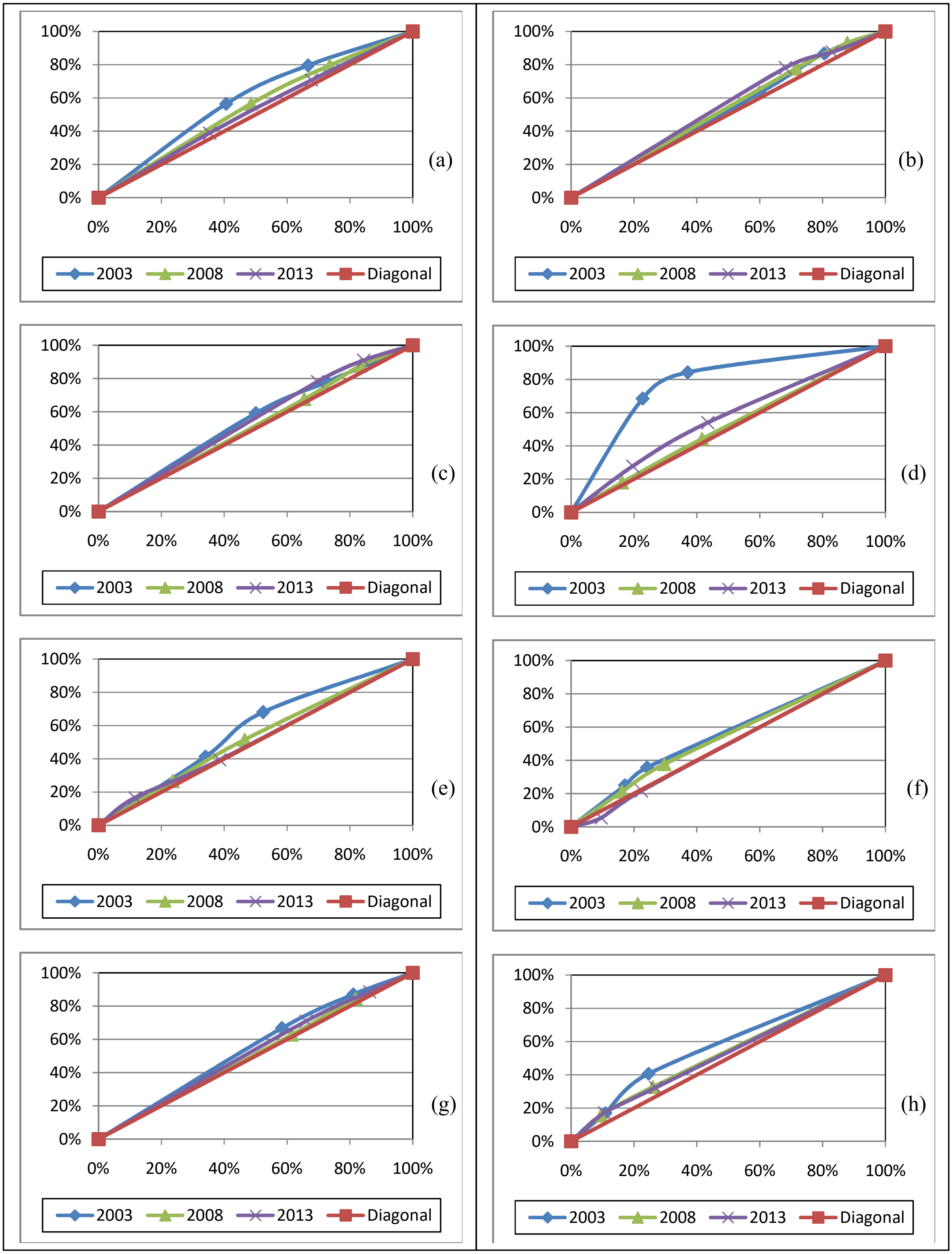
Appendix 49: Regression Residuals for CMR

STATES	2003 NDHS			2008 NDHS			2013 NDHS		
	CMR	Predicted	Residuals	CMR	Predicted	Residuals	CMR	Predicted	Residuals
Abia	0	11.65518	-11.65518	34	31.65149	2.34851	10.1	12.92358	-2.82358
Abuja	52.6	39.85761	12.74239	20.6	22.87082	-2.27082	10.2	11.61919	-1.41919
Adamawa	40	50.06053	-10.06053	55.4	43.275	12.125	21	30.59585	-9.59585
Akwa Ibom	30.1	41.30142	-11.20142	48.1	38.06795	10.03205	15.9	14.98534	0.91466
Anambra	0	42.45646	-42.45646	45	34.7876	10.2124	13.1	11.99789	1.10211
Bauchi	78.1	77.9742	0.1258	61.8	51.58947	10.21053	55.3	42.16698	13.13302
Bayelsa	111.1	84.13446	26.96554	31.8	39.05045	-7.25045	13.6	10.23066	3.36934
Benue	27.6	56.99082	-29.39082	22.1	36.1308	-14.0308	24.7	32.44723	-7.74723
Borno	68.8	58.53089	10.26911	44.1	65.21557	-21.11557	22.3	30.25923	-7.95923
Cross River	11.5	45.05532	-33.55532	18.7	22.55303	-3.85303	21.8	17.08918	4.71082
Delta	14.2	18.97048	-4.77048	23.5	31.15639	-7.65639	15.3	12.08204	3.21796
Ebonyi	47.6	42.64897	4.95103	30	35.52722	-5.52722	32.5	26.85101	5.64899
Edo	49.4	42.93773	6.46227	22.4	24.9301	-2.5301	15.4	13.04981	2.35019
Ekiti	27.8	11.94394	15.85606	27.6	12.99586	14.60414	5.3	8.96835	-3.66835
Enugu	16.7	43.80402	-27.10402	21.6	32.66636	-11.06636	15.5	15.7848	-0.2848
Gombe	91.5	60.74473	30.75527	51.7	40.12737	11.57263	43.8	36.52868	7.27132
Imo	8.9	7.90127	0.99873	29.1	36.82963	-7.72963	17.8	13.30227	4.49773
Jigawa	122.6	94.81865	27.78135	72.1	62.14172	9.95828	52.7	43.63966	9.06034
Kaduna	42.1	46.11412	-4.01412	46.6	41.57508	5.02492	8.7	25.29416	-16.59416
Kano	55.2	64.40238	-9.20238	77	54.06682	22.93318	36.2	34.46691	1.73309
Katsina	40.9	65.74994	-24.84994	64.9	67.94528	-3.04528	43.1	40.10521	2.99479
Kebbi	56.3	86.3483	-30.0483	39.9	63.60787	-23.70787	37.4	40.69429	-3.29429
Kogi	67.5	31.38725	36.11275	32.5	20.58471	11.91529	18.4	13.4285	4.9715
Kwara	0	27.05582	-27.05582	12.3	30.9251	-18.6251	15.8	10.77766	5.02234
Lagos	16.5	8.57505	7.92495	12.8	17.31602	-4.51602	6.6	8.75797	-2.15797
Nasarawa	39	50.44555	-11.44555	22.9	38.31805	-15.41805	25.8	19.86625	5.93375
Niger	58.3	54.96949	3.33051	72.4	53.92746	18.47254	16.8	23.31655	-6.51655
Ogun	20.4	12.71397	7.68603	12	18.84323	-6.84323	11.6	11.19843	0.40157
Ondo	24.4	29.65468	-5.25468	27.2	26.57144	0.62856	22.8	18.26733	4.53267
Osun	37	4.82114	32.17886	12.6	6.73162	5.86838	4.7	10.27273	-5.57273
Oyo	20	8.6713	11.3287	9.6	17.83204	-8.23204	20	17.4258	2.5742
Plateau	18.9	48.61672	-29.71672	26.2	21.6754	4.5246	10.8	34.50899	-23.70899
Rivers	53.5	28.40338	25.09662	33.5	35.53867	-2.03867	16.2	12.79735	3.40265
Sokoto	93.3	97.61002	-4.31002	81.7	60.70327	20.99673	52.4	41.24129	11.15871
Taraba	32.8	77.78169	-44.98169	42	38.24088	3.75912	25.7	37.91722	-12.21722
Yobe	133.3	75.18283	58.11717	53.9	53.03605	0.86395	40.1	44.18666	-4.08666
Zamfara	132.3	89.9097	42.3903	54.2	64.79418	-10.59418	54	44.35497	9.64503

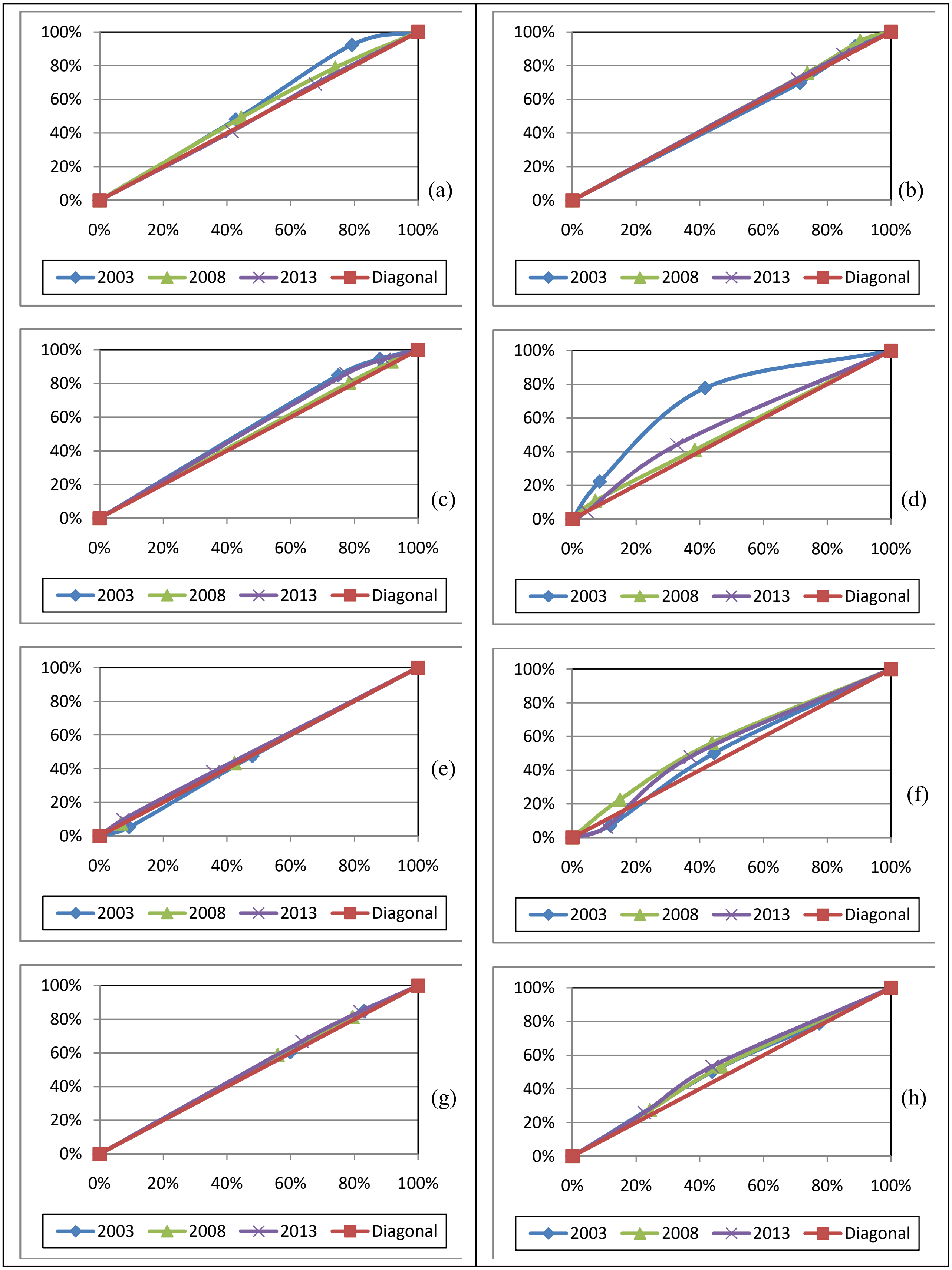
Calculated by Author

Appendix 50: Regression Residuals for U5MR

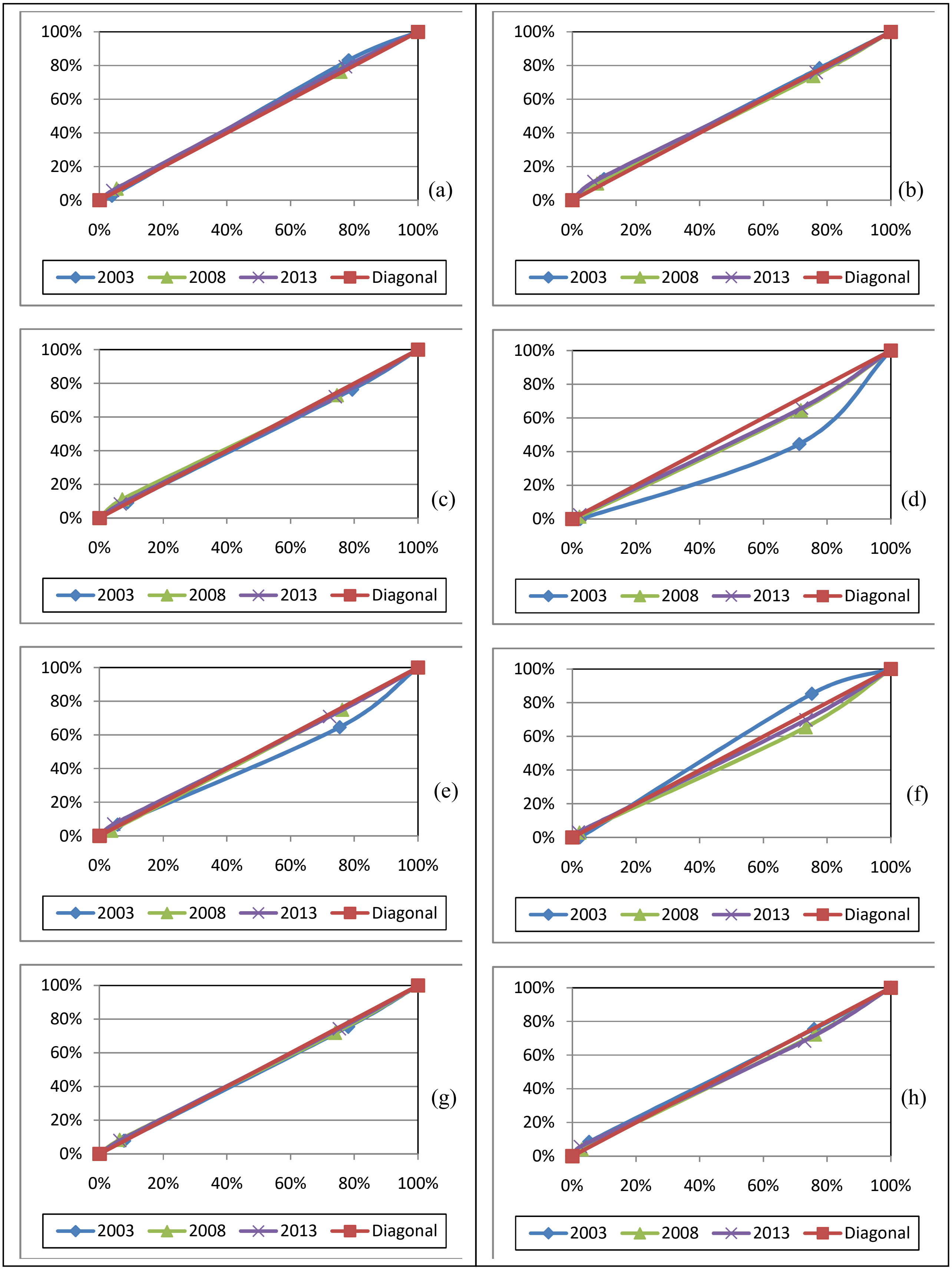
STATES	2003 NDHS			2008 NDHS			2013 NDHS		
	U5MR	Predicted	Residuals	U5MR	Predicted	Residuals	U5MR	Predicted	Residuals
Abia	43.5	-1.19989	44.69989	114.3	115.8124	-1.5124	87	84.56363	2.43637
Abuja	52.6	64.38407	-11.78407	81.1	55.64471	25.45529	62.8	61.73792	1.06208
Adamawa	188	200.92096	-12.92096	150.7	120.57556	30.12444	97.9	97.96219	-0.06219
Akwa Ibom	95.5	121.44818	-25.94818	113.1	117.04198	-3.94198	72.8	59.36181	13.43819
Anambra	27.8	62.44258	-34.64258	93	108.82843	-15.82843	73.8	77.6983	-3.8983
Bauchi	160.6	149.70101	10.89899	136.4	126.50759	9.89241	131.4	124.13536	7.26464
Bayelsa	233.3	201.83247	31.46753	126.4	115.65328	10.74672	56.3	45.74405	10.55595
Benue	128.7	113.32705	15.37295	114.4	120.02365	-5.62365	92	101.33858	-9.33858
Borno	169.7	174.04634	-4.34634	129.1	124.60794	4.49206	48.8	84.16163	-35.36163
Cross River	86	139.55237	-53.55237	62.5	93.68784	-31.18784	60.7	68.78268	-8.08268
Delta	147.2	105.2757	41.9243	104.9	123.57183	-18.67183	73.9	75.34797	-1.44797
Ebonyi	215.7	208.62311	7.07689	120.2	101.82046	18.37954	113.7	101.58386	12.11614
Edo	93	133.25416	-40.25416	95	86.58559	8.41441	44.9	58.83264	-13.93264
Ekiti	102.6	90.45681	12.14319	76.1	68.56992	7.53008	60.9	50.99121	9.90879
Enugu	78.1	61.12994	16.97006	101.5	103.27596	-1.77596	79.7	89.18235	-9.48235
Gombe	162.3	188.24094	-25.94094	110.1	114.49411	-4.39411	110.5	101.9217	8.5783
Imo	17.7	54.63153	-36.93153	130.3	131.51928	-1.21928	89.9	98.46868	-8.56868
Jigawa	227.3	187.41985	39.88015	123.1	100.33433	22.76567	134.5	123.13203	11.36797
Kaduna	139.5	132.33673	7.16327	114	101.8571	12.1429	44.9	56.7468	-11.8468
Kano	137.1	141.35529	-4.25529	163	133.17315	29.82685	101.3	100.31537	0.98463
Katsina	115.9	125.31704	-9.41704	126.3	139.08627	-12.78627	90.3	111.81354	-21.51354
Kebbi	137.3	185.40297	-48.10297	99.7	115.75779	-16.05779	122.5	103.20437	19.29563
Kogi	126.4	99.26757	27.13243	84	78.52117	5.47883	55.6	66.77464	-11.17464
Kwara	25	54.51032	-29.51032	42.8	79.5026	-36.7026	67.5	48.04673	19.45327
Lagos	67.7	83.49852	-15.79852	62.8	59.51661	3.28339	63.6	56.03489	7.56511
Nasarawa	221.1	181.66971	39.43029	82.8	97.06264	-14.26264	83.7	69.2841	14.4159
Niger	130	123.23014	6.76986	146	146.24582	-0.24582	64.6	79.46636	-14.86636
Ogun	93.5	122.84719	-29.34719	81	83.55522	-2.55522	64.5	57.36778	7.13222
Ondo	133.3	119.71255	13.58745	66.9	74.97805	-8.07805	85.4	79.49483	5.90517
Osun	107.1	76.04923	31.05077	42.6	46.79624	-4.19624	40.9	53.46562	-12.56562
Oyo	29.7	68.72132	-39.02132	66.2	66.7998	-0.5998	61.1	63.34476	-2.24476
Plateau	102.6	104.55529	-1.95529	98.5	102.23016	-3.73016	80.2	103.98898	-23.78898
Rivers	177.6	116.19371	61.40629	93.2	87.95413	5.24587	74.8	61.0006	13.7994
Sokoto	162.7	200.55587	-37.85587	159.7	144.26866	15.43134	126.5	113.35256	13.14744
Taraba	165.1	175.09009	-9.99009	118.1	112.00617	6.09383	96.6	107.14324	-10.54324
Yobe	182.9	139.71424	43.18576	107.9	132.802	-24.902	96	93.77394	2.22606
Zamfara	238.9	217.48504	21.41496	117.9	124.93157	-7.03157	156.3	138.23429	18.06571
Calculated by Author									



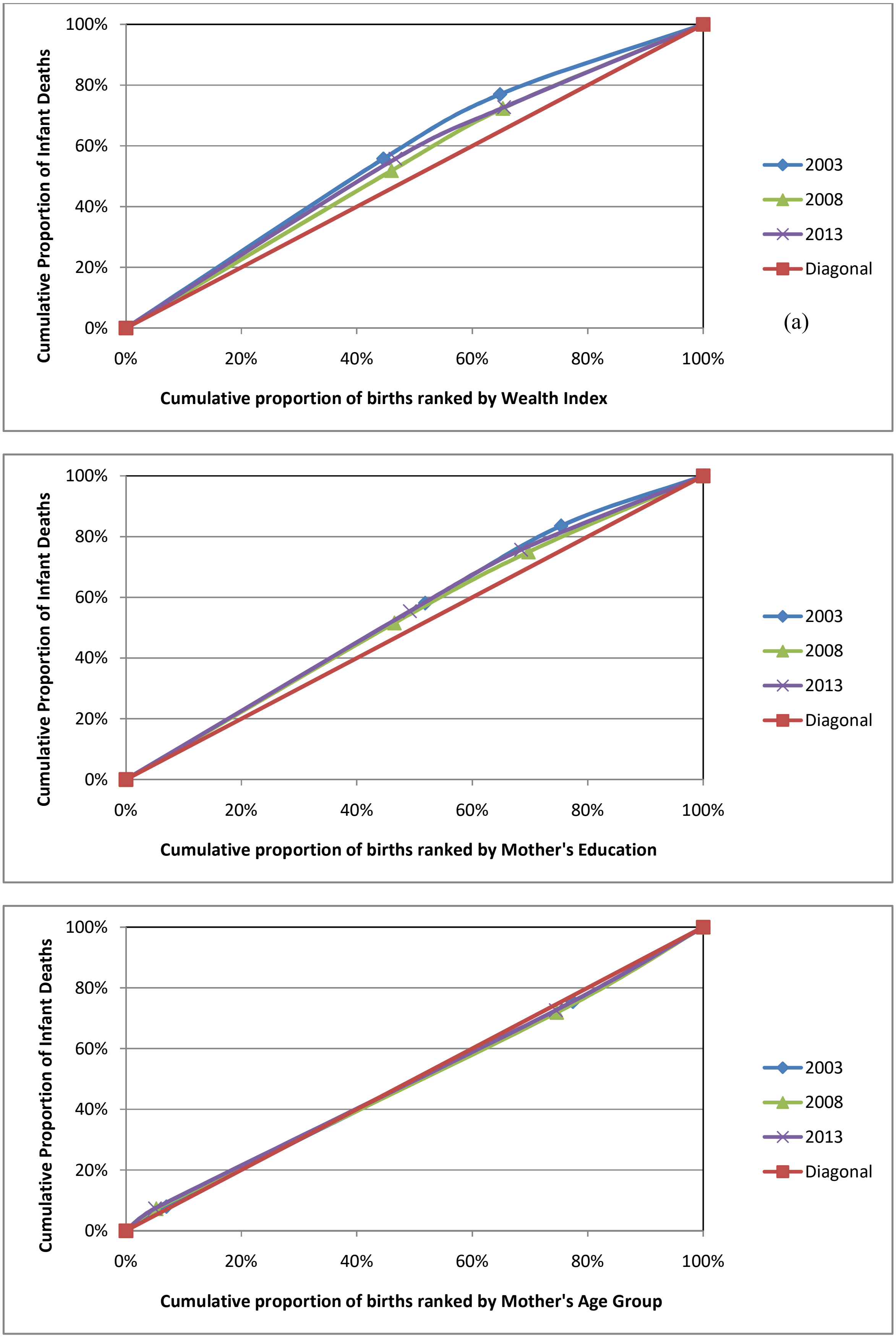
Appendix 51a-h: Concentration Curves for IMR by Wealth for (a) Northcentral, (b) Northeast, (c)Northwest,(d) Southeast, (e) Southsouth and (f) Southwest regions and for (g) rural and (h) urban areas respectively



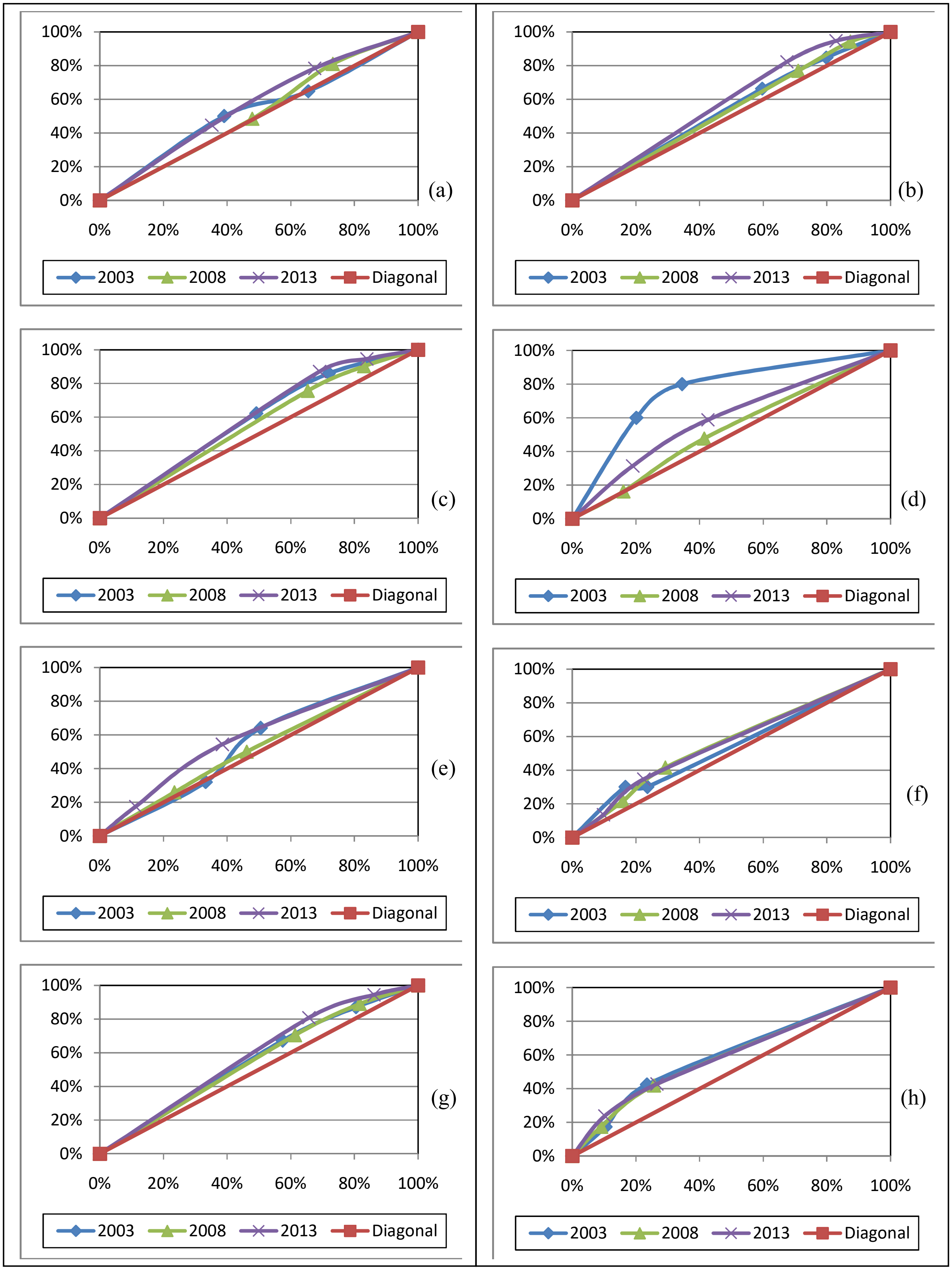
Appendix 52a-h: Concentration Curves for IMR by Mother's education for (a) Northcentral, (b)Northeast, (c) Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g)rural and (h) urban areas respectively



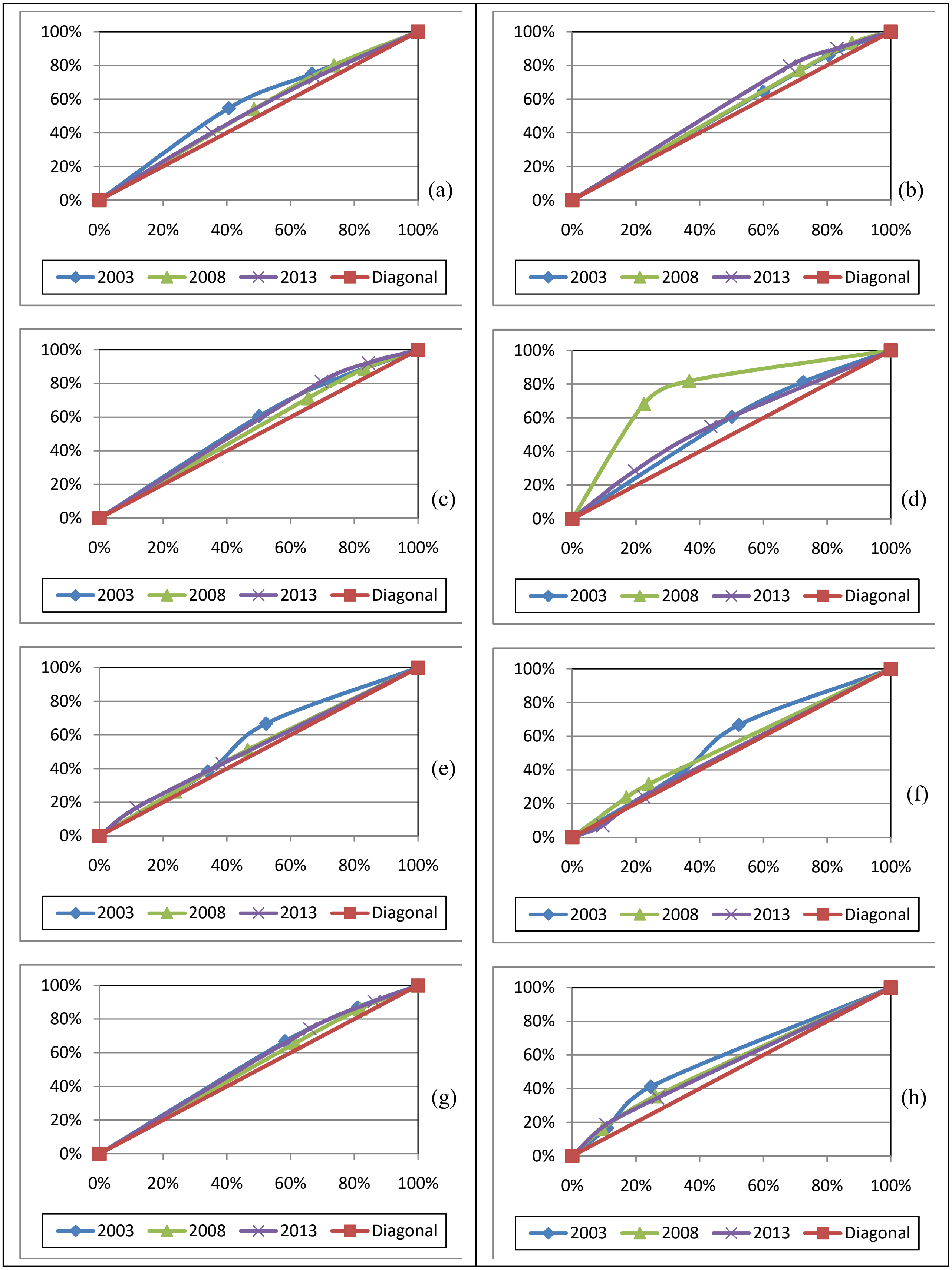
Appendix 53a-h: Concentration Curves for IMR by Mother's age for (a) Northcentral, (b)Northeast, (c) Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g) rural and (h)urban areas respectively



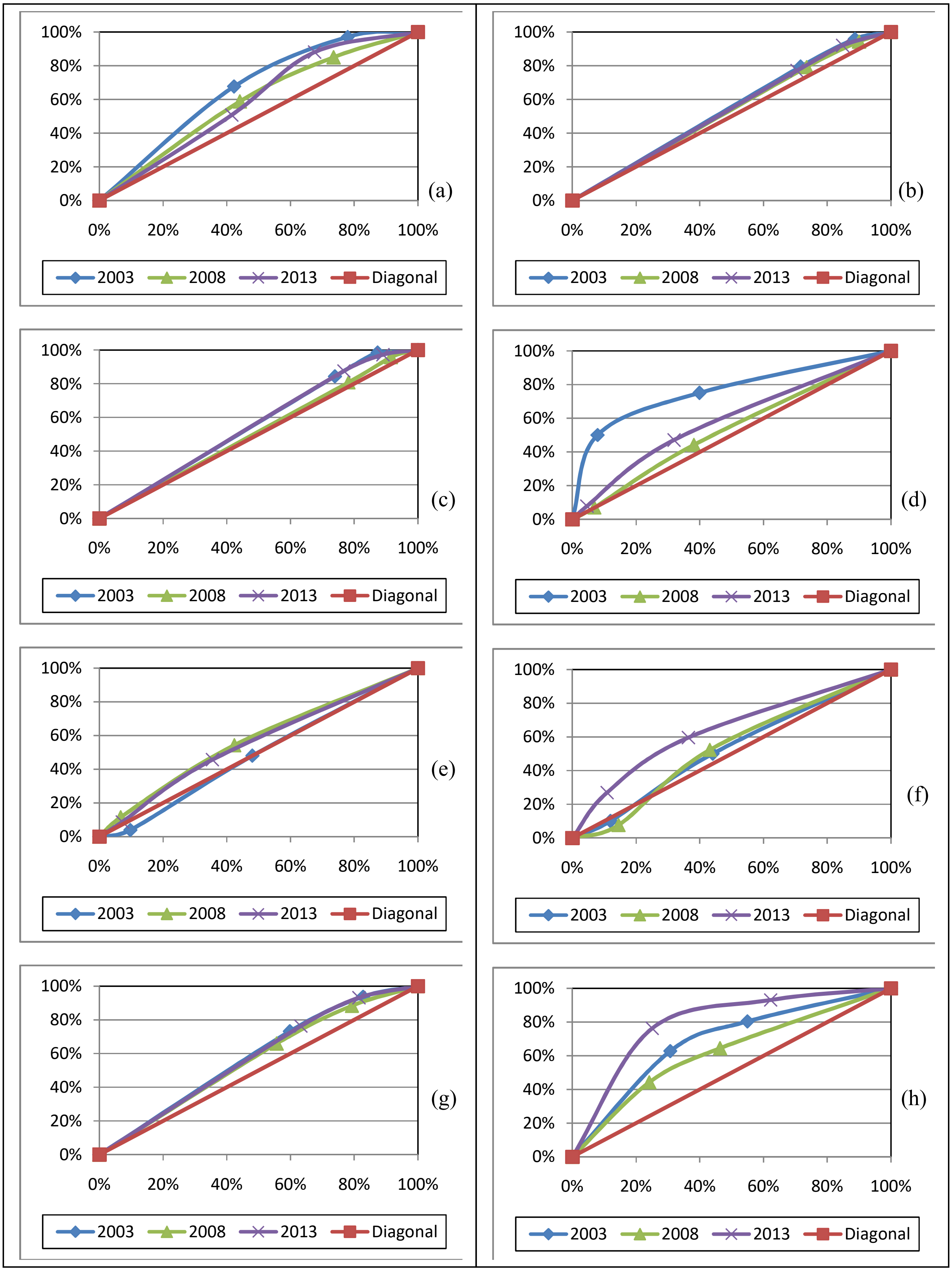
Appendix 54a-c: Concentration Curves for IMR by Wealth, Mother's education and Age



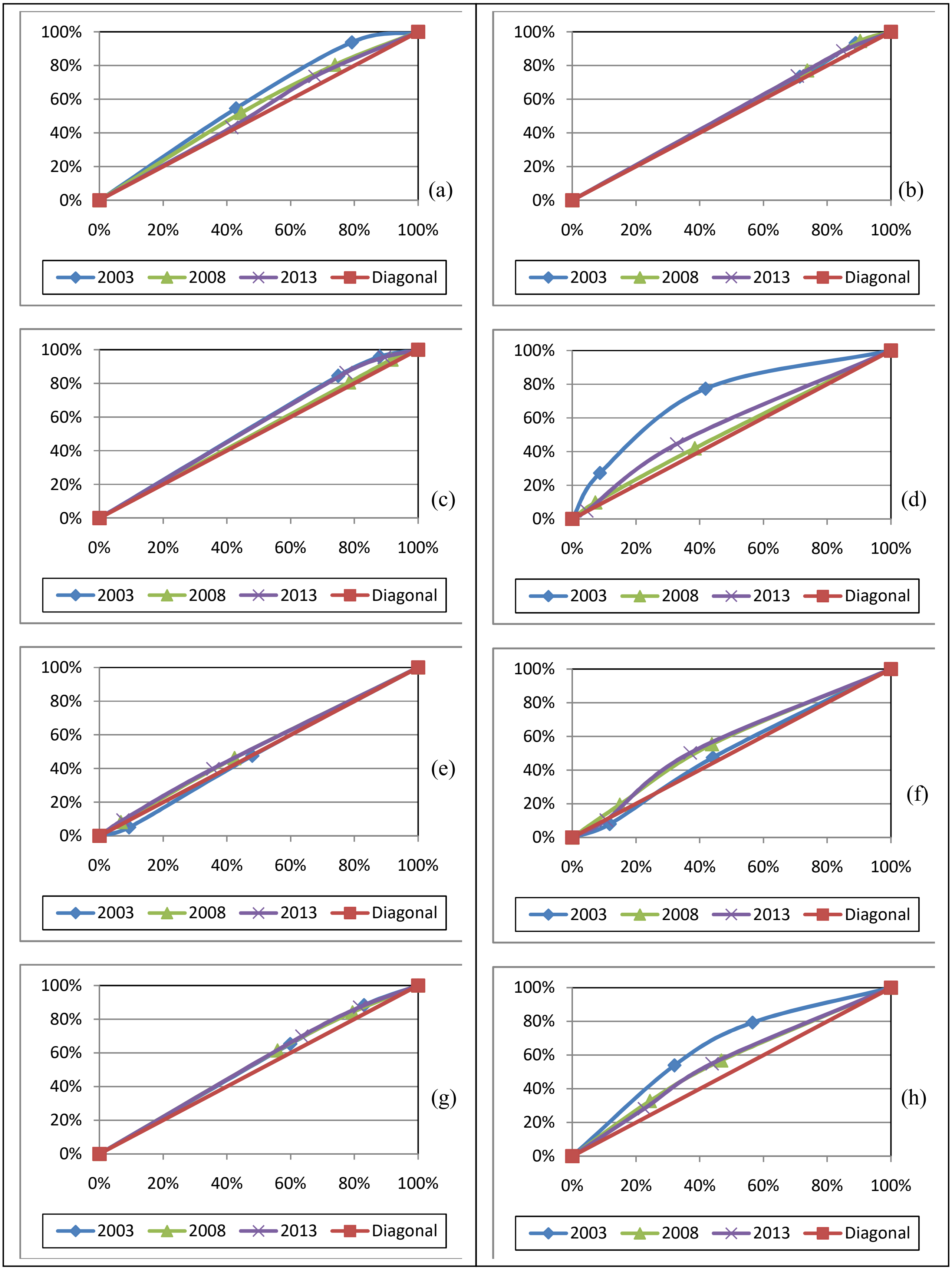
Appendix 55a-h: Concentration Curves for CMR by Wealth for (a) Northcentral, (b) Northeast, (c)Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g) rural and (h)urban areas respectively



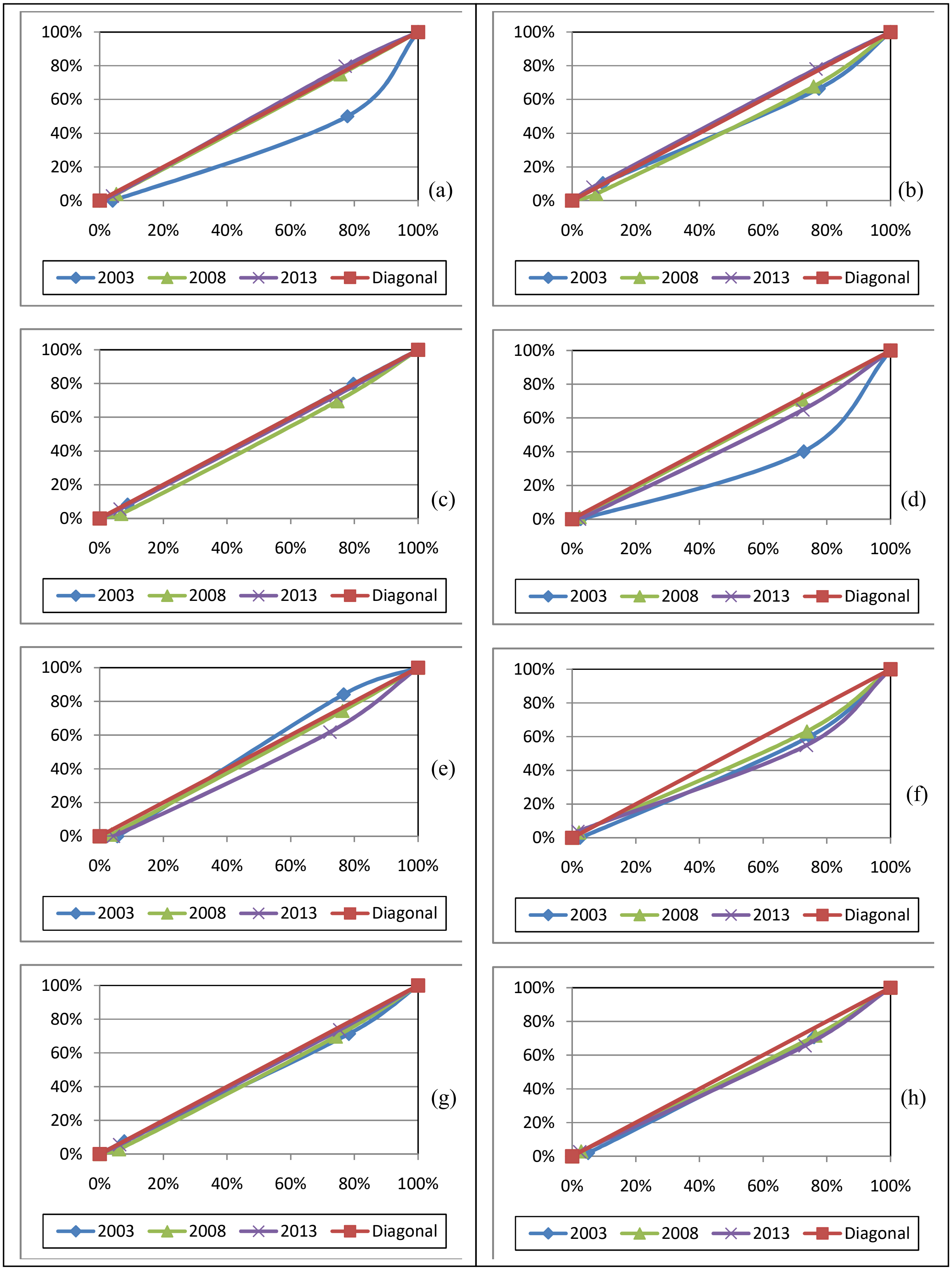
Appendix 56a-h: Concentration Curves for U5MR by Wealth for (a) Northcentral, (b) Northeast, (c) Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g) rural and (h)urban areas respectively



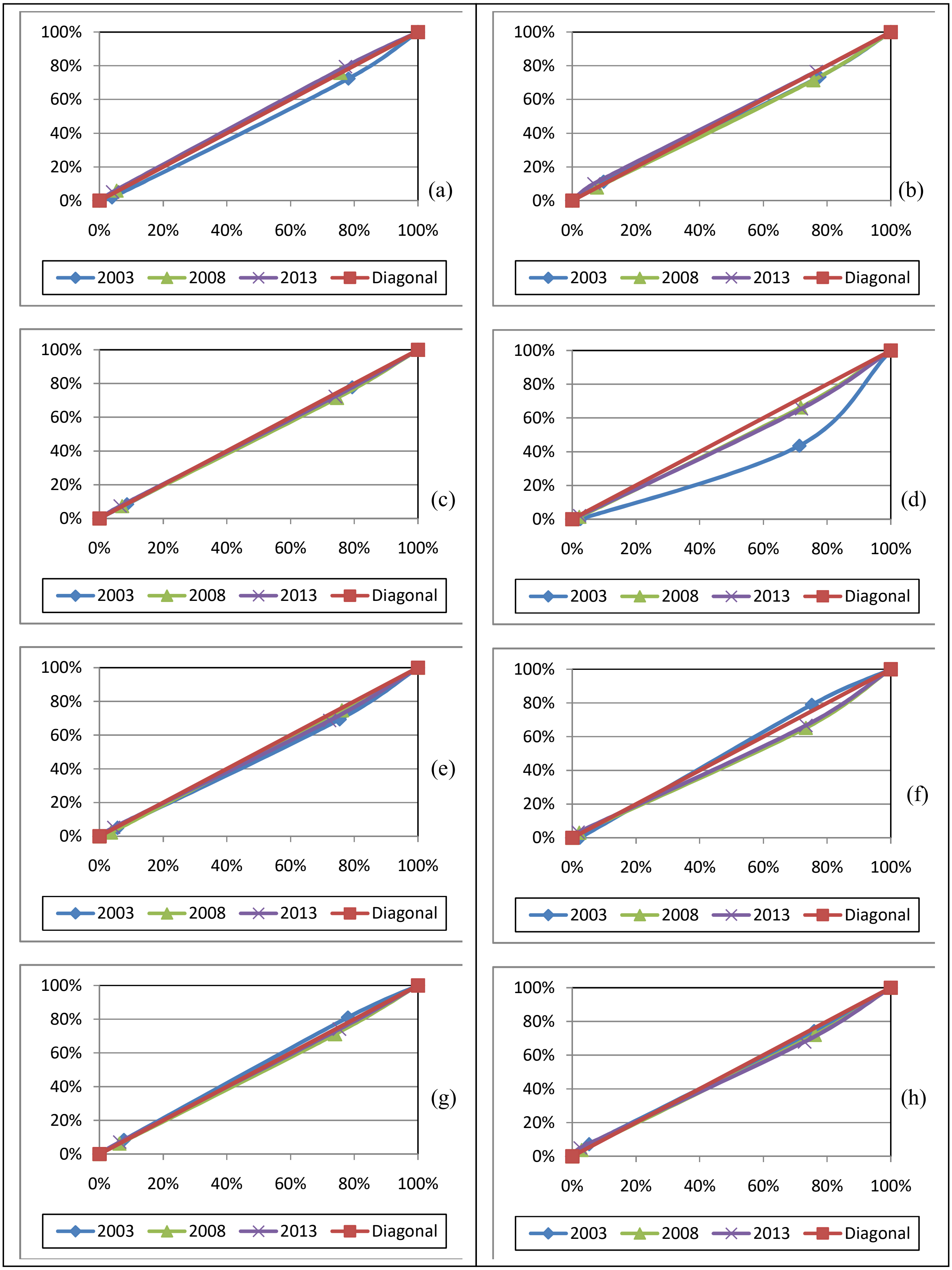
Appendix 57a-h: Concentration Curves for CMR by Mother's education for (a) Northcentral, (b)Northeast, (c) Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g)rural and (h) urban areas respectively



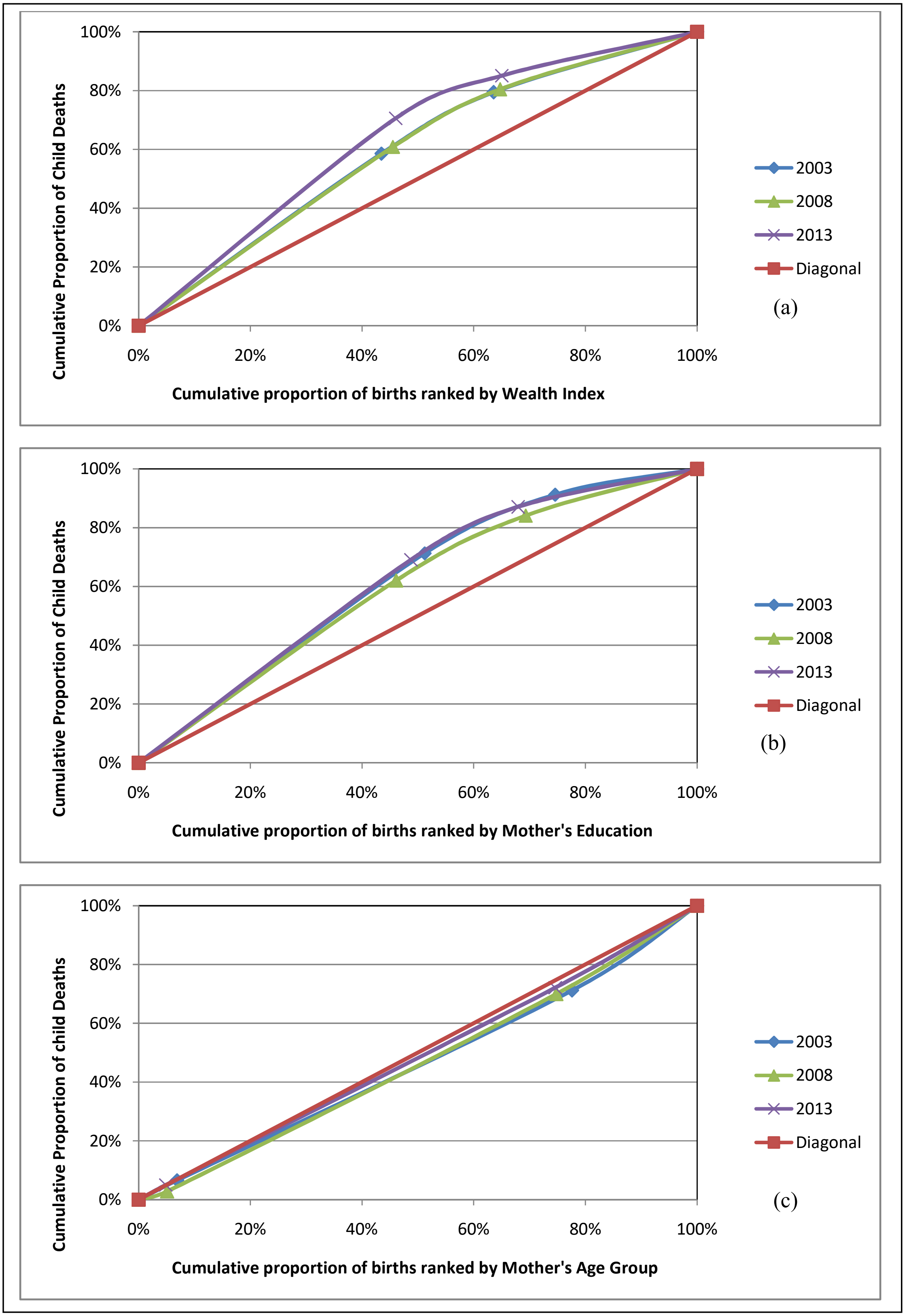
Appendix 58a-h: Concentration Curves for U5MR by Mother's education for (a) Northcentral, (b)Northeast, (c) Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g)rural and (h) urban areas respectively



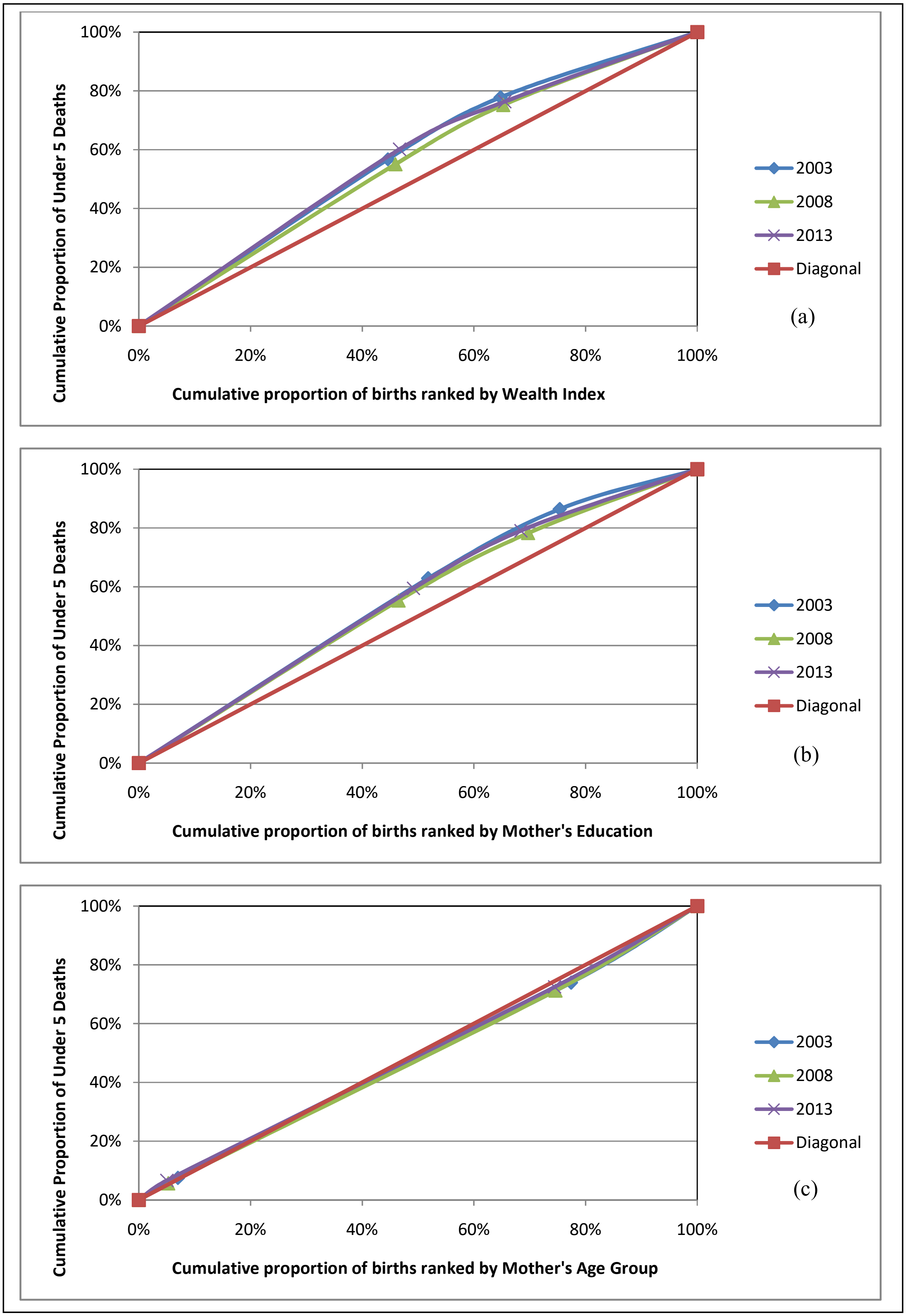
Appendix 59a-h: Concentration Curves for CMR by Mother's age for (a) Northcentral, (b)Northeast, (c) Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g)rural and (h) urban areas respectively



Appendix 60a-h: Concentration Curves for U5MR by Mother's age for (a) Northcentral, (b)Northeast, (c) Northwest, (d) Southeast, (e) Southsouth and (f) Southwest regions and for (g)rural and (h) urban areas respectively



Appendix 61a-c: Concentration Curves for CMR by Wealth, Mother's education and Age respectively



Appendix 62a-c: Concentration Curves for U5MR by Wealth, Mother's education and Age